(IT/HS/B/T/422) Management

Plant Management: Plant location, plant layout, types of maintenance such as break down, predictive & preventive maintenance, stores management, industrial safety, causes & cost of accidents, safety programs, production planning & control job, batch & process type of production.

Plant Location:

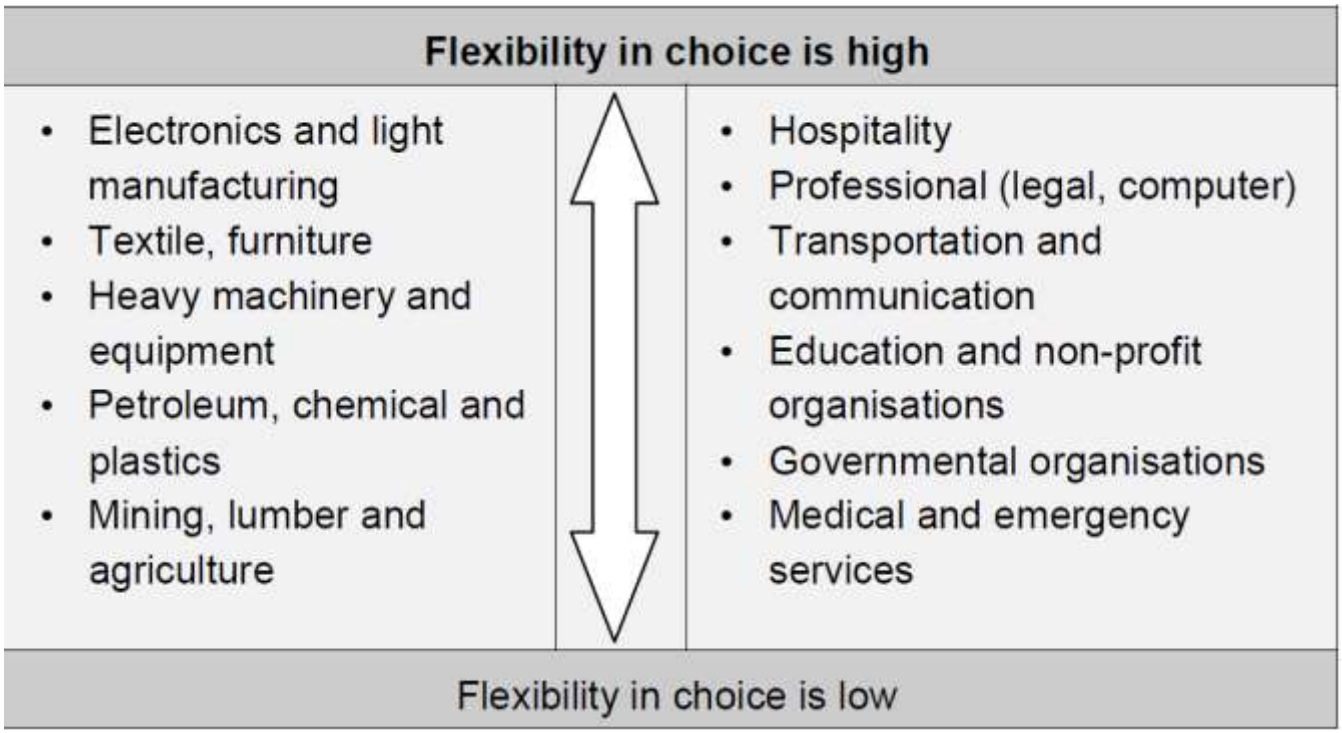
A plant location cannot be changed frequently since a large capital needs to be invested to build the plant and machinery in the selected area. Therefore, before selecting a plant location, a long range forecasting is to be made to foresee the future needs of the company.

Location identification for an organisation is an important strategic level decision taken by the top management. It involves planning and management of the plant location. Location decisions are strategic decisions that bind the organisation to a certain place. Hence utmost care has to be taken while selecting the location

While locating a plant, the following long range forecasting needs are to be considered:

- The company's expansion plan and policy
- Diversification plan for the products
- Changing market conditions
- The changing sources of raw materials
- Many other factors that influence the choice of the location decision

Selecting a location to a large extent is governed by the flexibility factor based on the type of industry or service. While some industries are completely dependent upon the location for survival, other industries may have varied degrees of flexibility. Flexibility in choice is obviously an advantage and a better decision can be taken



Planning the location of the plant

The general factors that influence the plant location are listed as follows:

• ***Availability of land –*** Availability of land plays an important role in determining the plant location. On several occasions, our plans, calculations and forecasts suggest a particular area as the best to start an organisation. However, availability of land may be in question. Insuch cases, we will have to choose the second best location.

• ***Availability of inputs –*** While choosing a plant location, it is very important for the organisation to get the labour at the right time and good quality raw materials. The plant should be located:

- Near to the raw material source
- At the market place
- Close to the market when universally available, so as to minimise the transportation cost

• ***Closeness to market places –*** Organisations can choose to locate the plant near to the customers' market or far from them, depending upon the product they produce. It is advisable to locate the plant near to the market place, when:

- The projected life of the product is low
- The transportation cost is high
- The products are delicate and susceptible to spoilage
- After sales services have to be prompt

The advantages of locating the plant near to the market place are:

- Consistent supply of goods to the customers
- Reduction of the cost of transportation

• ***Communication facilities –*** Communication facility is also an important factor which influences the location of a plant. Regions with good communication facilities namely postal and telecommunication links should be given priority for the selection of sites

• ***Infrastructure –*** Infrastructure plays a prominent role in deciding the location. The basic infrastructure needed in any organisation are:

- ***Power –*** For example, industries which run day and night require continuous power supply. So, they should be located near the power stations and should ensure continuous power supply throughout the year.
- ***Water –*** For example, process industries such as, paper, chemical, and cement, require continuous water supply in large amount. So, such process industries need to be located near the source of water supply.

- ***Waste disposal –*** For example, for process industries such as, paper and sugarcane industries, facility for disposal of waste is the key factor.

• ***Transport –*** Transport facility is a must for facility location and layout of location of the plant. Timely supply of raw materials to the company and supply of finished goods to the customers is an important factor. The basic modes of transportation are by air, road, rail, water, and pipeline. The choice of location should be made depending on these basic modes. Cost of transportation is also an important criterion for plant location.

• ***Government support –*** The factors that demand additional attention for plant location are the policies of the state governments and local bodies concerning labour laws, building codes, and safety.

• ***Housing and recreation –*** Housing and recreation factors also influence the plant location. Locating a plant with or near to the facilities of good schools, housing and recreation for employees will have a greater impact on the organisation. These factors seem to be unimportant, but there is a difference as they motivate the employees and hence the location decisions.

Special factors

The special factors that influence the plant location are:

- Economic stability – outside investments
- Cultural factors
- Wages
- Joint ventures – support of big time players

Location decision sequence

Location decisions start from the national level, and move to the site level after moving through regional level and the community level. This means that, first the country of choice is to be selected, followed by regional choices and finally community levels have to be selected

Rating methods

In the case of general factors or special factors – each factor has its own importance in determining the location of a plant. Therefore, ranking them and giving weightage for them is one of the ways of determining the location.

The methods which determine the most likely location are:

- Rating plan method
- Factor rating method
- Point rating method
- Break-even analysis
- Centre of gravity method

The score or points for each location for each factor considered can be a raw score on an arbitrary scale for example, 0 to 100. Here the analyst or the decision maker allots the score based on perception. The number of factors considered varies on the type of industry and also the relevant factors based on the location. On the other hand, the scores can be also weighted. This is due to the fact that the factors considered may have their own relative importance expressed as percentage weight. Then the weighted score is calculated by multiplying the raw score by the corresponding factor weight. The location with the highest total will be the final choice.

Rating plan method

In rating plan method, the various factors for locating a plant are given ratings depending upon the perception of the management. The location which gets the maximum rating, considering all the factors, is chosen for locating the plant

Ex Pavan is planning to start an industry in India. He has four options to locate the plant, Chandigarh, Bhopal, Bangalore, and Cochin. He used the rating plan method to select the best location suitable for his business needs. Pavan initially listed important factors of the business need. According to the rating plan method, in column 2 of the same table, he has given the proportional values for each factor in percentages. For example, the proportionate values given to the factors are 20%, 15%, 20%, 15%, etc. The total of the proportionate value is 100%. Table depicts the rating plan approach used by Pavan.

Factors	Proportional Value % age	Chandigarh	Bhopal	Bangalore	Cochin
Availability of labour	20	20	10	15	05
Raw material sources	15	15	10	15	10
Market proximity	20	20	20	15	10
Site	15	10	10	15	10
Government policies	10	5	10	5	10
Infrastructure for employees	10	10	5	10	5
Scope for expansion	10	10	10	5	5
Total	**100**	**90**	**85**	**80**	**55**

When individual ratings are given to the factors for each city we see that Chandigarh has maximum rating (90 out of 100) and therefore, Pavan has chosen, Chandigarh for locating the plant.

Factor rating method

In factor rating method, each of the factors for location is rated and the rating of the competitive locations is considered Then, the products of the rating are added and the location which gets the maximum product of rating is selected

Sl. No.	Factor	Factor rating	Location rating			Product of rating		
			A	B	C	A	B	C
1	Suitability of labour	6	8	6	5	48	36	30
2	Proximity to suppliers	7	6	9	6	42	56	42
3	Transportation facilities	5	8	7	9	40	35	45
4	Tax advantage	4	3	8	7	12	32	28
5	Power	7	8	6	9	56	42	63
6	Water	6	8	8	8	48	48	48
7	Housing	3	5	7	9	15	21	27
8	Education	4	6	6	8	24	24	32
9	Climate	3	5	9	6	15	27	18
10	Community	3	5	6	5	15	18	15
11	Availability of land	5	6	8	7	30	40	35
12	Owner's preference	3	4	6	5	12	18	15
					Total score :	**357**	**397**	**398**

Column 3 - of table shows the factor rating of each factor as determined by the managers. For example, the factor rating of housing is determined to be 3. Similarly for remaining factors the manager has listed the factor ratings.

Column 4 – Location rating, displays the ratings of location A, B, and C as determined by the managers. For example, for suitability of labour factor, the manager has rated 8 for Location A, 6 for Location B, and 5 for

Location C. Similarly, the location rating for remaining factors is listed in the table.
Column 5 – Product of rating, lists the product of ratings of location A, B, and C.

For example, the calculation of product of rating for the factor suitability of labour is as follows:

- Product of rating A: Factor rating x Location rating A = 6 x 8 = 48
- Product of rating B: Factor rating x Location rating B = 6 x 6 = 36
- Product of rating C: Factor rating x Location rating C = 6 x 5 = 30

When we add product of ratings of location A, B & C, you can see that the total of location C got the maximum product of rating, 398, when compared to A and B.

However, we find that both B and C have almost the same total. In such cases, personal preference or reconsideration of any of the factors may be advisable. So, one of these places for setting up the plant is chosen. This rating method is amenable to the consideration of various other factors which are relevant for locating the plant. The decision may even be changed, looking into the expansion programmes or the development of nearby places, which may be suitable for a particular industry.

Qs

Ravi is planning to start a new industry in India. For locating the plant, he tabulated the factor rating and the location rating of 2 locations - Goa and Cochin. Find the best location based on the factor rating method with the details depicted in table

Sl. No.	Location factor	Factor rating	Rating	
			Goa	Cochin
1	Facility utilisation	7	3	5
2	Total production per month	4	4	3
3	Tax advantage	7	4	5
4	Land and construction costs	5	1	2
5	Employee preferences	3	5	3

Sl. No.	Location factor	Factor rating	Location rating		Product of rating	
			Goa	Cochin	Goa	Cochin
1	Facility utilisation	7	3	5	21	35
2	Total production per month	4	4	3	16	12
3	Tax advantage	7	4	5	28	35
4	Land and construction costs	5	1	2	5	10
5	Employee preferences	3	5	3	15	9
				Total	**85**	**101**

The total score for Cochin is higher than that of Goa. Hence location Cochin is the best choice.

Point rating method
In point rating method, we apportion a fraction of a suitably selected total rating and see how many points we can allocate to the locations under consideration. We should compare the totalled ratings and decide the preference.

Consider the data in table In column 3, max points, if we decide to have 1000 points as the maximum possible score considering all factors, we can then evaluate each location and allocate points. Column 4, 5, 6, & 7 indicates the maximum rating for each factor. By adding the given ratings for factors of each location, we get 540 for Location A, 670 for Location B, 690 for Location C, and 745 for Location D. The location which gets the maximum rating would be chosen, that is, location D is chosen. Table depicts the point rating method used for various locations.

Sl. No.	Factor	Max points	Location A	Location B	Location C	Location D
1	Proximity to suppliers	250	150	120	200	175
2	Proximity to customers	350	200	300	250	250
3	Labour availability	200	100	150	150	175
4	Educational facilities	100	60	60	30	70
5	Climate	100	30	40	60	75
	Total	**1000**	**540**	**670**	**690**	**745**

Qs
A chain of auto components store wishes to build a new distribution centre to serve the southern region of a country. It is considering threepossible locations namely Gopalpur, Kalyan Nagar and Penwar. Table depicts the factors, weights, and ratings being considered. Which city should they choose?

		Ratings		
Factor	Weights	Gopalpur	Kalyan Nagar	Penwar
Nearness to markets	20	4	7	5
Labour cost	5	8	8	4
Taxes	15	8	9	7
Nearness to suppliers	10	10	6	10

		Ratings			Weighted Ratings		
Factor	**Weig-hts**	**Gopalpur**	**Kalyan Nagar**	**Penwar**	**Gopalpur**	**Kalyan Nagar**	**Penwar**
Nearness to markets	20	4	7	5	80	140	100
Labour cost	5	8	8	4	40	40	20
Taxes	15	8	9	7	120	135	105
Nearness to suppliers	10	10	6	10	100	60	100
		Sum of Weighted ratings:			340	375	325

Therefore based upon the weighted rating, Kalyan Nagar should be chosen.

Break-even analysis

Every manufacturing company will have three major contributors to cost:

1. Investments made for land, plant and machinery resulting in interest and depreciation
2. Recurring expenses, which are not proportional to the quantity of production
3. Variable costs, which are directly proportional to the quantities produced

For our calculations, we combine the first two costs together and call them fixed costs. We call those costs that depend on the quantity of production as variable costs

We compare the total costs for different locations on estimated amounts per annum and select whichever location costs the least. However, we will have to consider the possible variations in production levels during the foreseeable time spans and take a decision

It may be noted that what are considered as fixed costs at one time will not remain so for any length of time, though they are not influenced by the production volume. For example, the rent may remain constant only for one or two years and will change later. However for calculation purpose we can consider the costs as fixed over the planning horizon.

Kote Steel company is considering building a plant in one of three possible locations. They have estimated the following parameters for each location. Identify the volume for which each location would be suitable

Location	Fixed Cost	Variable Cost
Belladur	300,000	5.75
Kisanganj	800,000	2.75
Shafypet	100,000	8.00

Transition between Belladur and Kisanganj:

$$\begin{aligned} 300,000 + (5.75x) &= 800,000 + (2.75x) \\ 3x &= 500,000 \\ x &= 166,000 \end{aligned}$$

Transition between Belladur and Shafypet

$$\begin{aligned} 300,000 + (5.75x) &= 100,000 + (8.00x) \\ 200,000 &= 2.25x \\ 88,888 &= x \end{aligned}$$

Hence from 0 to 88888 units, Shafypet is suitable
From 88888 to 166000 units, Belladur is suitable
From 166000 units onwards Kisanganj would be suitable

Qs :

Suvarna enterprises are planning to set up a new plant and are considering three locations namely Pantnagar, Ganganagar, and Goripara. Table depicts the estimated fixed and variable costs. For what range of output each location will be suitable. If the company has a target volume of units, which location is best?

Location	Fixed cost in Rs.	Variable cost in Rs.
Pantnagar	200000	50
Ganganagar	400000	30
Goripara	700000	15

Solution
From 0 to 10,000 units, Pantnagar is suitable
From 10,000 to 20,000 units, Ganganagar is suitable
Above 20,000 units, Goripara is suitable

Centre of gravity method –

This method is used mainly when:
- Transportation costs, either for distribution of products or collection of materials from different suppliers, is the main criterion
- Production rates are high
- The volume and weights of materials that have to be moved are huge
- Time taken, either to receive material from suppliers or delivery to customers, is critical

It is better to locate the facility at such a place, which caters to the different points most optimally. The vital factor is the load, that is, number of items, or the weights that need to be moved from the central location to the existing or demanding points. We use this method when, both distance and load have to be considered for optimality in terms of cost

Table depicts the tonnages that would be supplied from five locations to a plant

	Load	Coordinates (X, Y)
Location A	2100	(50, 250)
Location B	3800	120,500
Location C	3200	475, 610
Location D	1200	680,370
Location E	2500	470,120

Locate the five places in a graph using the x and y coordinates and then locate the centre of gravity point P. We will calculate the x and y coordinates of the central location (P) such that the cost of shipment from such central location gives the minimum cost in the following way:

$$C_X = \frac{\sum L_i \ X_i}{SL_i}$$

$$C_Y = \frac{\sum L_i \ Y_i}{SL_i}$$

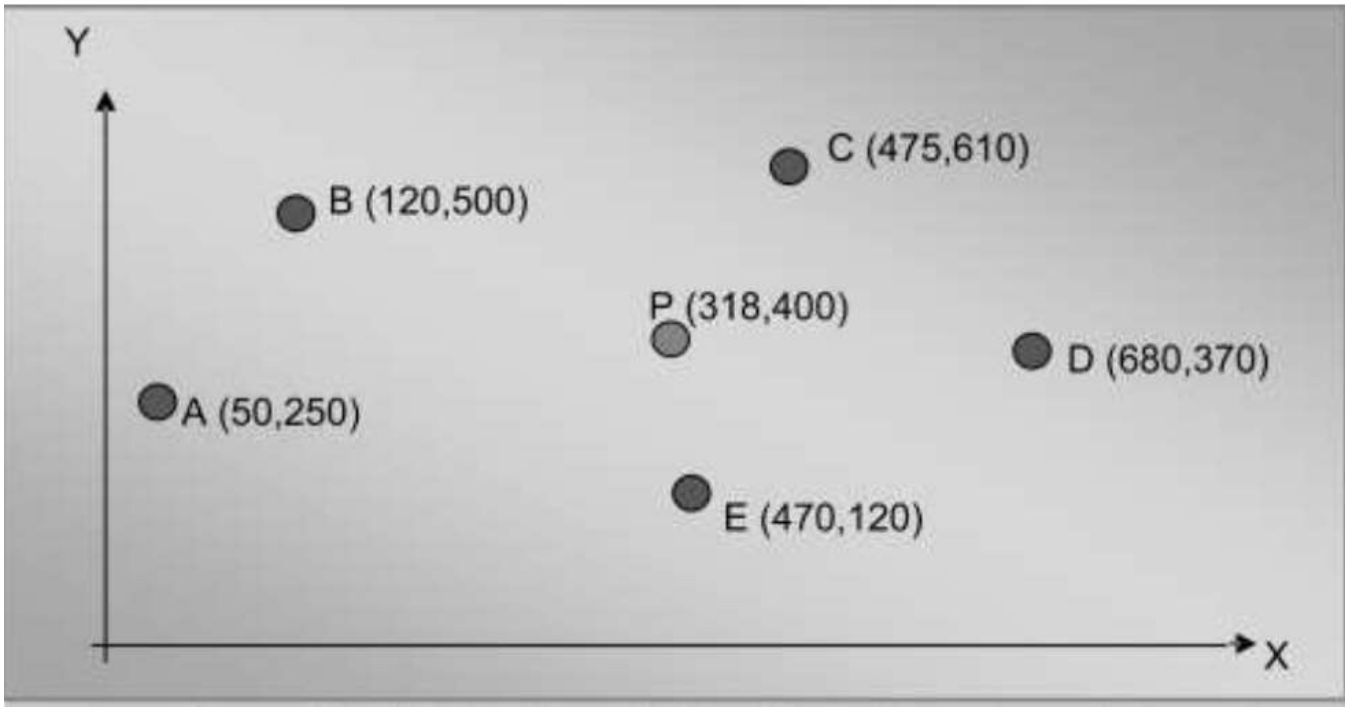
Location	Coordinates (X, Y)	Load (L_i)	L_x (or) $\sum L_i \ X_i$	L_y (or) $\sum L_i \ Y_i$
Location A	(50, 250)	2100	105000	525000
Location B	(120,500)	3800	456000	1900000
Location C	(475, 610)	3200	1520000	1952000
Location D	(680,370)	1200	816000	444000
Location E	(470,120)	2500	1175000s	300000
Total		12800	3977500	5121000

$$C_X = \frac{\sum L_i \ X_i}{SL_i}$$

$$C_X = \frac{3977500}{12800} = 318$$

$$C_Y = \frac{\sum L_i \ Y_i}{SL_i}$$

$$C_Y = \frac{5121000}{12800} = 400$$



Qs *A new facility is going to be established in Bangalore. Customers will travel from the seven locations to the new facility when they need service. The co-ordinates for the centre of each location, along with the projected populations, measured in thousands are given here. Table depicts the details of the seven centres and co-ordinate distances along with the population for each centre. Find the target area's centre of gravity for the new facility.*

Sl. No	Centres	Co-ordinate distances (x_i, y_i)	Population (L)
1	A	(3, 4.5)	6
2	B	(2.2, 5)	5
3	C	(10,4.5)	2
4	D	(5,2)	14
5	E	(6, 6)	8
6	F	(9, 3)	18
7	G	(9,4)	15

Sl. No.	Centres	(x, y)	Population (L)	L_x	L_y
1	A	(3, 4.5)	6	18	27
2	B	(2.2, 5)	10	22	50
3	C	(10,4.5)	2	20	9
4	D	(5, 2)	14	70	28
5	E	(6, 6)	8	48	48
6	F	(9, 3)	18	162	54
7	G	(9, 4)	15	135	60
Total			**73**	**475**	**276**

$$C_X = \frac{\sum L_i \ X_i}{SL_i} \qquad C_Y = \frac{\sum L_i \ Y_i}{SL_i}$$

$$C_X = \frac{475}{73} = 6.5 \qquad C_Y = \frac{276}{73} = 3.78$$

The centre of gravity calculated is (6.5, 3.78). Managers can now search in the vicinity for the optimal location using the centre of gravity as starting point.

Note: Ranking the factors and giving weight age for them is one of the ways of determining the plant location. The methods used to determine the location are 'rating plan method', 'factor rating method', 'point rating method', 'break-even analysis', and 'centre of gravity method

Rating method is largely dependent on the decision maker's choice of factors and weights. Hence, it is quite possible that two different persons may come out with their individual ratings and the ratings may not necessarily tally with each other.

Break-even analysis on the other hand assumes that in the foreseeable future the cost value do not change significantly. It also assumes the relationships to be linear. However, it is well known that the cost values with higher volumes do not rise in the same proportion

PLANT LAYOUT

Production systems whether manufacturing a product or being responsible for providing a service need a specific place to carry out their operations. pathways for people to move. In addition, space is required to store materials, tools, and other accessories and also to provide necessary support services like dining, parking of vehicles, resting, health care, and space to interact with customers.

Keeping these diverse requirements a specific area of space is identified and neatly divided and allocated for various activities and movements. This arrangement in general is called a "layout" and represents typically a floor plan and also additional details

Typically, a layout refers to the arrangement of facilities connected with production, support, customer service, and other activities. It involves the physical arrangement of work centers, storage, space for material handling and movement, utility areas and other essential spaces required for production and operations. Plant layout is also defined as the organization of a company's physical facilities to promote the efficient use of equipment, material, people and energy.

How does a layout differ from a floor plan?

A floor plan refers to two dimensional space; namely length and breadth for different functional requirements whereas a layout looks at three dimensional requirements, that is, the layout also looks for utilisation of volumetric space.

The major objectives of a good plant layout are:

- Reduced risk to health and safety of employees
- Improved morale and worker satisfaction
- Increased output
- Fewer production delays
- Savings in floor space - production, storage, and service
- Reduced material handling
- Greater utilization of machinery, manpower, and service
- Reduced inventory-in-process
- Shorter manufacturing time
- Reduced clerical work and indirect labor
- Easier and better supervision
- Less congestion and confusion
- Easier adjustment to changing conditions
- Facilitate the overall production process.
- Minimize material handling costs
- Increase production throughout
- Effective utilization of available space

- Improve employee morale
- Utilize labor effectively
- Avoid unnecessary capital investment
- Provide flexibility
    - Reduce in-process inventories

Classification of Facilities

- Production facilities – Workshops, tool room, machine shop, assembly, heat treatment, painting, testing and inspection.
- Support facilities – Storage, packing, administrative, library, service centre, reception.
- Employee utilities – Vehicles' parking, canteen, healthcare, rest room.
- Additional facilities – Conference hall, board room, customer service, training hall.

The facilities in a service industry are almost similarly developed for various activities.

For example, in an airport the layout consists of:

- Runways for landing and take-off
- Parking area for employees and passengers
- Cargo area
- Baggage collection and retrieval
- Counters
- Security check area
- Canteens
- Administrative offices
- Storage area
- Health care
- Restrooms

Basis for Types of Layouts

The type of layout is generally determined by the following:

- **Type of product** – Different products and services require different areas for various processes and support functions. For example, an electronic product manufacturing layout is smaller and simpler compared to a tractor manufacturing unit.

- **Types of production processes** – Different production processes require different size of areas for operations. For example, a machining process for an automobile component requires a larger area compared to a sheet punching for a utensil.

- **Volume of production** – The space requirements are directly proportional to the volume of production.

Why Layout Decisions are Important

Layout decisions are important for three basic reasons:

- They require substantial investments of both money and effort
- They involve long term commitments which make mistakes difficult to overcome
- They have a significant impact on the cost and efficiency of short-term operations

Further layout once set, may be difficult to change, because layout changes are resisted by personnel, who would have adjusted to the existing layout and many times such changes often require them to alter daily routines or to undergo retraining. Secondly, making any changes involves substantial

investment in time and money, also disturbs the existing schedule and may even lead to temporary shutdown of operations till the new layout becomes fully operational. This eventually leads to loss of revenue for quite some time.

Many occasions demand a redesign of existing layout both due to expansion of capacity and due to technical reasons. Most common reasons for redesign of layouts include the following:

- Inefficient operations (for example, high cost, bottlenecks)
- Accidents or safety hazards
- Changes in the design of products or services
- Introduction of new products or services
- Changes in volume of output or mix of outputs
- Changes in the methods or equipment
- Changes in environmental or other legal requirements
- Morale problems

Nature of Layout Problems

The kinds of plant layout problems fall into four classes:

- ***Planning a complete new plant –*** Arranging all the facilities to work as an integrated whole. The challenge is when a company goes into production of a new product or moves to a new area. This is usually handled by a team of specialists.

- ***Expanding or moving to an existing plant –*** Here the buildings and services already exist posing limitations to the free-hand of the layout engineer. The problem is, one of adapting the product, facilities, and personnel of an existing organisation to a different but existing plant. This is the time for abandoning old practices and equipment and changing to improvement methods.

- ***Rearranging a present layout –*** This involves new and efficient methods and equipment. The problem is one of using as much of the existing facilities as is consistent with new plans and methods. The problem occurs often with changes in model or style of products or with modernisation of productive equipment.

- ***Minor adjustments in existing layouts –*** Reasons are changes in operating conditions; changes in design of certain parts, increase in sales volume, addition of new but similar product, adopting new equipment, or new conveyor, or inspection changes. All these mean adjustments are in the arrangement of work areas, personnel, and material placement. These adjustments present the most frequent layout problems. Here the layout engineer must build into or onto an existing arrangement, various improvements without changing the over-all layout plan and with a minimum of costly interruptions or adjustments to the existing installation.

Manufacturing Facility Layouts

The layout developed for a manufacturing purpose has to primarily favour easy and smooth operations to enable the desired level of output. It is equally important to take into account the possible expansions in volume and variety of output. In addition, productivity, quality, and safety related issues are given due importance to ensure the desired output with the assured quality. Therefore, factors considered while developing layouts for manufacturing operations are as follows:

- The required capacity per time period of the facility
- The size, number and sequence of the machines that are necessary
- Technology of the productive processes
- Safety precautions, health care provisions, comfort needs, personal care needs
- Accommodations for employees
- Building and size constraints
- The expected growth trends of the organisation

- The size, shape, weight, bulkiness, fragility, and other characteristics of the material.

Types of Layout

The four basic varieties of layouts for manufacturing facilities are:

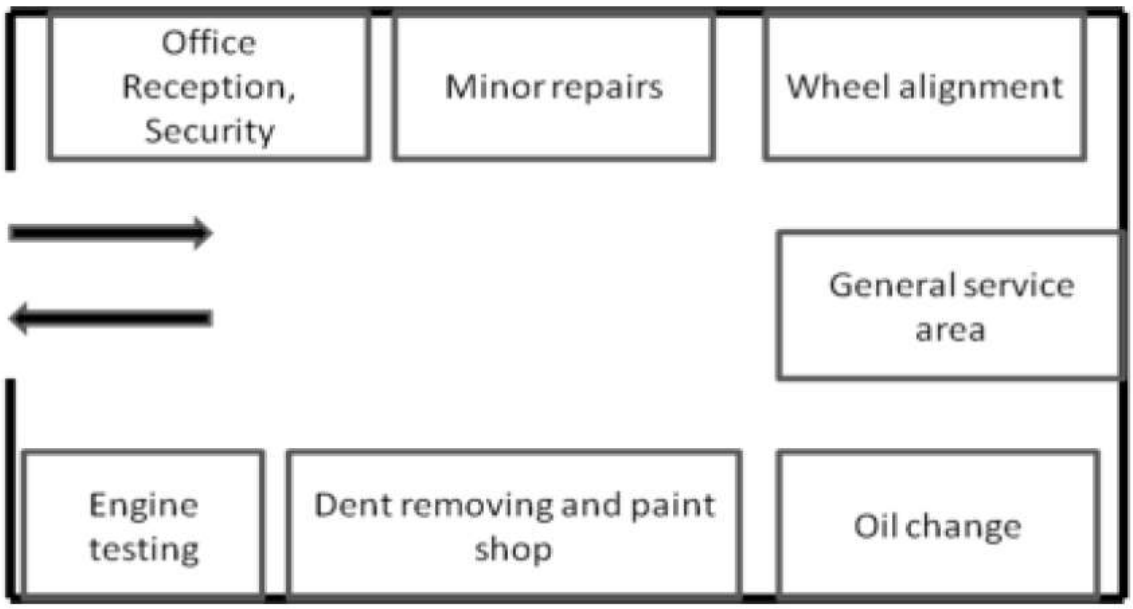
- Process layout
- Product layout
- Group technology layout
- Fixed position layout

PROCESS LAYOUT

This type of layout is concerned with the grouping of machines, process, or services according to their function. This grouping of machines by function is characteristic of job shops and batch type production facilities. Hence this type of layout is also called as **functional layout.**

Process layout typically uses general purpose machines that can be changed over rapidly to new operations for different product designs.
Consider a car service and repair centre. There may be several departments or functional areas which are arranged based on space and technical requirements like number of persons working, machines installed, number of vehicles coming on an average, and other requirements. Each car entering into the service centre will follow the following steps:

- Arrival at office
- Customer informs about the type of problem
- Front office guides the customer to drive the car to the required departments
- Car is given the necessary service
- Customer returns to front office and makes payment
- Car exits from the service centre

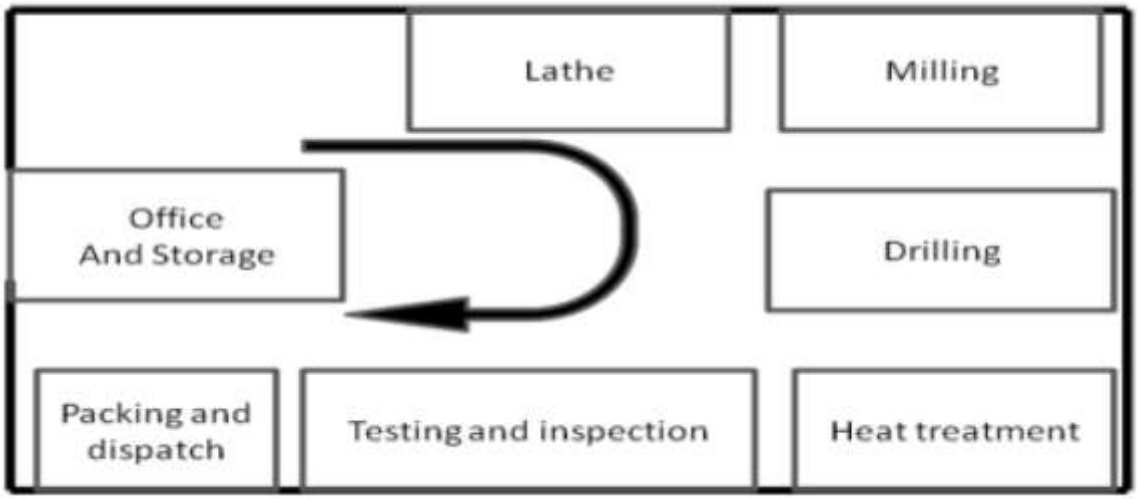


EXAMPLE OF A CAR SERVICE CENTRE

PRODUCT LAYOUT

Product layout commonly referred to as **'line layout',** focuses on the sequence of production or assembly operations required for manufacturing or assembling a part or a product. These are used in mass or continuous production. Examples are automobile assembly, cement manufacturing, oil refining

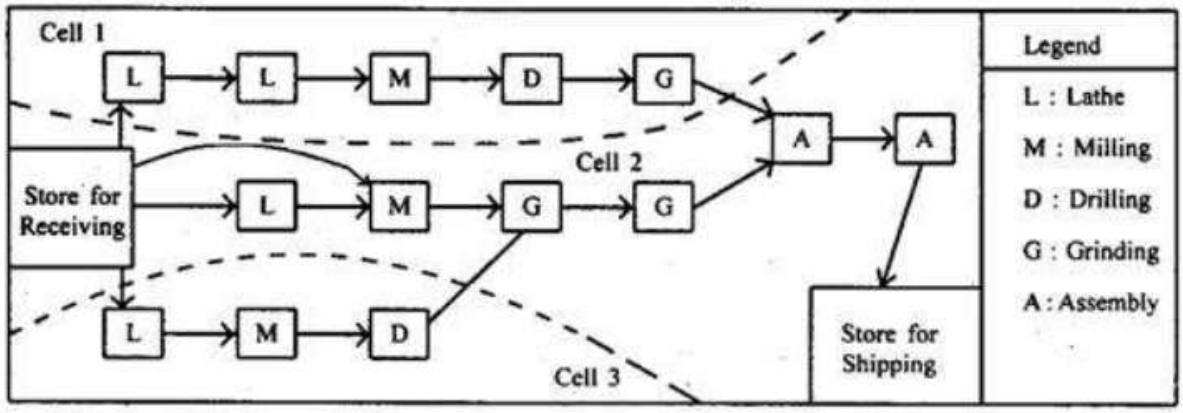
In contrast to process layouts, they are not flexible as they are specifically designed for making or assembling one product. These layouts typically use specialised machines that are set up once to perform a specific operation for a long period of time on one product



EXAMPLE OF A COMPONENT MANUFACTURING LAYOUT

GROUP TECHNOLOGY LAYOUT

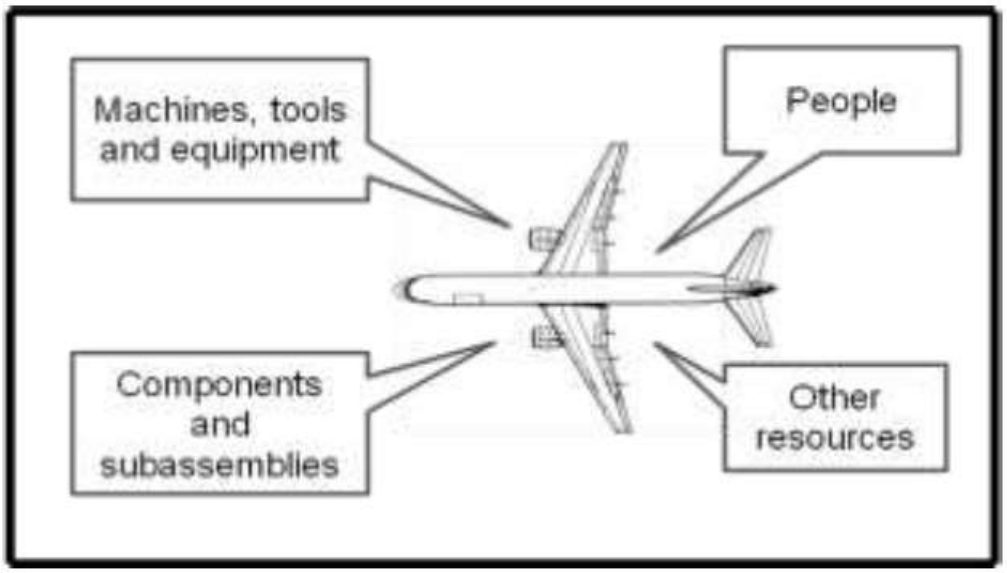
In group technology, machines are grouped into a cell. The cell acts like a product layout which is land within a larger process layout environment. It requires that each cell process is a family of parts that have many common characteristics, such as machining operations, similar machine set - ups and common raw materials. Due to these common characteristics, the parts can be produced in a different path through a cell much like a product layout.



Facilities Arrangement in a Group Technology Layout

FIXED POSITION LAYOUT

In this type of layout, the product is located in a fixed position and all the resources like workers, materials, machines and equipment's are transported to that location. Missile assembly, large aircraft assembly, ship construction and bridge construction are examples of fixed-position layouts. These layouts are used when a product is bulky, large, heavy or fragile. These minimise the amount of product movement required.



AIRCRAFT ASSEMBLY

HYBRID LAYOUT

Most manufacturing facilities use a combination of layout types. For example, one may basically adopt a process layout with one section of the facility using an assembly line, or vice versa. Such combinations of layouts are called hybrid layouts

LAYOUT PLANNING : When to select product layout or process layout?

Sl No	Product Layout	Process Layout
1	Mass production of one product or similar types of products	A large variety of' products with low to medium demand
2	Standardised product with little or no design changes	Emphasis is on special orders or products having significant and frequent design changes
3	Possibility of achieving good equipment and labour balances	Difficult to achieve good equipment and labour balances
4	Minimum requirement of in process inspection	Many inspections are required in a sequence of operations
5	Use of special purpose machines	Use of general purpose machines
6	Materials or products permit bulk or continuous handling by mechanical means	Materials or product are too large or heavy and used in small quantities
7	The same machine or work station is seldom used for more than one operation	Frequent need to use the same machine or work station for two or more different operations
8	Production of stock i.e. for steady demand	Production for individual orders
9	Movement of equipment is generally not very costly	Expensive machinery which is costly to move is involved

When to use Fixed Position Layout ?

This type of layout is preferred when

- The operation or process requires only hand tools and/or simple or light machines
- The cost of moving major components is very high
- There is a demand for skill
- Production of product is only at specified times

As stated in ***Systematic layout planning*** by Muther R. (1984), there are four levels of detail in a plant layout design:

- **Site layout –** shows how the building should be located
- **Block layout –** shows the sizes of departments in buildings and their relative location
- **Detailed layout –** shows the arrangements of machines and workstations in the departments
- **Workstation layout –** shows locations of every part of the workstation

There are essentially two types of approaches in designing a new layout.

In the first method; the departments or functional areas to be located adjacent or non-adjacent are identified, using a closeness rating suggested by Richard Muther.

In the second method; the total distance travelled becomes the focal point, and the departments are organised essentially to minimise the total distance travelled by materials and or by people**.**

According to Richard Muther's, simplified systematic layout planning, following steps are suggested for developing new layouts:

- Chart the relationships
- Establish space requirements
- Diagram activity relationships
- Draw space relationships
- Evaluate alternative arrangements
- Detail the selected layout plan

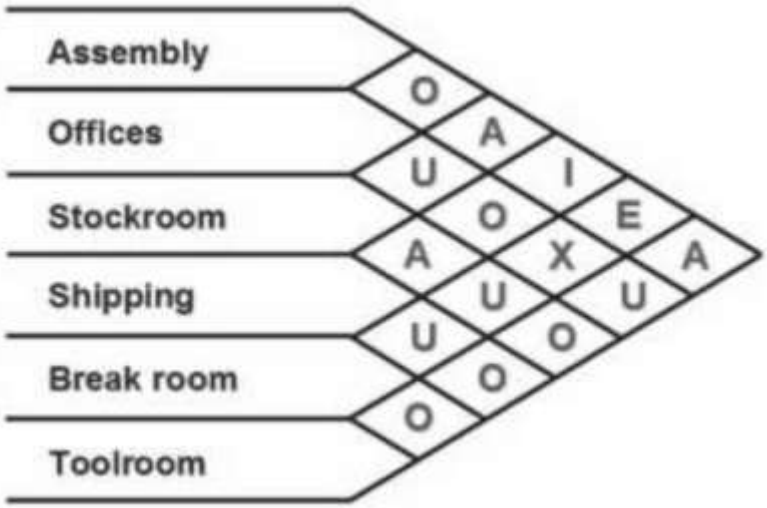
The closeness between pairs of departments is based on the following criteria:
- Departments use same equipment or facilities
- Departments share the same personnel or records
- Common sequence of work flow in the departments
- Ease of communication
- Similar work performed

Closeness is avoided if departments:
- Have unsafe or unpleasant conditions
- Operations in one department disturbs the neighboring department

The "closeness rating" is expressed using a letter code and later converted to a number to simplify the calculations.

The letter codes stated here help to express the degree of closeness between two departments taken as a pair:

A – Absolutely necessary =	16
E – Essential or especially important =	8
I – Important =	4
O – Ordinarily important or okay =	1
U – Unimportant =	0
X – Undesirable =	-80



Present Layout – REL Chart (Relationship Charts)

Current Layout

	Assembly	Offices	Stockroom	Shipping	Break room	Tool room
Assembly	-	O	A	I	E	A
Offices		-	U	O	X	U
Stockroom			-	A	U	O
Shipping				-	U	O
Break room					-	O

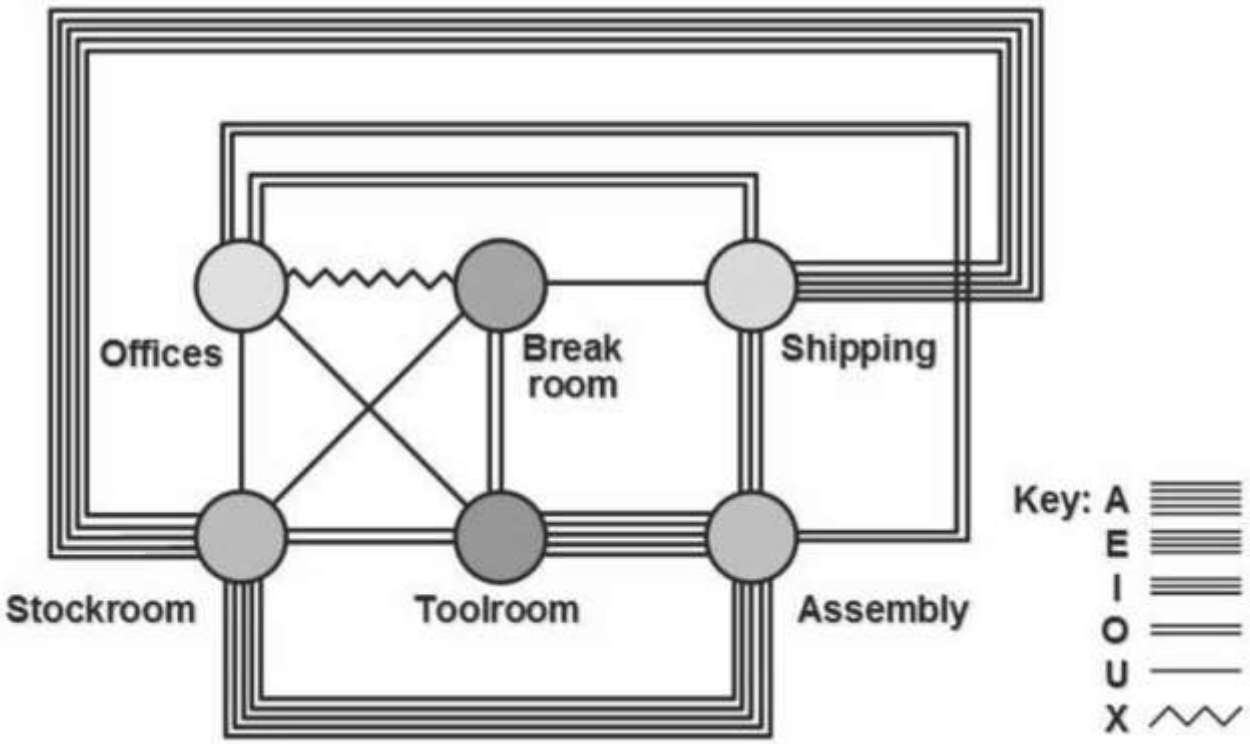
Proposed Layout

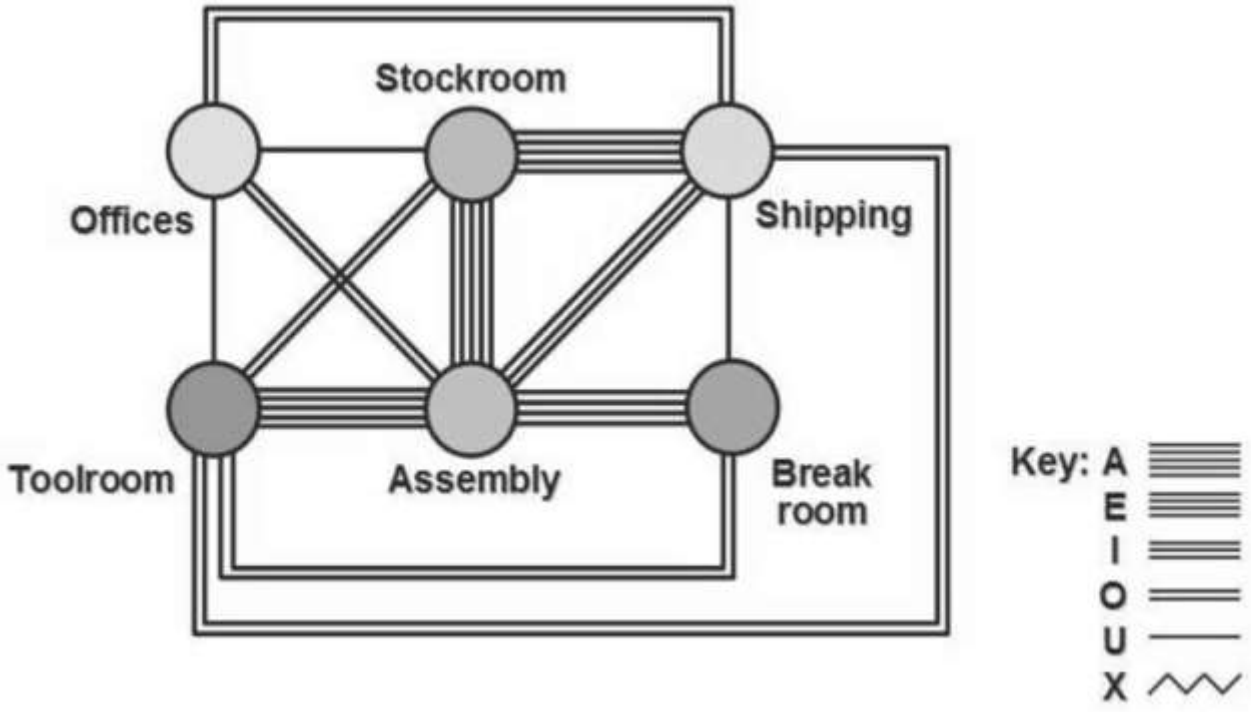
	Assembly	Offices	Stockroom	Shipping	Break room	Tool room
Assembly		O	A	E	A	A
Offices			U	O		U
Stockroom				A		O
Shipping					U	O
Break room						O

	Assembly	Offices	Stockroom	Shipping	Break room	Tool room	Total
Assembly		1	16	4	8	16	45
Offices			0	1	-80	0	-79
Stockroom				16	0	1	17
Shipping					0	1	1
Break room						1	1
							-15

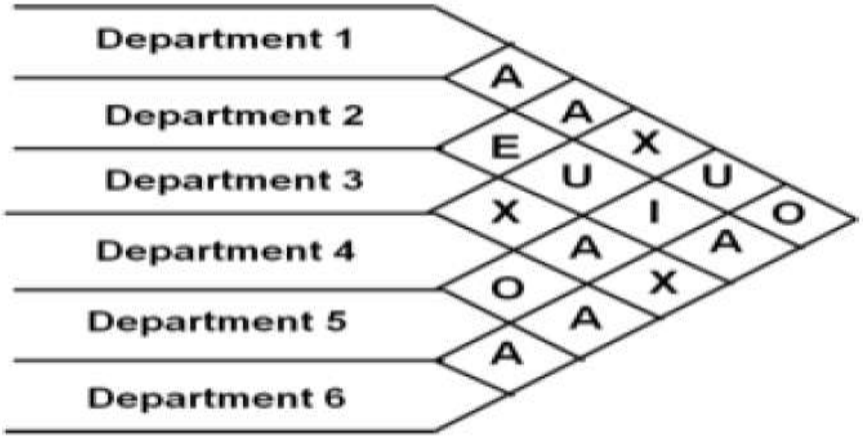
	Assembly	Offices	Stockroom	Shipping	Break room	Tool room	Total
Assembly		1	16	8	16	16	57
Offices			0	1		0	1
Stockroom				16		1	17
Shipping					0	1	1
Break room						1	1
							77

Current vs Proposed Layout


Offices
Break room
Shipping
Stockroom
Toolroom
Assembly
Key: A E I O U X


Stockroom
Offices
Shipping
Toolroom
Assembly
Break room
Key: A E I O U X

Qs Consider six departments numbered 1 to 6 and the closeness rating as depicted in Figure



“A” rating: 1-2, 1-3, 2-6, 3-5, 4-6, 5-6
“X” rating: 1-4, 3-4, 3-6

Assuming a 2 (rows) by 3 (columns) grid for the department configuration, the following solution is generated as depicted in table

Department configuration			Solution		
			1	2	6
			3	5	4

EVALUATING PLANT LAYOUTS

A layout once developed must be evaluated for its effectiveness or efficiency. No one measure of success can be identified for this purpose and to a large extent several measures may have to be used to evaluate or compare layouts.

Each layout problem is quite unique and hence, there is no general procedure readily available which can be used for evaluating a layout. For instance, in a case where material handling is the primary problem in establishing a new layout, total distance moved by a product could perhaps be considered as a measure of effectiveness. One overall measure that is often used is the return on investment.

Techniques for evaluating layout may be generally classified as:

- Systematic
- Optimising

Systematic technique provides an organised approach to selecting the best layout whereas the optimising techniques enable the determination of a solution which is the best.

The following methods are applicable:

- Cost comparison
- Productivity evaluation
- Space and/or volume utilisation evaluation

One common technique that is helpful in determining the magnitude of product flow is the materials handling between departments. The tool is called the travel chart or the load-distance matrix, which assists in designing a new layout and valuating a layout.

A typical travel chart will show; how many items or how much material is being transported or how many people are moving between departments, and it is necessary to find out what is the corresponding total time or distance. This is usually done by multiplying the load by the distance traveled and is used as a measure to evaluate the layout. Typically called as the load x distance analysis, it also helps to find busy routes and also indicates how much of backward movement or reverse flow takes place in the given layout.

Travel Chart

To: / From	A	B	C	D	E
A		15	20	6	
B	3		12		14
C	20			10	6
D	18		4		12
E		14		18	

All diagonal elements will be zero indicating nothing can go to a department from the same department. For example from A to A it is zero units transported. The values above the diagonal indicate the movement in the forward direction, and the values below the diagonal represent possible back tracking and attempt should be made to eliminate or minimise this. The units or numbers used in the travel chart represent an amount of material handling for example, pallet loads per day, frequency of trips, etc. The calculation procedure enables the evaluation of different layouts; to find out the total load times, the distance for each layout, and the results are tabulated. It is to be remembered that while the load remains the same the other variable namely; the distance keeps depending on the relative location of the departments.

In a linearly arranged layout as depicted in the

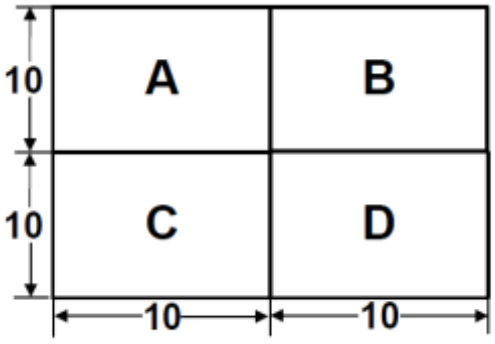
A	B	C	D	E

How are the distances measured?

- The department or area identified for each operation is assumed to be rectangular in most of the cases though this may not be the case always. Rarely irregular shapes may also be encountered.
- Firstly, in all the cases the distance from one room or one department to another room or department is measured from geometrical centre to geometrical centre, as the average distance considering the various possible locations within the given area.
- Secondly, the distances are always assumed to be along the straight paths, and the travel is along the straight (rectilinear) direction only disregarding diagonal movements though possible in some cases.
- Further, in many cases, it is assumed that the departments are all of the same size to simplify the measurements and the calculations.

Two data tables are usually provided to calculate the load-distance values. One table gives the load or quantity moved between the departments and other table or figure gives the distances.

Qs
A small workshop has four departments A, B, C, and D, each measuring 10 metres by 10 metres. The initial layout is depicted in figure. The number of trips between each pair of departments is: A and B = 50, A and C = 20, A and D = 30, B and C = 10, B and D = 25, and C and D = 40

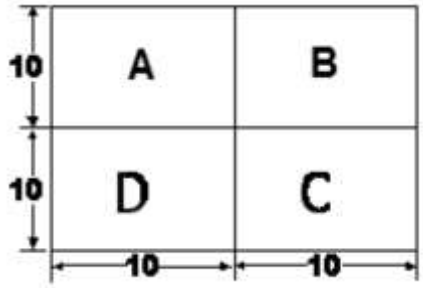


1. Determine the total load distance in the given layout ?
2. Suggest one improved layout, which is the total load distance for this layout should be less than the total load distance of the original layout ?

Table depicts the load x distance between various departments

Between	Load	Distance	Load X Distance
A and B	50	10	500
A and C	20	10	200
A and D	30	20	600
B and C	15	20	300
B and D	20	10	200
C and D	40	10	400
Total			2200

From the calculations it is clear that two major values namely 600 and 500 are between A and C, and A and D. A and C are adjacent and hence, C and D will be interchanged to make A and D adjacent to each other. Then the resultant layout will be as depicted in the figure



Again the load-distance calculations are carried out and the results are depicted in the table

Between	Load	Distance	Load X Distance
A and B	50	10	500
A and C	20	20	400
A and D	30	10	300
B and C	15	10	150
B and D	20	20	400
C and D	40	10	400
Total			2150

We notice that the total load distance has decreased from 2200 to 2150 and hence, this change is justifiable

Qs Four departments A, B, C, and D are to be located in four rooms marked 1, 2, 3, and 4 as depicted in the figure

1	2	3	4

The centre to centre distance between adjacent rooms is 20 feet. The flows between the departments are as depicted in the table

To → From ↓	A	B	C	D
A	-	25	30	20
B	-	-	15	25
C	35	-	-	50
D	40	-	-	-

The supervisor, Mr. Jeff wants department B to be in Room 2 only. Obtain the layout satisfying this condition and find the total cost of movement?

Suppose Mr. Jeff agrees to give up his choice and wants a layout with the minimum total cost of movement, what will be the new layout and its total movement cost? What improvement do you see?

Qs

Six departments marked A, B, C, D, E, and F are to be located in six production areas marked 1, 2, 3, 4, 5 and 6. The quantity moved between the departments is depicted in the table

From – To	A	B	C	D	E	F
A		50	100			20
B			30	50	10	
C				20		100
D					50	
E						
F						

Obtain the layout that minimises the total distance traveled. The adjacent departments are located at a distance of 1 unit (say equal to 20 feet).

1	**2**	**3**
4	**5**	**6**

Ans

A	C	F
B	D	E

The total load X distance is = 490 units

PLANT MAINTENANCE

Plant maintenance is defined as a set of activities that are necessary to keep machinery, parts & types of equipment in good operating conditions to avoid production stoppage and loss.

Objectives of maintenance management

1. Minimizing the loss of production time due to equipment failure
2. To reduce loss due to the production stoppage.
3. To keep all productive assets in good working conditions
4. Improve the quality of the product and improve productivity
5. Helps to reduce the total maintenance cost of repair, preventive maintenance & inventory carrying a cost due to a spare part inventory.

The following are different types of maintenance.

1. Breakdown Maintenance

This is also called corrective maintenance it occurs when work gets stopped because of a machine breakdown. In this sense, maintenance becomes repair work. Repairs are made after the equipment is out of order

For eg- A electric motor will not start if the conveyor belt is ripped or the shaft has broken. In this case, the maintenance department checks into difficulty and makes the necessary repairs

2. Preventive Maintenance

In contrast to corrective maintenance, preventive maintenance is undertaken before the need arises and aims to minimize the possibility of un-anticipated production interruptions or a major breakdown, preventive maintenance consists of,

a) Proper design and installation of equipment.
b) periodic inspection of plant & equipment.
c) Repetitive servicing of types of machinery.
d)Adequate lubrication, cleaning, and painting of the building.

3. Predictive Maintenance

One of the new types of maintenance that may be anticipated to gain increasing attention. In this sensitive instrument is used to predict trouble conditions that can be measured on a continuous basis and this enables the maintenance of people to plan for an overhaul.

4. Routine Maintenance

This includes activities such as periodic inspection cleaning, lubrication& repair of production equipment. This can be classified into two types,

i) Running maintenance :
In this, the maintenance work is carried out while the equipment is in operating condition.

ii) Shutdown maintenance
Here the maintenance work is carried out when the machine or equipment is out of service.

5. Planned Maintenance

The breakdown of a machine does not occur in a planned manner but maintenance work can be planned well in advance. Planned maintenance is also known as scheduled maintenance it involves the inspection of all plants & equipment, machinery, and building according to a predetermined schedule.

STORES MANAGEMENT

The Objectives of Stores management play a vital role in the operations of company. It is in direct touch with the user departments in its day-to-day activities. The most important purpose served by the stores is to provide uninterrupted service to the manufacturing divisions. Further, stores are often equated directly with money, as money is locked up in the stores.

FUNCTIONS OF STORES

The functions of stores can be classified as follows:

1. To receive raw materials, components, tools, equipment's and other items and account for them.
2. To provide adequate and proper storage and preservation to the various items.
3. To meet the demands of the consuming departments by proper issues and account for the consumption.
4. To minimize obsolescence, surplus and scrap through proper codification, preservation and handling.
5. To highlight stock accumulation, discrepancies and abnormal consumption and effect control measures.
6. To ensure good house keeping so that material handling, material preservation, stocking, receipt and issue can be done adequately.
7. To assist in verification and provide supporting information for effective purchase action.

Codification

It is one of the functions of stores management. Codification is a process of representing each item by a number, the digit of which indicates the group, the sub-group, the type and the dimension of the item. Many organizations in the public and private sectors, railways have their own system of codification, varying from eight to thirteen digits. The first two digits represents the major groups, such as raw materials, spare parts, sub-contracted items, hardware items, packing material, tools, oil, stationery etc. The next two digits indicate the sub-groups, such as, ferrous, non-ferrous etc. Dimensional characteristics of length, width, head diameter etc. constitute further three digits and the last digit is reserved for minor variations.

Whatever may be the basis, each code should uniquely represent one item. It should be simple and capable of being understood by all. Codification should be compact, concise, consistent and flexible enough to accommodate new items. The groupings should be logical, holding similar parts near to one another. Each digit must be significant enough to represent some characteristic of the item

Objectives of Codification

The objectives of a rationalized material coding system are:

1. Bringing all items together.
2. To enable putting up of any future item in its proper place.
3. To classify an item according to its characteristics.
4. To give a unique code number to each item to avoid duplication and ambiguity.
5. To reveal excessive variety and promote standardization and variety reduction.
6. To establish a common language for the identification of an item.

7. To fix essential parameters for specifying an item.
8. To specify item as per national and international standards.
9. To enable data processing and analysis.

Advantages of Codification

As a result of rationalized codification, many firms have reduced the number of items. It enables systematic grouping of similar items and avoids confusion caused by long description of items since standardization of names is achieved through codification, it serves as the starting point of simplification and standardization. It helps in avoiding duplication of items and results in the minimization of the number of items, leading to accurate record. Codification enables easy recognition of an item in stores, thereby reducing clerical efforts to the minimum. If items are coded according to the sources, it is possible to bulk the items while ordering. To maximize the aforesaid advantages, it is necessary to develop the codes as concerned, namely, personnel from design, production, engineering, inspection, maintenance and materials.

INDUSTRIAL SAFETY

The concept of industrial safety is mainly related to the minimization of various industrial hazards. Any physical or chemical situation which can result in the injury of an individual or can cause any kind of harm to the health of a person is termed as a hazard. Hazards can result in some types of dangers or threats. Due to the occurrence of millions of industrial accidents causing either the death or momentary or permanent disability of the manpower and huge losses caused to the property and assets damages and unutilized man and machines hours, the significance of industrial safety is becoming more important**.**

Currently, a lot of attempts are made towards controlling the frequency and intensity of accidents. In order to Protect societal interest different types of rules related to safety are formulated for different areas.

In the entire world, the industries and corporate world comprehended the benefits which are obtained from the prevention of accidents

What is the Importance of Industrial Safety?

Accident Avoidance:
The chances of an industrial accident are controlled effectively with the help of employee safety, which can be obtained by haying the required safety equipment and informing the manpower about the various dimensions of safety.

Cost Prevention:
Different types of direct and indirect costs which can result from industrial accidents in any organization can be avoided. The direct costs of any accidents are mainly the total compensation amount which is paid to the employees for any kind of disability or death; on the other hand, indirect costs are the costs incurred in the payment of hospitalization and treatment of the victim employee.

Improved Employee Satisfaction and Commitment:
With the help of employee safety, a working environment having greater motivation and satisfaction of the manpower can be created. Broadly, having a safer working environment for performing the operations is expected by a worker from his or her employer. Greater job satisfaction and higher motivation can be obtained by the workers if these expectations are fulfilled by the employers.

Legal Compliance:

By facilitating the worker's safety, adherence to the different laws which are made for facilitating a safe and healthy working place to the employees can be ensured. Different types of employee safety actions are initiated by the organizations not only to have improved job satisfaction, motivation of the workers, and controlling the HR cost but also helps in adhering to the statutory guidelines.

Better Industrial Relations:
Cordial and harmonious labor-management relations can be ensured with the help of employee safety provisions. For creating a work environment that is healthy and free from any kind of accidents, different types of safety methods are used by the employers and this will manifest in the form of good feelings in the workforce towards the firm. A harmonious industrial relationship in long term can be obtained if there are no serious industrial accidents in the organization.

Causes of Industrial Accidents:

1. Unsafe Conditions (Work-Related Causes):
These, of one sort or another, are the biggest cause of accidents. Such causes are associated with defective plants, equipment, tools, materials, buildings etc. These can be termed 'technical causes. They arise when there are improper or inadequate safety guards on machines; when machines break down; when improper personal protection equipment is installed; when mechanical or construction designs are defective and unsafe; and when control devices, which have been installed to make the operation of machines safe and accident free are lacking or defective; or when there is an absence of proper maintenance and supervision of these devices

Eg Improperly guarded equipment , Defective equipment., Hazardous arrangement or procedure in and or around, machines or equipment. Unsafe storage; congestion, overloading, Inadequate safety devices.,. Wrong and faulty lay-out, and bad location , Improper illumination — glare, insufficient light, . Improper ventilation — insufficient air charge, impure air source. , Poor house-keeping.

2. Unsafe Acts:
These acts may be the result of lack of knowledge or skill on the part of the employee, certain physical defects and wrong attitudes.

Eg Operating without authority, Failing to secure equipment or warning other employees of possible danger., Failing to use safe attire or personal protective equipment, Throwing materials on the floor carelessly, Operating or working at unsafe levels of speed, either too fast or too slow,. Making safety devices inoperative by removing, adjusting, disconnecting them, Using unsafe equipment or using equipment unsafely, Using unsafe procedures in loading, placing, mixing, combining, aking unsafe positions, under suspended loads. , Lifting improperly, Cleaning, adjusting, oiling, repairing, etc. or moving a dangerous equipment. Distracting, teasing, abusing, startling, quarreling, day-dreaming, horseplay.

3. Other Causes:

These causes arise out of unsafe situational and climate conditions and variations — such as bad working conditions, rough and slippery floors, excessive glare, heat, humidity, dust and fume-laden atmosphere; very long hours of work; unsatisfactory behaviour of domineering supervisors; excessive noise and carelessness in the handling of such inflammable materials such as gasoline, solvents, oil and grease, explosives etc.

SAFETY PROGRAMS :

A safety programme intends to identify when where and why accidents occur. On the same lines a safety programme aims at reducing accidents and associated losses. A safety programme is initiated with the assumption that it is possible to prevent most work connected accidents.

A safety programme is a continuous process and tries to be decrease the influence of personal and environmental factors which cause accidents. Normally a safety programme consists of providing safety equipment's and special training to workmen or employees.

Indian standards Institute has done commendable job in this context and lays down as follows:

(i) Safety precautions to be taken during manifesting operations.
(ii) Standards for proper lighting, ventilation and proper layout of the industrial unit.
(iii) Standards and specifications of safe industrial operations and practices etc.
(iv) Requirements for effective maintenance of tools and equipment's.
(v) Guidance on safe cutting and welding processes.
(vi) Guidance on use of powered industrial trucks, belt conveyors and fire protection equipment's.
(vii) Safety requirements for personal protective equipment's.
(viii) Classification of hazardous chemicals and provision of accident provision tags.
(ix) Markings for handling and lebelling of dangerous items/ goods.
(x) Standards for safety:
    (a) In industrial building
    (b) Safety procedures to be followed in electrical work
    (c) in use of electrical appliances in hazardous area and explosive atmosphere.

(xi) Specifications for protective clothing, safety helmets face shields and safety equipment for eyes ears lags hands and feet etc

Production Planning and Control

For efficient, effective and economical operation in a manufacturing unit of an organization, it is essential to integrate the production planning and control system. Production planning and subsequent production control follow adaption of product design and finalization of a production process.

Production planning and control address a fundamental problem of low productivity, inventory management and resource utilization.

Production planning is required for scheduling, dispatch, inspection, quality management, inventory management, supply management and equipment management. Production control ensures that production team can achieve required production target, optimum utilization of resources, quality management and cost savings.

Planning and control are an essential ingredient for success of an operation unit. The benefits of production planning and control are as follows:

- It ensures that optimum utilization of production capacity is achieved, by proper scheduling of the machine items which reduces the idle time as well as over use
- It ensures that inventory level are maintained at optimum levels at all time, i.e. there is no over-stocking or under-stocking.
- It also ensures that production time is kept at optimum level and thereby increasing the turnover time.
- Since it overlooks all aspects of production, quality of final product is always maintained.

Production Planning

Production planning is one part of production planning and control dealing with basic concepts of what to produce, when to produce, how much to produce, etc. It involves taking a long-term view at overall production planning. Therefore, objectives of production planning are as follows:

- To ensure right quantity and quality of raw material, equipment, etc. are available during times of production.
- To ensure capacity utilization is in tune with forecast demand at all the time.

A well thought production planning ensures that overall production process is streamlined providing following benefits:

- Organization can deliver a product in a timely and regular manner.
- Supplier are informed will in advance for the requirement of raw materials.
- It reduces investment in inventory.
- It reduces overall production cost by driving in efficiency.

Production planning takes care of two basic strategies' product planning and process planning. Production planning is done at three different time dependent levels i.e. long-range planning dealing with facility planning, capital investment, location planning, etc.; medium-range

planning deals with demand forecast and capacity planning and lastly short term planning dealing with day to day operations.

Production Control

Production control looks to utilize different type of control techniques to achieve optimum performance out of the production system as to achieve overall production planning targets. Therefore, objectives of production control are as follows:

- Regulate inventory management
- Organize the production schedules
- Optimum utilization of resources and production process

The advantages of robust production control are as follows:

- Ensure a smooth flow of all production processes
- Ensure production cost savings thereby improving the bottom line
- Control wastage of resources
- It maintains standard of quality through the production life cycle.

Production control cannot be same across all the organization. Production control is dependent upon the following factors:

- Nature of production(job oriented, service oriented, etc.)
- Nature of operation
- Size of operation

Production planning and control are essential for customer delight and overall success of an organization.

Types of Production

Some of the most important types of production are:
(i) Job Production
(ii) Batch production and
(iii) Mass or flow production

The final decision regarding any particular method of production is very much affected by the nature of the products and the quantity to be produced.

(i) Job Production:

Under this method peculiar, special or non-standardized products are produced in accordance with the orders received from the customers. As each product is non- standardized varying in size and nature, it requires separate job for production. The machines and equipment's are adjusted in such a manner so as to suit the requirements of a particular job.

Job production involves intermittent process as the work is carried as and when the order is received. It consists of bringing together of material, parts and components in order to assemble and commission a single piece of equipment or product.

Ship building, dam construction, bridge building, book printing are some of the examples of job production. Third method of plant layout viz., Stationery Material Layout is suitable for job production

The job production possesses the following characteristics.

1. A large number of general purpose machines are required.
2. A large number of workers conversant with different jobs will have to be employed.
3. There can be some variations in production.
4. Some flexibility in financing is required because of variations in work load.
5. A large inventory of materials, parts and tools will be required.
6. The machines and equipment setting will have to be adjusted and re-adjusted to the manufacturing requirements.
7. The movement of materials through the process is intermittent.

Job production has the following limitations:

1. The economies of large scale production may not be attained because production is done in short-runs.

2. The demand is irregular for some products.

3. The use of labour and equipment may be an inefficient.
4. The scientific assessment of costs is difficult.

(ii) Batch production:

Batch production pertains to repetitive production. It refers to the production of goods, the quantity of which is known in advance. It is that form of production where identical products are produced in batches on the basis of demand of customers' or of expected demand for products.

This method is generally similar to job production except the quantity of production. Instead of making one single product as in case of job production, a batch or group of products are produced at one time. It should be remembered here that one batch of products may not resemble with the next batch.

Under batch system of production the work is divided into operations and one operation is done at a time. After completing the work on one operation it is passed on to the second operation and so on till the product is completed. Batch production can be explained with the help of an illustration. An enterprise wants to manufacture 20 electric motors. he work will be divided into different operations. The first operation on all the motors will be completed in the

first batch and then it will pass on to the next operation. The second group of operators will complete the second operation before the next and so on. Under job production the same operators will manufacture full machine and not one operation only.

Batch production can fetch the benefits of repetitive production to a large extent, if the batch is of a sufficient quantity. Thus batch production may be defined as the manufacture of a product in small or large batches or lots by series of operations, each operation being carried on the whole batch before any subsequent operation is operated. This method is generally adopted in case of biscuit and confectionery and motor manufacturing, medicines, tinned food and hardware's like nuts and bolts etc.

The batch production method possesses the following characteristics:

1. The work is of repetitive nature.
2. There is a functional layout of various manufacturing processes.
3. One operation is carried out on whole batch and then is passed on to the next operation and so on.
4. Same type of machines is arranged at one place.
5. It is generally chosen where trade is seasonal or there is a need to produce great variety of goods.

Mass or flow production:

This method involves a continuous production of standardized products on a large scale. Under this method, production remains continuous in anticipation of future demand. Standardization is the basis of mass production. Standardized products are produced under this method by using standardized materials and equipment. There is a continuous or uninterrupted flow of production obtained by arranging the machines in a proper sequence of operations. Process layout is best suited method for mass production units.

Flow production is the manufacture of a product by a series of operations, each article going on to a succeeding operation as soon as possible. The manufacturing process is broken into separate operations.

The product completed at one operation is automatically passed on to the next till its completion. There is no time gap between the work done at one process and the starting at the next. The flow of production is continuous and progressive.

Characteristics:

The mass or flow production possesses the following characteristics.

1. The units flow from one operation point to another throughout the whole process.

2. There will be one type of machine for each process.

3. The products, tools, materials and methods are standardized.

4. Production is done in anticipation of demand.

5. Production volume is usually high.

6. Machine set ups remain unchanged for a considerable long period.

7. Any fault in flow of production is immediately corrected otherwise it will stop the whole production process.

Suitability of flow/mass production:

1. There must be continuity in demand for the product.
2. The products, materials and equipments must be standardised because the flow of line is inflexible.
3. The operations should be well defined.
4. It should be possible to maintain certain quality standards.
5. It should be possible to find time taken at each operation so that flow of work is standardised.
6. The process of stages of production should be continuous.

Advantages of mass production:

A properly planned flow production method, results in the following advantages:

1. The product is standardised and any deviation in quality etc. is detected at the spot.
2. There will be accuracy in product design and quality.
3. It will help in reducing direct labour cost.
4. There will be no need of work-in-progress because products will automatically pass on from operation to operation.
5. Since flow of work is simplified there will be lesser need for control.
6. A weakness in any operation comes to the notice immediately.
7. There may not be any need of keeping work-in-progress, hence storage cost is reduced.