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ASPIRE TO EXCEL



DEPARTMENT OF MECHANICAL ENGINEERING

SUBJECT NOTES

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UNIT – I

PLANT LOCATION

Every entrepreneur is faced with the problem of deciding the best site for location of his plant or factory.

What is 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 alternative sites. It is a strategic decision that cannot be changed once taken. If at all changed only at considerable loss, the location should be selected as per its own requirements and circumstances. Each individual plant is a case in itself. Businessman should try to make an attempt for optimum or ideal location.

What is an ideal location?

An ideal location is one where the cost of the product is kept to minimum, with a large market share, the least risk and the maximum social gain. It is the place of maximum net advantage or which gives lowest unit cost of production and distribution. For achieving this objective, small-scale entrepreneur can make use of locational analysis for this purpose.

LOCATIONAL ANALYSIS

Locational analysis is a dynamic process where entrepreneur analyses and compares the appropriateness or otherwise of alternative sites with the aim of selecting the best site for a given enterprise. It consists the following:

- (a) Demographic Analysis:** It involves study of population in the area in terms of total population (in no.), age composition, per capita income, educational level, occupational structure etc.
- (b) Trade Area Analysis:** It is an analysis of the geographic area that provides continued clientele to the firm. He would also see the feasibility of accessing the trade area from alternative sites.
- (c) Competitive Analysis:** It helps to judge the nature, location, size and quality of competition in a given trade area.
- (d) Traffic analysis:** To have a rough idea about the number of potential customers passing by the proposed site during the working hours of the shop, the traffic analysis aims at judging the alternative sites in terms of pedestrian and vehicular traffic passing a site.
- (e) Site economics:** Alternative sites are evaluated in terms of establishment costs and operational costs under this. Costs of establishment is basically cost incurred for permanent physical facilities but operational costs are incurred for running business on day to day basis, they are also called as running costs.

Two sites A and B are evaluated in terms of above mentioned two costs as follows:

Table Comparative Costs of Alternative Locations

Costs	Site A (Rs.)	Site B (Rs.)
<i>Cost of establishments:</i>		
Land and Buildings	350000	230000
Equipment	60000	60000
Transport facilities	20000	30000
<i>Cost of operations:</i>		
Materials, freight and carriage	34000	24000
Taxes and insurance	10000	7500
Labour	100000	70000
Water, power and fuel	10000	8000
Total	584000	429500

The above cost statement indicates that site B is preferable to site A keeping in mind economic considerations only although in some respects site A has lower costs. By applying the definition of ideal location which is the place of maximum net advantage or which gives lowest unit cost of production and distribution, site B would be preferred.

SELECTION CRITERIA

The important considerations for selecting a suitable location are given as follows:

- a) Natural or climatic conditions.
- b) Availability and nearness to the sources of raw material.
- c) Transport costs-in obtaining raw material and also distribution or marketing finished products to the ultimate users.
- d) Access to market: small businesses in retail or wholesale or services should be located within the vicinity of densely populated areas.
- e) Availability of Infrastructural facilities such as developed industrial sheds or sites, link roads, nearness to railway stations, airports or sea ports, availability of electricity, water, public utilities, civil amenities and means of communication are important, especially for small scale businesses.
- f) Availability of skilled and non-skilled labour and technically qualified and trained managers.
- g) Banking and financial institutions are located nearby.
- h) Locations with links: to develop industrial areas or business centers result in savings and cost reductions in transport overheads, miscellaneous expenses.
- i) Strategic considerations of safety and security should be given due importance.
- j) Government influences: Both positive and negative incentives to motivate an entrepreneur to choose a particular location are made available. Positive includes cheap overhead facilities like electricity, banking transport, tax relief, subsidies and liberalization. Negative incentives are in form of restrictions for setting up industries in urban areas for reasons of pollution control and decentralization of industries.
- k) Residence of small business entrepreneurs want to set up nearby their homelands

One study of locational considerations from small-scale units revealed that the native place or homelands of the entrepreneur was the most important factor. Heavy preference to homeland suggests that small-scale enterprise is not freely mobile. Low preference for Government incentives suggests that concessions and incentives cannot compensate for poor infrastructure.

Table given below also suggests that the locational choice undergo change with differences in the levels of development across the regions (hills and plains).

Factors Affecting Location Decision

Considerations	Entrepreneur's Response					
	Hills		Plains		Total	
	No.	%	No.	%	No.	%
Homeland	15	67	11	39	26	52
Government Incentives	3	14	1	4	4	8
Availability of Raw material	0	0	1	4	1	2
Availability of labour	2	9	0	0	2	4
Availability of market	0	0	5	18	5	10
Availability of infrastructure Facilities	1	5	9	32	10	20
Others	1	5	1	4	2	4
Total	22	100	28	100	50	100

SIGNIFICANCE

From the discussion above, we have already learnt that location of a plant is an important entrepreneurial decision because it influences the cost of production and distribution to a great extent. In some cases, you will find that location may contribute to even 10% of cost of manufacturing and marketing. Therefore, an appropriate location is essential to the efficient and economical working of a plant. A firm may fail due to bad location or its growth and efficiency may be restricted.

PLANT LAYOUT

The efficiency of production depends on how well the various machines; production facilities and employee's amenities are located in a plant. Only the properly laid out plant can ensure the smooth and rapid movement of material, from the raw material stage to the end product stage. Plant layout encompasses new layout as well as improvement in the existing layout.

It may be defined as a technique of locating machines, processes and plant services within the factory so as to achieve the right quantity and quality of output at the lowest possible cost of manufacturing. It involves a judicious arrangement of production facilities so that workflow is direct.

DEFINITION

A plant layout can be defined as follows:

Plant layout refers to the arrangement of physical facilities such as machinery, equipment, furniture etc. within the factory building in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of material to the shipment of the finished product.

According to Riggs, "the overall objective of plant layout is to design a physical arrangement that most economically meets the required output – quantity and quality."

According to J. L. Zundi, "Plant layout ideally involves allocation of space and arrangement of equipment in such a manner that overall operating costs are minimized.

IMPORTANCE

Plant layout is an important decision as it represents long-term commitment. An ideal plant layout should provide the optimum relationship among output, floor area and manufacturing process. It facilitates the production process, minimizes material handling, time and cost, and allows flexibility of operations, easy production flow, makes economic use of the building, promotes effective utilization of manpower, and provides for employee's convenience, safety, comfort at work, maximum exposure to natural light and ventilation. It is also important because it affects the flow of material and processes, labour efficiency, supervision and control, use of space and expansion possibilities etc.

ESSENTIALS

An efficient plant layout is one that can be instrumental in achieving the following objectives:

- a) Proper and efficient utilization of available floor space
- b) To ensure that work proceeds from one point to another point without any delay
- c) Provide enough production capacity.
- d) Reduce material handling costs
- e) Reduce hazards to personnel
- f) Utilize labour efficiently
- g) Increase employee morale

- h) Reduce accidents
- i) Provide for volume and product flexibility
- j) Provide ease of supervision and control
- k) Provide for employee safety and health
- l) Allow ease of maintenance
- m) Allow high machine or equipment utilization
- n) Improve productivity

TYPES OF LAYOUT

As discussed so far the plant layout facilitates the arrangement of machines, equipment and other physical facilities in a planned manner within the factory premises. An entrepreneur must possess an expertise to lay down a proper layout for new or existing plants. It differs from plant to plant, from location to location and from industry to industry. But the basic principles governing plant layout are more or less same.

As far as small business is concerned, it requires a smaller area or space and can be located in any kind of building as long as the space is available and it is convenient. Plant layout for Small Scale business is closely linked with the factory building and built up area.

From the point of view of plant layout, we can classify small business or unit into three categories:

1. Manufacturing units
2. Traders
3. Service Establishments

1. Manufacturing units

In case of manufacturing unit, plant layout may be of four types:

- (a) Product or line layout
- (b) Process or functional layout
- (c) Fixed position or location layout
- (d) Combined or group layout

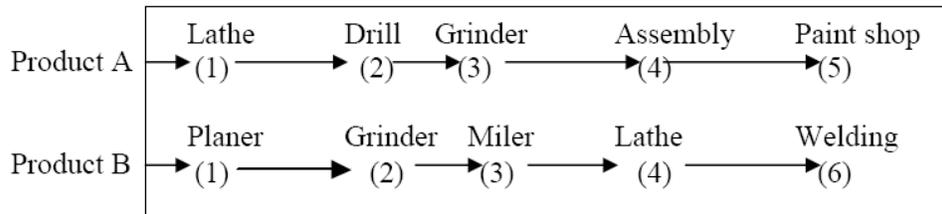
(a) Product or line layout:

Under this, machines and equipments are arranged in one line depending upon the sequence of operations required for the product. The materials move from one workstation to another sequentially without any backtracking or deviation. Under this, machines are grouped in one sequence. Therefore materials are fed into the first machine and finished goods travel automatically from machine to machine, the output of one machine becoming input of the next, e.g. in a paper mill, bamboos are fed into the machine at one end and paper comes out at the other end. The raw material moves very fast from one workstation to other stations with a minimum work in progress storage and material handling.

The grouping of machines should be done keeping in mind the following general principles.

- a) All the machine tools or other items of equipments must be placed at the point demanded by the sequence of operations
- b) There should no points where one line crossed another line.
- c) Materials may be fed where they are required for assembly but not necessarily at one point.
- d) All the operations including assembly, testing packing must be included in the line

A line layout for two products is given below.



Advantages: Product layout provides the following benefits:

- a) Low cost of material handling, due to straight and short route and absence of backtracking
- b) Smooth and uninterrupted operations
- c) Continuous flow of work
- d) Lesser investment in inventory and work in progress
- e) Optimum use of floor space
- f) Shorter processing time or quicker output
- g) Less congestion of work in the process
- h) Simple and effective inspection of work and simplified production control
- i) Lower cost of manufacturing per unit

Disadvantages: Product layout suffers from following drawbacks:

- a. High initial capital investment in special purpose machine
- b. Heavy overhead charges
- c. Breakdown of one machine will hamper the whole production process
- d. Lesser flexibility as specially laid out for particular product.

Suitability: Product layout is useful under following conditions:

- 1) Mass production of standardized products
- 2) Simple and repetitive manufacturing process
- 3) Operation time for different process is more or less equal
- 4) Reasonably stable demand for the product
- 5) Continuous supply of materials

Therefore, the manufacturing units involving continuous manufacturing process, producing few standardized products continuously on the firm's own specifications and in anticipation of sales

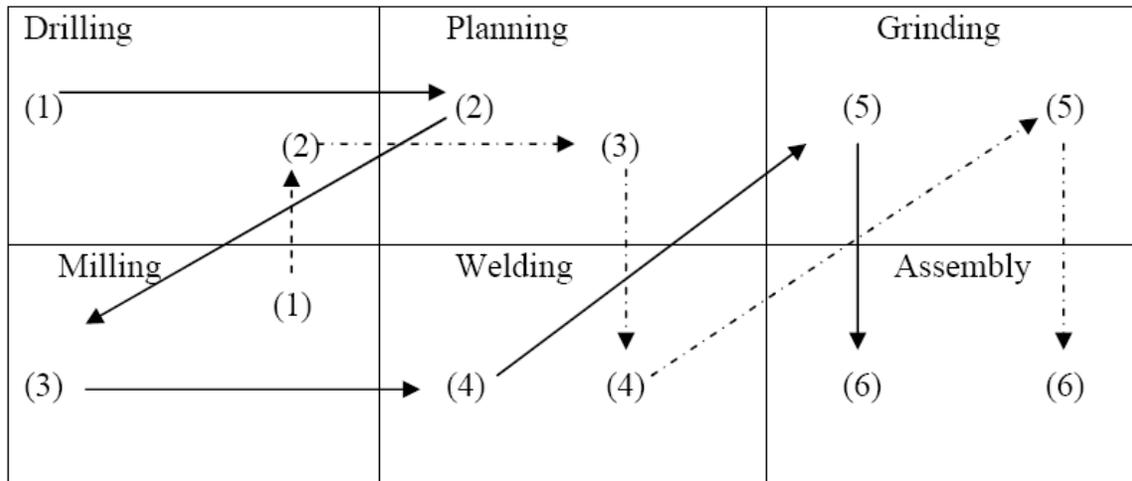
would prefer product layout e.g. chemicals, sugar, paper, rubber, refineries, cement, automobiles, food processing and electronics etc.

(b) Process layout:

In this type of layout machines of a similar type are arranged together at one place. E.g. Machines performing drilling operations are arranged in the drilling department, machines performing casting operations be grouped in the casting department. Therefore the machines are installed in the plants, which follow the process layout.

Hence, such layouts typically have drilling department, milling department, welding department, heating department and painting department etc. The process or functional layout is followed from historical period. It evolved from the handicraft method of production. The work has to be allocated to each department in such a way that no machines are chosen to do as many different job as possible i.e. the emphasis is on general purpose machine.

The work, which has to be done, is allocated to the machines according to loading schedules with the object of ensuring that each machine is fully loaded. Process layout is shown in the following diagram.



Product A: —————→

Product B: - - - - ->

Process layout showing movement of two products

The grouping of machines according to the process has to be done keeping in mind the following principles

- a) The distance between departments should be as short as possible for avoiding long distance movement of materials
- b) The departments should be in sequence of operations
- c) The arrangement should be convenient for inspection and supervision

Advantages: Process layout provides the following benefits

- a) Lower initial capital investment in machines and equipments. There is high degree of machine utilization, as a machine is not blocked for a single product
- b) The overhead costs are relatively low
- c) Change in output design and volume can be more easily adapted to the output of variety of products
- d) Breakdown of one machine does not result in complete work stoppage
- e) Supervision can be more effective and specialized
- f) There is a greater flexibility of scope for expansion.

Disadvantages: Product layout suffers from following drawbacks

- a. Material handling costs are high due to backtracking
- b. More skilled labour is required resulting in higher cost.
- c. Time gap or lag in production is higher
- d. Work in progress inventory is high needing greater storage space
- e. More frequent inspection is needed which results in costly supervision

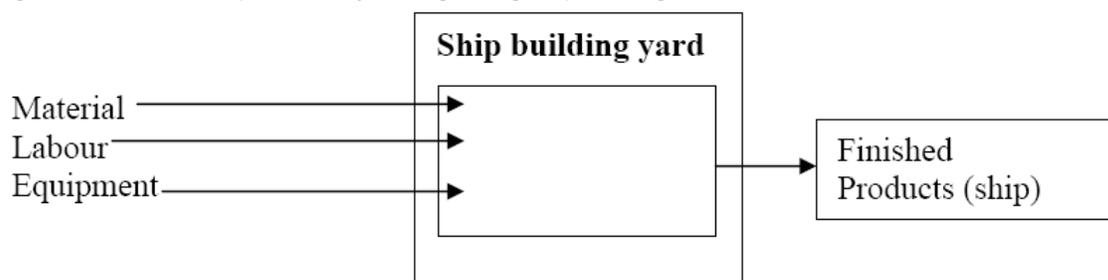
Suitability: Process layout is adopted when

- 1. Products are not standardized
- 2. Quantity produced is small
- 3. There are frequent changes in design and style of product
- 4. Job shop type of work is done
- 5. Machines are very expensive

Thus, process layout or functional layout is suitable for job order production involving non-repetitive processes and customer specifications and non-standardized products, e.g. tailoring, light and heavy engineering products, made to order furniture industries, jewelry.

(c) Fixed Position or Location Layout

In this type of layout, the major product being produced is fixed at one location. Equipment labour and components are moved to that location. All facilities are brought and arranged around one work center. This type of layout is not relevant for small scale entrepreneur. The following figure shows a fixed position layout regarding shipbuilding.



Advantages: Fixed position layout provides the following benefits

- a) It saves time and cost involved on the movement of work from one workstation to another.
- b) The layout is flexible as change in job design and operation sequence can be easily incorporated.
- c) It is more economical when several orders in different stages of progress are being executed simultaneously.
- d) Adjustments can be made to meet shortage of materials or absence of workers by changing the sequence of operations.

Disadvantages: Fixed position layout has the following drawbacks

- a. Production period being very long, capital investment is very heavy
- b. Very large space is required for storage of material and equipment near the product.
- c. As several operations are often carried out simultaneously, there is possibility of confusion and conflicts among different workgroups.

Suitability: The fixed position layout is followed in following conditions

- 1. Manufacture of bulky and heavy products such as locomotives, ships, boilers, generators, wagon building, aircraft manufacturing, etc.
- 2. Construction of building, flyovers, dams.
- 3. Hospital, the medicines, doctors and nurses are taken to the patient (product).

(d) Combined layout

Certain manufacturing units may require all three processes namely intermittent process (job shops), the continuous process (mass production shops) and the representative process combined process [i.e. miscellaneous shops].

In most of industries, only a product layout or process layout or fixed location layout does not exist. Thus, in manufacturing concerns where several products are produced in repeated numbers with no likelihood of continuous production, combined layout is followed. Generally, a combination of the product and process layout or other combination are found, in practice, e.g. for industries involving the fabrication of parts and assembly, fabrication tends to employ the process layout, while the assembly areas often employ the product layout. In soap, manufacturing plant, the machinery manufacturing soap is arranged on the product line principle, but ancillary services such as heating, the manufacturing of glycerin, the power house, the water treatment plant etc. are arranged on a functional basis.

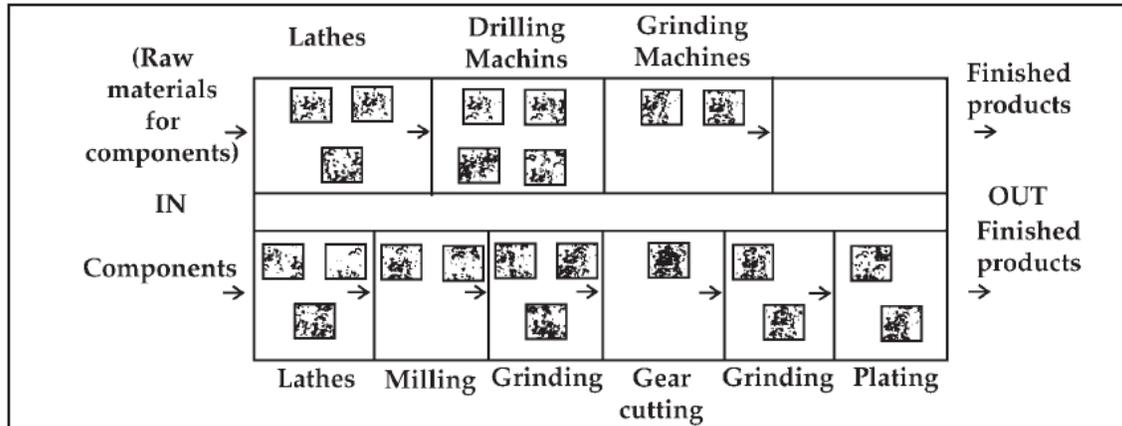


Fig. Component flow in combined layout

2. Traders

When two outlets carry almost same merchandise, customers usually buy in the one that is more appealing to them. Thus, customers are attracted and kept by good layout i.e. good lighting, attractive colours, good ventilation, air conditioning, modern design and arrangement and even music. All of these things mean customer convenience, customer appeal and greater business volume.

The customer is always impressed by service, efficiency and quality. Hence, the layout is essential for handling merchandise, which is arranged as per the space available and the type and magnitude of goods to be sold keeping in mind the convenience of customers.

There are three kinds of layouts in retail operations today.

1. Self service or modified self service layout
2. Full service layout
3. Special layouts

The self-service layouts, cuts down on sales clerk's time and allow customers to select merchandise for themselves. Customers should be led through the store in a way that will expose them to as much display area as possible, e.g. Grocery Stores or department stores. In those stores, necessities or convenience goods should be placed at the rear of the store. The use of color and lighting is very important to direct attention to interior displays and to make the most of the stores layout.

All operations are not self-service. Certain specialty enterprises sell to fewer numbers of customers or higher priced product, e.g. Apparel, office machines, sporting goods, fashion items, hardware, good quality shoes, jewelry, luggage and accessories, furniture and appliances are all examples of products that require time and personal attention to be sold. These full service layouts provide area and equipment necessary in such cases.

Some layouts depend strictly on the type of special store to be set up, e.g. TV repair shop, soft ice cream store, and drive-in soft drink stores are all examples of business requiring special design. Thus, good retail layout should be the one, which saves rent, time and labour.

3. Services centers and establishment

Services establishments such as motels, hotels, restaurants, must give due attention to client convenience, quality of service, efficiency in delivering services and pleasing office ambience. In today's environment, the clients look for ease in approaching different departments of a service organization and hence the layout should be designed in a fashion, which allows clients quick and convenient access to the facilities offered by a service establishment.

FACTORS INFLUENCING LAYOUT

While deciding his factory or unit or establishment or store, a small-scale businessman should keep the following factors in mind:

a) *Factory building*: The nature and size of the building determines the floor space available for layout. While designing the special requirements, e.g. air conditioning, dust control, humidity control etc. must be kept in mind.

b) *Nature of product*: product layout is suitable for uniform products whereas process layout is more appropriate for custom-made products.

c) *Production process*: In assembly line industries, product layout is better. In job order or intermittent manufacturing on the other hand, process layout is desirable.

d) *Type of machinery*: General purpose machines are often arranged as per process layout while special purpose machines are arranged according to product layout

e) *Repairs and maintenance*: machines should be so arranged that adequate space is available between them for movement of equipment and people required for repairing the machines.

f) *Human needs*: Adequate arrangement should be made for cloakroom, washroom, lockers, drinking water, toilets and other employee facilities, proper provision should be made for disposal of effluents, if any.

g) *Plant environment*: Heat, light, noise, ventilation and other aspects should be duly considered, e.g. paint shops and plating section should be located in another hall so that dangerous fumes can be removed through proper ventilation etc. Adequate safety arrangement should also be made.

Thus, the layout should be conducive to health and safety of employees. It should ensure free and efficient flow of men and materials. Future expansion and diversification may also be considered while planning factory layout.

DYNAMICS OF PLANT LAYOUT

Plant layout is a dynamic rather than a static concept meaning thereby if once done it is not permanent in nature rather improvement or revision in the existing plant layout must be made by keeping a track with development of new machines or equipment, improvements in manufacturing process, changes in materials handling devices etc. But, any revision in layout must be made only when the savings resulting from revision exceed the costs involved in such revision.

Revision in plant layout may become necessary on account of the following reasons:

- a) Increase in the output of the existing product
- b) Introduction of a new product and diversification

- c) Technological advancements in machinery, material, processes, product design, fuel etc.
- d) Deficiencies in the layout unnoticed by the layout engineer in the beginning.

APPLICABILITY OF PLANT LAYOUT

Plant layout is applicable to all types of industries or plants. Certain plants require special arrangements which, when incorporated make the layout look distinct from the types already discussed above. Applicability of plant layout in manufacturing and service industries is discussed below.

In case of the manufacturing of *detergent powder*, a multi-storey building is specially constructed to house the boiler. Materials are stored and poured into the boiler at different stages on different floors. Other facilities are also provided around the boiler at different stations.

Another applicability of this layout is the manufacture of *talcum powder*. Here machinery is arranged vertically i.e. from top to bottom. Thus, material is poured into the first machine at the top and powder comes out at the bottom of the machinery located on the ground floor.

Yet another applicability of this layout is the *newspaper plant*, where the time element is of supreme importance, the accomplishment being gapped in seconds.

Here plant layout must be simple and direct so as to eliminate distance, delay and confusion. There must be a perfect coordination of all departments and machinery or equipments, as materials must never fail.

Plant layout is also applicable to *five star hotels* as well. Here lodging, bar, restaurant, kitchen, stores, swimming pool, laundry, shaving saloons, shopping arcades, conference hall, parking areas etc. should all find an appropriate place in the layout. Here importance must be given to cleanliness, elegant appearance, convenience and compact looks, which attract customers.

Similarly plant layout is applicable to a *cinema hall*, where emphasis is on comfort, and convenience of the cinemagoers. The projector, screen, sound box, fire fighting equipment, ambience etc. should be of utmost importance.

A plant layout applies besides the grouping of machinery, to an arrangement for other facilities as well. Such facilities include receiving and dispatching points, inspection facilities, employee facilities, storage etc.

Generally, the receiving and the dispatching departments should be at either end of the plant. The storeroom should be located close to the production, receiving and dispatching centers in order to minimize handling costs. The inspection should be right next to other dispatch department as inspections are done finally, before dispatch.

The maintenance department consisting of lighting, safety devices, fire protection, collection and disposal of garbage, scrap etc. should be located in a place which is easily accessible to all the other departments in the plant. The other employee facilities like toilet facilities, drinking water facilities, first aid room, cafeteria etc. can be a little away from other departments but should be within easy reach of the employees. Hence, there are the other industries or plants to which plant layout is applicable.

Line Balancing

Assembly line balancing is associated with a product layout in which products are processed as they pass through a line of work centres. An assembly line can be considered as a “production sequence” where parts are assembled together to form an end product. The operations are carried out at different workstations situated along the line.

The Problem of Line Balancing:

It arises due to the following factors

1. The finished product is the result of many sequential operations.
2. There is a difference in production capacities of different machines Line balancing is the apportionment of sequential work activities into workstations in order to gain a high utilisation of labour and equipment so as to minimise the idle time. For example, the production capacities of two machines A and B are as under for a particular job: A 50 pieces/hour; B 25 pieces/hour.

Now, if only one machine of each is provided, then machine B will produce 25 units/hour where as the machine A can produce 50 units. But because of the sequence, only 25 units are produced per hour, i.e., machine A will work only 50 per cent of its capacity and the remaining 30 minutes in one hour, it is idle. This idle time can be minimised by introducing one more machine of kind B in the production line.

Steps in Solving Line Balancing Problems

1. Define task.
2. Identify precedence requirements.
3. Calculate minimum number of workstations required to produce desired output.
4. Apply heuristics to assign task to each station.
5. Evaluate effectiveness and efficiency.
6. Seek further improvement.

Three important parameters in line balancing

Total station time

$$1. \text{ Line efficiency (LE)} = \frac{\text{Total station tim}}{\text{Cycle time} \times \text{no of workstations}} \times 100$$

$$2. \text{ Balance delay (BD)} = \frac{\text{Total idle time for all workstation}}{\text{Total available working time on all station}} \times 100$$

$$\text{BD} = (1-\text{LE})$$

$$3. \text{ Smoothness Index (SI)} = \sum_{i=1}^k (\text{Max. station time} - \text{station times of station } i)^2$$

SI = 0, means a perfect balance

K = total number of workstations < total number of elements

Also, CT > maximum time of any work element n

Terms used in the context of Line Balancing:

1. Workstation: A work station is a location on assembly line where given amount of work is performed.
2. Cycle time: It is the amount of time for which a unit that is assembled is available to any operator on the line or it is the time the product spends at each work station.

$$\text{Cycle Time (CT)} = \frac{\text{Available time period}}{\text{Output units required / period}} = \frac{\text{AT}}{\text{Output}}$$

3. Task: The smallest grouping of work that can be assigned to a workstation.
4. Predecessor task: A task that must be performed before performing another (successor) task.
5. Task time: Standard time to perform element task.
6. Station time (sk): Total standard work content of specific workstation.
7. Balance Delay (BD): Percentage of total idle time on the line to total time spent by the product from beginning to end of line.

$$\text{B.D} = \frac{n \cdot \text{CT} - \sum_{k=1}^n s_k \times 100}{n \times \text{CT}}$$

B.D= Balance delay

n = number of work stations, CT = Cycle time

sk = Station time

MATERIALS HANDLING

To manufacture any product, it is necessary either that materials move from one step of the manufacturing process to another or that operators move to the materials. The most common practice, of course, is to move the materials. This movement of materials from one processing area to another and from department to department necessitates the use of much personnel and equipment and the handling of treatment tonnages of materials.

Consideration for the handling of work-in-processes materials, as well as raw material and finished goods, has always been a part of the production systems design process. Basic cost accounting evaluation of the cost of manufacturing products reveals that when materials handling costs are separated from other costs, they can be seen to be significant.

Recently, the materials handling function has been undergoing significant changes in concept and implementation. Management has been changing its view of materials handling as the routine transfer of materials from place to place and is beginning to think of it as part of a total materials flow system. This change in thinking has come about largely as a result of new automatic handling and storage equipment and systems that are integrated closely with automatic processing and sophisticated management information and control systems.

Definition of Materials Handling

In a broad sense, materials handling includes all movement of materials, in a manufacturing situation. It has been defined by the Materials Handling Division, American Society of Mechanical Engineers, as follows: "Materials handling is the art and science involving the moving, packing, and storing of substances in any form." This is an all inclusive definition and can include fluids and semi-fluids, as well as discrete items. For the sake of simplicity, we shall limit our discussion in this chapter to the movement of discrete items, such as gears, tires, castings, and boxes. Similarly, we shall consider only the movement of materials within the plant or storage areas. Movement of materials between plants- particularly when common carriers are used – is generally considered a problem in traffic and is frequently handled by a separate traffic department.

Objectives of Materials Handling

The simplest solution to the materials handling problem- "No movement, no cost" is hardly practicable for a complete manufacturing process. It is basically sound approach when one is attempting to improve a complete production cycle and when the number of handling can be reduced. It is also a good solution in the making of heavy industrial equipment.

In the latter situation it is often more feasible to bring the tools and workers to the product than to transport the product to the machine or work area.

In addition to the objective of reducing the overall costs of materials handling by reducing the number of handling involved, the following may be considered as objectives of the engineer in his or her approach to this problem.

Lower the unit materials handling costs. It is obvious that if the overall materials handling costs are reduced the unit costs will be reduced. This approach requires the costs of handling be allocated to or identified with the units of product, or its component parts that moved.

Reduce the manufacturing cycle time: The total time required to make a product from the receipt of raw materials to the finished goods can be reduced through effective materials handling.

Contribute toward a better control of the flow of goods: A principle way in which good materials handling practice can effect savings is by making the control of goods easier particularly in continuous manufacturing, where all operations are “tied together” by the materials handling plan.

Provide for improved working conditions and greater safety in the movement of materials many of the provisions of the occupational Safety and Health Act require adherence to safe handling practices. These must be followed. In addition, it is evident that the safe handling of materials will be reflected in a better industrial accident record.

Provide for fewer rejects: Care in the handling of the product will contribute to a better quality level of the goods produced. Products damaged by inefficient handling are all too often a major cost to manufacturer.

Achieve decreased storage requirement: Better movement and storage of materials should increase the utilization of storage space.

Gain Higher productivity at lower manufacturing cost : Any materials handling system, if it is worth its investments, is design to improve productivity. This improvement should be achieved by moving materials in the fastest, most efficient and economical way possible.

Principles of Material Handling

A good materials handling engineer will generally have several years of experience that can be brought to bear on the solution of materials handling problems or the design of materials handling systems.

For many years, discussions of principles of materials handling have been published by many experts in the field. The following list has been adapted from two of these sources:

1. Eliminate wasteful methods by
 - a. Reducing to a minimum the number of handlings of materials.
 - b. Eliminating unnecessary mixing and subsequent sorting.
 - c. Using mechanical aids to eliminate the use of hand labor in movement of materials.
 - d. Avoiding the unnecessary transfer of materials from floor to workplace or from container to container.
 - e. Increasing the speed of handling.
 - f. Utilizing containers and unit loads.

- g. Utilizing gravity as a moving force wherever practicable.
 - h. Introducing automatically into the materials handling plan.
2. In laying out the plant:
- a. Plan a system for materials flow and combine handling with processing wherever possible.
 - b. Provide for continuous or appropriate intermittent flow of materials.
 - c. Provide for the optimal flow of materials between operations and with a minimum of retrograde movement.
 - d. Plant the layout of the work-station area for a minimum of handling of the product.
 - e. Maximize the quantity and size of weight handled.
 - f. Coordinate the overall materials handling throughout the entire plant.
 - g. Provide for safe handling and safe equipment and integrate with the management information and control system.
 - h. Plan for adequate receiving, storage and shipping facilities.
 - i. Make optimum use of building cubage.
 - j. Design adequate aisle and access areas.
3. In the selection and application of materials handling equipment:
- a. Plan activities and analyze equipment needs before considering the purchase of new equipment.
 - b. Ensure that the existing equipment is being used effectively.
 - c. Use the simplest equipment that is adaptable to the problem: avoid the use of complicated mechanisms and controls.
 - d. Adopt standard equipment if possible; ensure that the purchase of special equipment is economically justified.
 - e. Select equipment that is flexible in its application.
 - f. Select equipment that will minimize the ratio of mobile equipment deadweights to pay loads.
 - g. Determine comparative costs of equipment before purchasing.
 - h. Recognize the need for different equipment for different jobs.
 - i. Recognize the need to provide suitable building conditions for the equipment.
 - j. Provide for alternative methods for use in emergencies.
 - k. Give consideration to the maintenance of the equipment.
- l. Replace obsolete methods and equipment with more efficient ones.

General Types of Materials Handling Equipment

Tompkins and White divide materials handling equipment into five classifications. They give the following list but note that numerous variations can exist within each category:

1. Conveyors
2. Monorails, hoists, and cranes
3. Industrial trucks

4. Containers and supports
5. Auxiliary and other equipment

Factors affecting the selection of Materials Handling Equipment

The selection of materials handling equipment requires the attaining of proper balance between the production problem, the capabilities of the equipment available, and the human element involved. The ultimate aim is to arrive at the lowest cost per unit of material handled.

Equipment factors to be taken into consideration may well include the following:

Adaptability: the load carrying and movement characteristics of the equipment should fit the materials handling problem.

Flexibility: Where possible the equipment should have flexibility to handle more than one material, referring either to class or size.

Load capacity: Equipment selected should have great enough load-carrying characteristics to do the job effectively, yet should not be too large and result in excessive operating costs.

Power: Enough power should be available to do the job.

Speed: Rapidity of movement of material, within the limits of the production process or plant safety, should be considered

Space requirements: The space required to install or operate materials handling equipment is an important factor in its selection.

Supervision required: As applied to equipment selection, this refers to the degree of automaticity designed into the equipment.

Ease of maintenance: Equipment selected should be easily maintained at reasonable cost.

Environment: Equipment selected must conform to any environment regulations.

Cost: The consideration of the cost of the equipment is an obvious factor in its selection.

Accounting for Materials Handling Costs

The cost of materials handling arises from two sources: the cost of owning and maintaining equipment and the cost of operating the system. General cost-accounting practice classifies the cost of handling materials as an indirect cost or overhead. This classification is based on the position that the movement of the materials does not contribute to their physical change or add value to them as a product or as a component part thereof.

In some manufacturing situations, such as a carbon black plant where the material is constantly moving during the production process, this contention of the cost accountants might be challenged. However, the problem of classification of unit handling costs of most situations is more of an academic than a practical nature.

Relation of Materials Handling to Flow of Material and Plant Layout

The pattern of flow of materials in a plant definitely affects the materials handling costs. The production process should be so planned and the machines and benches so arranged that the

handlings of materials are reduced to a minimum with as little backtracking of goods as possible. The type of manufacturing is a major factor in this respect.

In the layout of a plant for continuous manufacture the pattern of flow is planned well in advance; because of balanced machine and assembly lines, it lends itself to a well planned flow of component parts, subassemblies, and assemblies. This makes it possible to plan the handling of materials in advance, procure and install the best equipment for the job, and design for a minimum materials handling cost. However, once installed, the plan lacks flexibility- usually it cannot be changed without major expense.

Storage

Material in storage is generally thought to be stationary or idle. But the use of conveyors as storage devices is quite popular. These conveyors may be overhead and constantly moving, yet utilizing ceiling – space storage. Other storage installations may be like the skate conveyors. In one Midwestern furniture plant the complete floor of the finish drying room is covered by a large slat conveyor that moves very slowly: pieces placed on this “floor” at one side of the room are dry when they reach the other side.

Packaging

Whether packaging is or is not a phase of materials handling is to some degree an academic question. The unit load is in itself a “package”. Generally speaking, however, the term packaging is used to cover the preparation of the final product for shipment, particularly if the product is a consumer good.

From the viewpoint of a material handling problem, packaging of the incoming materials as well as of the outgoing product directly affect materials handling methods and equipment – and the resultant materials handling costs. The designing of the package of a product, although usually identified as a separate activity or function, is closely interrelated with materials handling, methods of production, and marketing. Attractively packaged goods on the shelves and counters of the store, as well as the identification of large shipments on trucks and railroad cars, are effective advertising and sales promotion.

Organization for Effective Materials Handling

Good materials handling practice is the responsibility of all members of the manufacturing team, from the top management down to the trucker working in the aisle of the plant. Very few other elements of manufacturing activity must be so carefully considered by each function in the manufacturing organization. Optimum effectiveness of materials handling procedures can only be attained if each individual recognizes and plays his part. Education and training in materials handling are prerequisite to minimum materials handling costs.

Responsibilities assigned such a staff group may well include:

1. Determining all new methods for the handling of new materials or products and selecting the equipment to be utilized.

2. Conducting research in materials handling methods and equipment.
3. Conducting education and training for all manufacturing personnel in good material handling practices.
4. Establishing controls of current materials handling costs by analysis of costs and comparison to budgets of either unit or total materials handling costs.
5. Initiating and conducting a continuing materials handling cost-reduction or cost improvement program.
6. Determining measurements for effectiveness of materials handling that can become the yard – sticks for progress in this activity.
7. Developing and conducting a preventive maintenance program for all materials handling equipment.

UNIT – II

WORK STUDY:

It is a general term for the techniques: methods study and work measurement which are used in the examination; of human work in all its contexts and systematically investigate all factors leading to improvement of efficiency.

Work study aims at finding the best and most efficient way of using the available resources—men, materials, money and machinery. Once the method study has developed an improved procedure for doing a work the work measurement or time study will study the time to complete a job.

METHOD STUDY

Definition of method study

Method study is a work study technique. It is used to simplify the job and develop more economical and effective method of doing work. It can be defined as bellow:

“Method study is the systematic recording and critical examination of the present and proposed ways of doing work, as a means of developing and applying easier and more effective methods to reduce costs”

Objectives of method study:

1. To improve the manufacturing processes and procedures.
2. To improve factory, office and work place layout.
3. To improve plant and equipment design. To reduce human fatigue and effort in performance of work.
4. To improve the use of man power, machine power and material.
5. To improve physical working conditions.
6. To develop effective material handling.
7. To ensure safety in all activities.

Processes analysis:

It is a device for recording a process in a compact manner as a means of better understanding and improvement. The chart represents graphically the separate steps or events that occur during the performance of a task or during a series of action.

It usually begins with a raw material entering the factory and follows it through every step such as transportation to storage, inspection, machining and assembly until it becomes a finished until itself or a part of a subassembly.

A careful study gives a graphical picture of every step in the process through the factory, from the graphical picture we can analyse and design better performance sketches.

The chart should be either the

- (a) Man type or (b) Material type and the two types should not be combined.

Process analysis has the following uses

- 1) It facilitates comprehension and understanding of the overall nature of process understudy.
- 2) When the work is of complicated nature it breaks the whole process into understandable subdivisions.
- 3) A standard and a convenient record is obtained which can be easily understood.

- 4) It brings into focus delays, imbalances, improper utilization of equipment or manpower and points in the direction of the improvement needed.
- 5) It facilitates easy and analysis.

In process analysis the following charts are studied.

- a) Out line process chart (operation process chart)
- b) Flow process chart, these are of man type, material type and equipment type.
- c) Flow diagram.
- d) String diagram.

Operation process chart (Outline process chart):

It gives a graphic representation of a process in chronological order, as the name indicates it does not go into details of every sequence of operation such as transportation, storage and delays. The operation process chart is also called Assembly process chart.

The following operation process chart shown is for a single product. Consider an example where a steel block is to be milled into a 'V' block in a milling machine as per the dimensions shown.

An equal angle cutter is used to mill the 'V' shape in the block, and the width of the slot is milled using a side and face cutter as shown below.

The following operation process chart shows a case where more than one product is involved. It shows the operations from raw material stage to finished product stage.

The method of charting can be understood by considering a case in which two plates are assembled and riveted.

It will be seen from the figure that the operation numbers are continuous from 1 to 3 then the part is inspected and temporarily stored till operations 4 and 5 on the second component are completed for inspection. Operations 6 and 8 are then carried out and the assembly thus completed is deposited in stores after inspection.

Flow Process Chart

It may be observed that an operation process chart gives an overall picture of a process but for economical production and proper layout more information regarding movement of men, materials, storage and delays are needed. This can be obtained by construction of a flow process chart. In general flow process chart contains considerably more information than the operation process chart. Flow process chart is generally used for the fabrication or assembly of a small article, it is prepared in much the same way as operation process chart (Outline process chart).

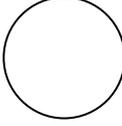
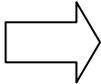
A flow process chart is defined as "a graphic representation of all the operations, transportations, inspections, delays and storage occurring during a process or procedure and also includes information such as time required and distance moved".

There are three types of flow process charts.

- 1) Man type flow process chart records the work and movement of the operator – It records only what the man does.
- 2) Material type flow process chart presents sequence of the events as to what happens to the materials – It records only what happens to the material
- 3) Equipment type flow process chart shows how the equipment is utilized – It records only how the equipments are used.

Process Chart Symbols:

Charts are generally represented by symbols, as they give a better picture and quick understanding of the process.

SI.No.	Event	Symbol	Description
1	Operation		Operation represents an action. An operation occurs when in any process an object is intentionally changed to bring the process nearer to completion. The change can be Physical, Chemical, Mechanical such as assembly or disassembly arrangement etc. An operation also includes planning and calculation work. Example: Cutting a steel rod or driving a nail.
2	Inspection		When an object is checked or verified as to quantity, quality, size, shape etc. An inspection is a checking step and does not bring the process nearer to completion. Example: Eggs being counted, diameter of a job being measured.
3	Transportation		A transportation occurs when an object is moved from one place to another by manual or mechanical means. Those movements of objects which are an integral part of an operation or inspection are not included in transportation. Example: Products being taken to a shop floor in a trolley, worker carrying trays.
4	Delay		It is a temporary storage of an object, it occurs when conditions are such that the next operation, inspection or transportation cannot be started immediately after previous operation, inspection or transportation. Example: Waiting for a lift, jobs awaiting machining, power failure during process.
5	Storage		A storage occurs when the objects are kept waiting for the process to start or for their removal to other locations after the process has ended. It is different from delay, since delay occurs during the process where as storage occurs at the start or at the end of a process. Another important point is that when objects are in storage they can be removed from there only after due authorizations from competent authority.
6	Transportation and inspection		Example: Counting the no. of egg trays in the delivery van when the van is moving from the form to store.
7	Operation and transportation		Example: Lables being struck on oil tins as they are transported on the belt conveyor.
8	Inspection and operation		Example: An oil tin being weighed as the tin is filled with oil, in this both the events occur simultaneously and are controlled

			automatically.
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Two Hand Process Chart:

The two hand process chart is "a chart in which the activities of a worker's hand are recorded, in their relationship to one another". It is commonly used for repetitive and short operations. Same symbols are used as in the case of other charts.

The act of making the chart enables the work study man to gain an intimate knowledge of the details of the job. The chart itself enables him to study each element of the job and its relation to other elements. Different ways of simplifying the work may be found, if they are charted, they can be compared easily to find out the best method. The two handed process chart can be applied to a great variety of assembly, machining and electrical jobs. It helps to visualize the complete sequence of activities in a repetitive task of short duration performed within the confines of a work place.

Procedure for preparing two – handed process chart:

1. Before start of recording, study the operation cycle few times.
2. Observe one hand at a time and record.
3. Record few symbols at a time.
4. Start observing and recording at a position which could be easily distinguished. The action of picking up or grasping a fresh part at the beginning of a cycle of work is a good point at which to start record.
5. Care must be taken while observing and recording. No activities should be left otherwise it will affect the whole study. Also, avoid combining operations and transportations or positioning, unless they actually occur at the same time.

Multiple Activity Chart:

A multiple activity chart is a chart in which the activities of more than one item are recorded on a common time scale to show their inter – relationship.

By using separate vertical columns to represent the activities of different operators or machines on a common time scale, the chart shows very clearly the period of idleness on the part of any items during the process. A study of the chart often makes it possible to rearrange the activities so that ineffective time is reduced

Objectives of multiple activity chart:

- (i) To detect the period of idleness on the part of men and machines.
- (ii) To determine the no. of machines which an operator should be able to look after.
- (iii) In organizing teams of workers on mass production work.
- (iv) To determine no. of workers necessary to perform a job involving team work.

A multiple activity chart consists of a series of columns drawn against a common time scale, which starts with zero and terminates at a cycle time of the job. The task to be recorded is broken into smaller activities and time for each activity is measured with the help of either a wrist watch or a stop watch. The activities and their times so observed are then recorded in an appropriate column.

Only two symbols are used in multiple activity chart, these are:

Man and Machine Chart:

Worker-machine charts or man-machine charts are graphical representation of simultaneous activities of a worker and the machine or equipment he or she operates. These charts help identify idle time and cost of both workers and machines. Alternative worker-machine combinations can be analysed to determine the most efficient arrangement of worker-machine interaction for carrying out a job.

Worker-machine charts show the time required to complete tasks that constitute a work cycle. A cycle is the length of time required to progress through one complete combination of work activities.

SIMO Chart

It is a graphic representation of the sequence of the therbligs or group of therbligs performed by body members of operator. It is drawn on a common time scale. In other words, it is a two-hand process chart drawn in terms of therbligs and with a time scale, see figure making the Simo Chart. A video film or a motion picture film is shot of the operation. The film is analyzed frame by frame. For the left hand, the sequence of therbligs (or group of therbligs) with their time values are recorded on the column corresponding to the left hand. The symbols are added against the length of column representing the duration of the group of therbligs. The procedure is repeated for the right and other body members (if any) involved in carrying out the operation.

It is generally not possible to time individual therbligs. A certain number of therbligs may be grouped into an element large enough to be measured as can be seen in Figure.

Uses of Simo Chart:

From the motion analysis shown about the motions of the two hands (or other body members) involved in doing an operation, inefficient motion pattern can be identified and any violation of the principle of motion economy can be easily noticed. The chart, therefore, helps in improving the method of doing the operation so that balanced two-handed actions with coordinated foot and eye motions can be achieved and ineffective motion can be either reduced or eliminated. The result is a smoother, more rhythmic work cycle that keeps both delays and operator fatigue to the minimum extent.

Flow Diagram:

Flow process chart only shows the sequence of various activities necessary for performing the specified work. It does not show clearly the path of movement of men and materials from one location to another. The path of movement can be better visualized by flow diagrams, string diagrams or models

The flow diagram is used to supplement the flow process chart. It is a plan of work area drawn with a suitable scale. It shows the relative position of productive machinery, storage area, gang ways etc. and the path followed by men or materials is marked on to flow diagram. All routes followed by different items are shown by joining the symbols with straight lines.

Steps in drawing a flow diagram:

1. Draw to scale the plan of the work area.
2. Mark the relative positions of machine tools, benches, store, racks, inspection booths, etc.
3. From the different observations, draw the actual movements (paths) of the material or the worker on the diagram and indicate the direction of the movement.
4. Each movement is serially numbered and indicated by an arrow for its direction.
5. Different colours are used to identify different types of movement.

A study of the flow diagram, along with the flow process chart, will trace out the undesirable characteristics of the layout which are responsible for increased transportation and delays. The flow diagram also shows the nature of back tracking involved which could be avoided by suitable changes in the layout. Therefore, flow diagrams are used in solving the plant layout problems and to demonstrate effectively the proposed movements both to management and workers.

STRING Diagrams:

There are many industrial activities in which the workers are moving at irregular intervals between a number of points in a working area, with or without material. Under such conditions a string diagram is the most useful technique for recording and examining the activities.

“The string diagram is a scale plan or model on which a thread is used to trace and measure the path of workers, material or equipment during a specified sequence of events”.

Construction of string diagram:

1. A layout of the work area is drawn to scale. Positions of machines, benches, stores, etc are drawn into scale on the work place layout, together with such doorways, pillars and portions as are likely to affect paths of movements.
2. The completed plan is then attached to a soft board and pins are driven into it firmly at every stopping point, the heads being allowed to stand well clear of the surface. Pins should also be driven in at all the turning points on the route.
3. A measured length of thread is then taken and tied around the pin at the starting point of the movements.
4. Each movement between the working places is indicated by laying the thread around the corresponding pins driven on the layout. Repetitive movements are indicated by laying the threading layers around the pins in the vertical plane.
5. The distance covered by the object is determined by subtracting the left over length of the thread from its original length.

The result is an over-all picture of the paths of movements of the operators, those which are most frequently traversed being covered with the greatest no. of strings. If two or more workers are studied over the same working area, different colour threads may be used to distinguish between their movements.

Cycle graph and Chrono cycle graph:

These techniques of analyzing the paths of motion made by an operator were developed by the Gilbreths. To make a cycle graph, a small electric bulb is attached to the finger, hand, or any other part of the body whose motion is to be recorded. By using still Photography, the path of light of bulb (in other words, that of the body member) as it moves through space for one complete cycle is photographed by keeping the working area relatively less illuminated. More than one camera may be used in different planes to get more details. The resulting picture (cycle graph) shows a permanent record of the motion pattern employed in the form of a closed loop of white continuous line with the working area in the background. A cycle graph does not indicate the direction or speed of motion.

It can be used for improving the motion pattern and Training purposes in that two cycle graphs may be shown with one indicating a better motion pattern than the other.

The Chrono cycle graph is similar to the cycle graph, but the power supply to the bulb is interrupted regularly by using an electric circuit. The bulb is thus made to flash. The procedure for taking photograph remains the same. The resulting picture (Chrono cycle graph), instead of showing continuous line of motion pattern, shows short dashes of line spaced in proportion to the speed of the body member photographed. Wide spacing would represent fast moves while close spacing would represent slow moves. The jumbling of dots at one point would indicate fumbling or hesitation of the body member. A chrono cycle graph can thus be used to study the motion pattern as well as to compute velocity, acceleration and retardation experienced by the body member at different locations.

The world of sports has used this analysis tool, updated to video, for extensively the purpose of training in the development of form and skill.

Advantages of cycle graph and Chrono cycle graph:

1. They can record all sorts of fast, complex and unrestricted movements which are not possible to trace otherwise.
2. They are useful for method improvement by motion analysis.
3. They are very useful in training and evaluating the workers.
4. Provides an aid in describing a motion pattern used in performing a task.
5. They can be used for comparing the two methods or motion patterns.

Limitations of cycle graph and Chrono cycle graph:

1. Light source (along with electric wires) tied to the hands of the worker may cause inconvenience to the worker.
2. It needs sufficient photographic practice to achieve good results.

Principles of motion economy:

Basically, principles of motion economy rules provide a way of doing work. It emphasizes how to use body members, how to locate the tools and equipments and how to design the work place. If these rules are applied, obviously it will result in higher output of manual labour with minimum fatigue.

They may be grouped under three headings:

- A) Use of human body
- B) Arrangement of the work place
- C) Design of tools and equipment

A) Use of human body

1. The two hands should begin and complete their movements at the same time.
2. The two hands should not be idle at the same time except during periods of rest.
3. Motions of the arms should be symmetrical and in opposite directions and should be made simultaneously.
4. Hand and body motion should be made at the lowest classification at which it is possible to do the work satisfactorily.
5. Smooth continuous motions of the hands are preferable to zigzag motions or straight line motions involving sudden and sharp changes in direction.
6. Ballistic movements are faster, easier and more accurate than restricted or controlled movements.
7. Rhythm is essential to the automatic performance or repetitive operations. The work should be arranged to permit easy and natural rhythm whenever possible.
8. Work should be arranged so that eye movements are confined to a comfortable area without the need for frequent changes of focus.

B) Arrangement of the work place

1. Definite and fixed stations should be provided for all tools and materials to permit habit formation.
2. Tools and materials should be pre-positioned to reduce searching.
3. Gravity feed bins and containers should be used to deliver the materials as close to the point of use as possible.

4. Tools, materials and controls should be located within the maximum working area and as near to the worker as possible to permit hand motions of lower classification and eye movements without frequent change of focus.
5. Tools and materials should be arranged to permit the best sequence of motions.
6. "Drop Deliveries" or ejectors should be used whenever possible so that the operator does not have to use his hands to dispose of the finished product.
7. Provision should be made for adequate lighting and a chair of the type and height to permit good posture should be provided.
8. The height of the work place and seat should be arranged to allow alternate standing and seating.
9. The colour of the work place should contrast with that of the work and thus reduce eye fatigue.

C) Design of tools and equipment:

1. The hand should be relieved of all work of holding the work piece where this can be done by jig, fixture or foot operated device.
2. Two or more tools should be combined wherever possible.
3. Where each finger performs the same specific movements as in type writing, the load should be distributed in accordance with the inherent capacities of the fingers.
4. Handles such as those of cranks and large screw drivers should be designed so as to permit as much of the surface of hand as possible to come into contact with the handle.
5. Levers, cross-bars and the hand wheels should be so placed that the operator can use them with the least change in body position and the greatest "Mechanical Advantage".

Therbligs

As result of several motion studies conducted Gilbreths concluded that any work can be done by using a combination of 17 basic motions, called Therbligs (Gilbreth spelled backward). These can be classified as effective therbligs and ineffective therbligs. Effective therbligs take the work progress towards completion. Attempts can be made to shorten them but they cannot be eliminated. Ineffective therbligs do not advance the progress of work and therefore attempts should be made to eliminate them by applying the Principles of Motion Economy. Table5 gives the therbligs along with their symbols and descriptions.

Micromotion study:

In some cases it is found that a more detailed investigation is needed. The technique employed for detailed analysis is called micromotion study and the chart used is a micromotion or simo chart. Frank B. and Dr. Lillian Gilbreth, who originally developed this method of motion study, found that all work could be broken down into 17 basic body motions. These basic motions were called "therbligs" (a form of Gilbreth in reverse) and are still known by that name. All jobs involve various combinations of these basic motions, and their interrelationships play a very important part in the analysis of jobs which are short in duration and rapid in performance. In fact, micromotion study technique is favored over other motion study methods because it can measure rapid jobs more effectively.

Because these motions are small and difficult to record, the Gilbreths also developed the use of a motion picture camera and a timing device for studying and measuring the basic motion patterns involved in doing work. Micromotion study is not too widely used at the present time because many work

improvements can be realized with the more simple forms of analysis. A micromotion study program is costly, and this also limits its use by many organizations.

Before rejecting micromotion study because of cost, serious consideration should be given to its many advantages. In long range planning, the detailed analysis may be well worth the investment. Some of the advantages are that micromotion study —

1. Provides more detail than other methods of observation.
2. Is more accurate than other methods.
3. Is more convenient than other methods.
 - a. The work can be studied at leisure from a film.
 - b. The film can be stopped at any place in the cycle and restudied.
4. Provides automatic timing.
5. Provides a permanent record free of errors.
6. Is useful in training operating personnel and methods analysts.
7. Allows observer to study all types of jobs and various crews.
8. Is useful as a basis for developing standard data.

Memo motion study:

It is a technique of using a motion picture camera in operation analysis. It differs from micro motion study in respect of the time of filming. The camera is fitted with a timing device and shoots the operation intermittently.

Work Measurement:

Introduction

Work measurement refer to the estimation of standard time, that is the time allowed for completing one piece of job using the given method. This is the time taken by an average experienced worker for the job with provisions for delays beyond the workers control.

There are several techniques used for estimation of standard time in industry. These include time study, work sampling, standard data, and predetermined time systems.

Definition:

Time study is a technique to estimate the time to be allowed to a qualified and well-trained worker working at a normal pace to complete a specified task.

This technique is based on measuring the work content of the task when performed by the prescribed method, with the allowance for fatigue and for personal and unavoidable delays.

Objectives and Applications:

Standard times for different operations in industry are useful for several applications like

- Estimating material machinery and equipment requirements.
- Estimating the production cost per unit as an input to
 - Preparation of budgets
 - Determination of selling price
 - Make or buy decision
- Estimating manpower requirements.
- Estimating delivery schedules and planning the work
- Balancing the work of operators working in a group.
- Estimating performance of workers and use as basis for incentive payment to those direct and in director labor who show greater productivity.

Uses of work measurement:

1. For wage incentive schemes:

For introducing successful incentive wage plan, individual worker's performance has to be measured. The standardized method and standard times will serve as basis for wage incentive plans.

2. For comparing various methods:

Time is a common measure for all jobs. Hence time standards are a basis for comparing various methods of doing the same job.

3. For securing efficient layout:

Time is the basis for determining the no. of equipments required. Once exact requirement of machines are known, efficient layout could be planned.

4. For assessing staff and equipment requirement:

Once the product quantity and the time required to produce one piece are known, it is simple arithmetic to estimate staff and equipment requirement.

5. For better production control:

The efficient function of production control is based upon determining "where and when" the work shall be done. This can be achieved only when we know the time for each operation. Time standard enables accurate scheduling and thus forms a basis for efficient production control.

6. For labour cost control:

Time standards enable calculation of labour cost based on the standard production. If this labour cost rate is more than the base rate, steps could be taken to control the costs.

7. For estimates for tenders and quotations:

It is essential now-a-days to estimate costs in advance of production to quote rates for tenders etc., By having time standards on direct labour, it is possible to predetermine the prime cost of the product.

8. For enforcing quality standards:

Production standards are based on the quantity of acceptable pieces produced in a given time. There will be no incentives for defective pieces made. Hence the workers will take more care and effort to produce only good parts and reduce scrap. Thus time standards enforces quality requirements.

9. For control of labour performance and machine utilization:

Since time standards help in production control, cost control and quality control, this automatically results in the control of labour performance and machine utilization.

10. For better customer service:

With the use of time standards, efficient production can be introduced. This enables manufacturers to supply goods to the customers at right time, in right quantity and quality at the right price.

The following techniques of work measurement:

- a) Time study (Stop watch time study)
- b) Synthetic times
- c) Predetermined motion time study (PMTS)
- d) Production study
- e) Work sampling
- f) Physiological methods
- g) Estimating

Analytical estimation
Stop watch time study

Time Study Procedure:

The procedure for time study can best be described step-wise, which are self explanatory.

Step 1: Define objective of the study. This involves statement of the use of the result, the precision desired, and the required level of confidence in the estimated time standards.

Step 2: Analyse the operation to determine whether standard method and conditions exist and whether the operator is properly trained. If need is felt for method study or further training of operator, the same may be completed before starting the time study.

Step 3: Select Operator to be studied if there is more than one operator doing the same task.

Step 4: Record information about the standard method, operation, operator, product, equipment, quality and conditions.

Step 5: Divide the operation into reasonably small elements.

Step 6: Time the operator for each of the elements. Record the data for a few number of cycles. Use the data to estimate the total numbers of observations to be taken.

Step 7: Collect and record the data of required number of cycles by timing and rating the operator.

Step 8: For each element **calculate** the representative watch time. Multiply it by the rating factor to get normal time.

$$\text{Normal time} = \text{Observed time} * \text{Rating factor}$$

Add the normal time of various elements to obtain the normal time for the whole operation.

Step 9: Determine allowances for various delays from the company's policy book or by conducting an independent study.

Step 10: Determine standard time by adding allowances to the normal time of operation.

$$\text{Standard time} = \text{Normal time} + \text{allowances}$$

Time study equipments –

The following equipment is needed for time study work.

Timing device

Time study observation sheet

Time study observation board

Other equipment

Timing Device

The stop watch and the electronic timer are the most widely used timing devices used for time study. The two perform the same function with the difference that electronics timer can measure time to the second or third decimal of a second and can keep a large volume of time data in memory.

Time Study Observation Sheet

It is a printed form with space provided for noting down the necessary information about the operation being studied like name of operation, drawing number, name of the operator, name of time study person, and the date and place of study. Space are provided in the form for writing detailed description of the process (element-wise), recording stop-watch readings for each element of the process, performance rating(s) of the operator, and computation Figure 2 Shows a typical time study observation sheet.

Time Study Board

It is a light -weight board used for holding the observation sheet and stopwatch in position. It is of size slightly larger than that of observation sheet used. Generally, the watch is mounted at the center of the top edge or as shown in Figure 3 near the upper right-hand corner of the board. The board has a clamp to hold the observation sheet. During the time study, the board is held against the body and the upper left arm by

the time study person in such a way that the watch could be operated by the thumb/index finger of the left hand. Watch readings are recorded on the observation sheet by the right hand.

Other Equipment

This includes pencil, eraser and device like tachometer for checking the speed, etc.

Different systems of performance rating

Normal Performance

There is no universal concept of Normal Performance. However, it is generally defined as the working rate of an average qualified worker working under capable supervision but not under any incentive wage payment scheme. This rate of working is characterized by the fairly steady exertion of reasonable effort, and can be maintained day after day without undue physical or mental fatigue.

The level of normal performance differs considerably from one company to another. What company A calls 100 percent performance, company B may call 80 percent, company C may call 125 percent and so on. It is important to understand that the level that a company selects for normal performance is not critical but maintaining that level uniform among time study person and constant with the passage of time within the company is extremely important.

There are, of course, some universally accepted benchmark examples of normal performance, like dealing 52 cards in four piles in 0.5 minute, and walking at 3 miles per hour (4.83 km/hr). In order to make use of these benchmarks, it is important that a complete description about these be fully understood, like in the case of card dealing, what is the distance of each pile with respect to the dealer, technique of grasping, moving and disposal of the cards.

Some companies make use of video films or motion pictures for establishing what they consider as normal speed or normal rate of movement of body members. Such films are made of typical factory jobs with the operator working at the desired normal pace. These films are reported to be useful in demonstrating the level of performance expected from the operators and also for training of time study staff.

Performance Rating

During the time study, time study engineer carefully observes the performance of the operator. This performance seldom conforms to the exact definition of normal or standard. Therefore, it becomes necessary to apply some 'adjustment' to the mean observed time to arrive at the time that the normal operator would have needed to do that job when working at an average pace. This 'adjustment' is called Performance Rating.

Determination of performance rating is an important step in the work measurement procedures. It is based entirely on the experience, training, and judgment of the work-study engineer. It is the step most subjective and therefore is subject to criticism.

It is the procedure in which the time study engineer compares the performance of operator(s) under observation to the Normal Performance and determines a factor called Rating Factor.

$$\text{Rating Factor} = \frac{\text{Observed Performance}}{\text{Normal Performance}}$$

System of Rating

There are several systems of rating, the performance of operator on the job. These are

11. Pace Rating
12. Westinghouse System of Rating
13. Objective Rating

14. Synthetic Rating

A brief description of each rating method follows

Pace Rating

Under this system, performance is evaluated by considering the rate of accomplishment of the work per unit time. The study person measures the effectiveness of the operator against the concept of normal performance and then assigns a percentage to indicate the ratio of the observed performance to normal or standard performance.

In this method, which is also called the speed rating method, the time study person judges the operators speed of movements, i.e. the rate at which he is applying himself, or in other words "how fast" the operator the motions involved.

Westinghouse System of Rating

This method considers four factors in evaluating the performance of the operator : Skill, effort, conditions and Consistency.

Skill may be defined as proficiency at following a given method. It is demonstrated by co ordination of mind and hands. A person's skill in given operation increases with his experience on the job, because increased familiarity with work bring speed, smoothness of motions and freedom from hesitations.

The Westinghouse system lists six classes of skill as poor fair, average, good, excellent in a Table1. The time study person evaluates the skill displayed by the operator and puts it in one of the six classes. As equipment % value of each class of skill is provided in the table, the rating is translated into its equivalent percentage value, which ranges from +15 % (for super skill) to -22 % (for poor skill).

In a similar fashion, the ratings for effort, conditions, and consistency are given using Table2 for each of the factors. By algebraically combining the ratings with respect to each of the four factors, the final performance-rating factor is estimated.

Objective Rating

In this system, speed of movements and job difficulty are rated separately and the two estimates are combined into a single value. Rating of speed or pace is done as described earlier, and the rating of job difficulty is done by selecting adjustment factors corresponding to characteristics of operation with respect to (i) amount of body used, (ii) foot pedals, (iii) bimanual ness, (iv) eye-hand co ordination, (v) handling requirements and (vi) weight handled or resistance encountered Mundel and Danner have given Table3 of % values (adjustment factor) for the effects of various difficulties in the operation performed.

For an operation under study, the numerical value for each of the six factors is assigned, and the algebraic sum of the numerical values called job difficulty adjustment factor is estimated.

The rating factor **R** can be expressed as

$$\mathbf{R = P \times D}$$

Where : **P** = Pace rating factor **D** = Job difficulty adjustment factor.

Synthetic Rating

This method of rating has two main advantages over other methods that (i) it does not rely on the judgment of the time study person and (ii) it give consistent results.

The time study is made as usual. Some manually controlled elements of the work cycle are selected. Using a PMT system (Pre-determined motion time system), the times for these elements are determined. The times of these elements are the performance factor is determined for each of the selected elements.

$$\text{Performance or Rating Factor, } \mathbf{R = P / A}$$

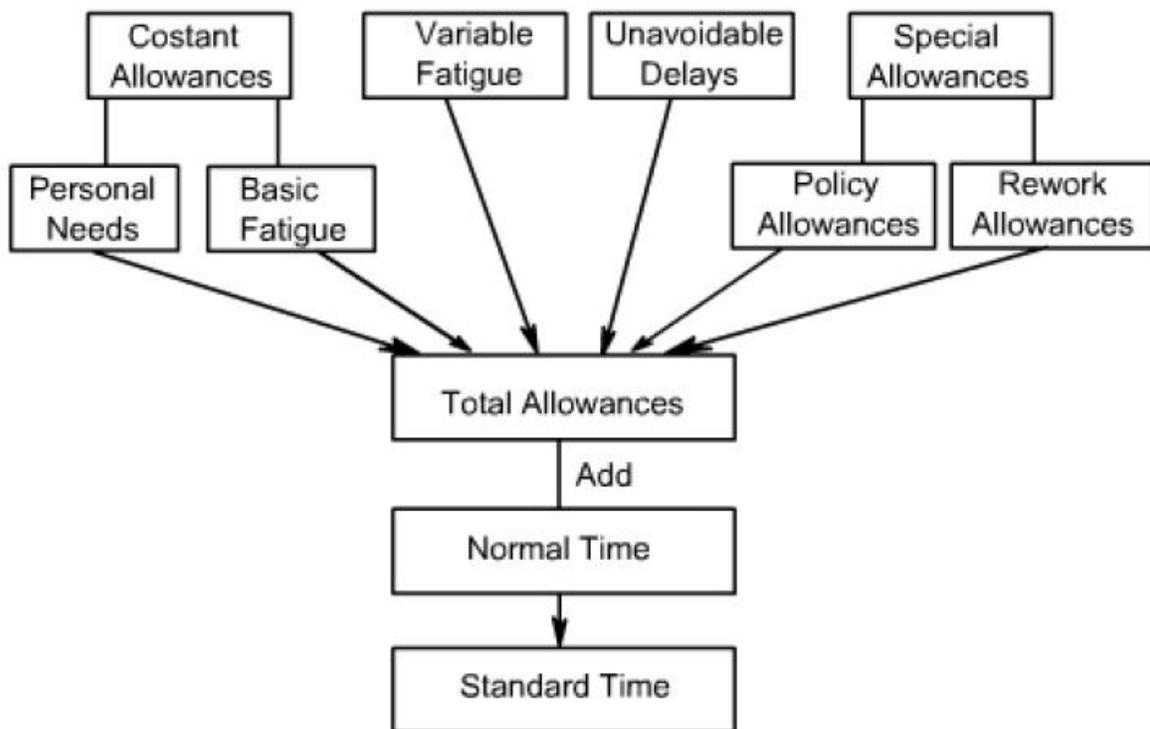
Where **P** = Predetermined motion time of the element , **A** = Average actual Observed time of the element.

The overall rating factor is the mean of rating factors determined for the selected elements, which is applied uniformly to all the manually controlled elements of the work cycle.

Time allowances – Allowances

The readings of any time study are taken over a relatively short period of time. The normal time arrived at, therefore does not include unavoidable delay and other legitimate lost time, for example, in waiting for materials, tools or equipment; periodic inspection of parts; interruptions due to legitimate personal need, etc. It is necessary and important that the time study person applies some adjustment, or allowances to compensate for such losses, so that fair time standard is established for the given job.

Allowances are generally applied to total cycle time as some percentage of it, but sometimes these are given separately as some % for machine time and some other % for manual effort time. However no allowance are given for interruptions which may be due to factor which are within the operator's control or which are avoidable.



Most companies allow the following allowances to their employees.

- Delay Allowance
- Fatigue Allowance
- Personal Allowance
- Special Allowance

Delay Allowance

This time allowance is given to an operator for the numerous interruptions that he experiences every day during the course of his work. These interruptions include interruptions from the supervisor, inspector, planners, expeditors, fellow workers, production personnel and others. This allowance also covers interruptions due to material irregularities, difficulty in maintaining specifications and tolerances, and interference delays where the operator has to attend to more than one machine.

Fatigue Allowance

This allowance can be divided into two parts: (i) basic fatigue allowance and (ii) variable fatigue allowance. The basic fatigue allowance is given to the operator to compensate for the energy expended for carrying out the work and to alleviate monotony. For an operator who is doing light work while seated, under good working conditions and under normal demands on the sensory or motor system, a 4% of normal time is considered adequate. This can be treated as a constant allowance.

The magnitude of variable fatigue allowance given to the operator depends upon the severity of the factor or conditions, which cause extra (more than normal) fatigue to him. As we know, fatigue is not homogeneous, it range from strictly physical to purely psychological and includes combinations of the two. on some people it has a marked effect while on others, it has apparently little or no effect. Whatever may be the kind of fatigue-physical or mental, the result is same-it reduces the work output of operator. The major factors that cause more than just the basic fatigue includes sever working conditions, especially with respect to noise, illumination, heat and humidity; the nature of work, especially with respect to posture, muscular exertion and tediousness and like that.

It is true that in modern industry, heavy manual work, and thus muscular fatigue is reducing day by day but mechanization is promoting other fatigue components like monotony and mental stress. Because fatigue in totality cannot be eliminated, proper allowance has to be given for adverse working conditions and repetitiveness of the work.

Personal Allowance

This is allowed to compensate for the time spent by worker in meeting the physical needs. A normal person requires a periodic break in the production routine. The amount of personal time required by operator varies with the individual more than with the kind of work, though it is seen that workers need more personal time when the work is heavy and done under unfavorable conditions.

The amount of this allowance can be determined by making all-day time study or work sampling. Mostly, a 5 % allowance for personal time (nearly 24 minutes in 8 hours) is considered appropriate.

Special Allowance

These allowances are given under certain special circumstances. Some of allowances and the conditions under which they are given are:

Small Lot Allowance:

This allowance is given when the actual production period is too short to allow the worker to come out of the initial learning period. When an operator completes several small-lot jobs on different setups during the day, an allowance as high as 15 percent may be given to allow the operator to make normal earnings.

Training Allowance:

This allowance is provided when work is done by trainee to allow him to make reasonable earnings. It may be a sliding allowance, which progressively decreases to zero over certain length of time. If the effect of learning on the job is known, the rate of decrease of the training allowance can be set accordingly.

Rework Allowance:

This allowance is provided on certain operation when it is known that some present of parts made are spoiled due to factors beyond the operator's control. The time in which these spoiled parts may be reworked is converted into allowance.

Different organizations have decided upon the amount of allowances to be given to different operators by taking help from the specialists / consultants in the field and through negotiations between the

management and the trade unions. ILO has given its recommendations about the magnitude of various allowances

PMTS

Predetermined Motion Time System

A predetermined motion time system (PMTS) may be defined as a procedure that analyzes any manual activity in terms of basic or fundamental motions required to performing it. Each of these motions is assigned a previously established standard time value in such a way that the timings for the individual motions can be synthesized to obtain the total time for the performance of the activity.

The main use of PMTS lies in the estimation of time for the performance of a task before it is performed. The procedure is particularly useful to some organizations because it does not require troublesome rating with each study.

Applications of PMTS are for

- (i). Determination of job time standards.
- (ii). Comparing the times for alternative proposed methods so as to find the economics of the proposals prior to production run.
- (iii) Estimation of manpower, equipment and space requirements prior to setting up the facilities and start of production.
- (iv) Developing tentative work layouts for assembly line prior to their working.
- (v) Checking direct time study results.

A number of PMTS are in use, some of which have been developed by individual organizations for their own use, while other organizations have publicized for universal applications.

The following are commonly used PMT systems

- Work factor (1938)
- Method Time Measurement (1948)
- Basic Motion Time (1951)
- Dimension Motion Time (1954)

Some important factors which be considered while selecting a PMT system for application to particular industry are

1. **Cost of Installation.** This consists mainly of the cost of getting expert for applying the system under consideration.
2. **Application Cost.** This is determined by the length of time needed to set a time standard by the system under consideration.
3. **Performance Level of the System.** The level of performance embodied in the system under consideration may be different from the normal performance established in the industry where the system is to be used. However, this problem can be overcome by 'calibration' which is nothing but multiplying the times given in the Tables by some constant or by the application of an adjustment allowance.
4. **Consistency of Standards.** Consistency of standards set by a system on various jobs is a vital factor to consider. For this, the system can be applied on a trial basis on a set of operations in the plant and examined for consistency among them.
5. **Nature of Operation.** Best results are likely to be achieved if the type and nature of operations in the plant are similar to the nature and type of operations studied during the development of the system under consideration.

Advantages and limitations of using PMT systems

Advantage

Compared to other work measurement techniques, all PMT system claim the following advantages:

1. There is no need to actually observe the operation running. This means the estimation of time to perform a job can be made from the drawings even before the job is actually done. This feature is very useful in production planning, forecasting, equipment selection etc.
2. The use of PMT eliminates the need of troublesome and controversial performance rating. For the sole reason of avoiding performance rating, some companies have been using this technique.
3. The use of PM times forces the analyst to study the method in detail. This sometimes helps to further improve the method.
4. A bye-product of the use of PM time is a detailed record of the method of operation. This is advantageous for installation of method, for instructional purposes, and for detection and verification of any change that might occur in the method in future.
5. The PM times can be usefully employed to establish elemental standard data for setting time standards on jobs done on various types of machines and equipment.
6. The basic times determined with the use of PMT system are relatively more consistent.

Limitations

There are two main limitations to the use of PMT system for establishing time standards. These are: (i) its application to only manual contents of job and (ii) the need of trained personnel. Although PMT system eliminates the use of rating, quite a bit of judgment is still necessarily exercised at different stages.

Work sampling

Work Sampling (also sometimes called ratio delay study) is a technique of getting facts about utilization of machines or human beings through a large number of instantaneous observations taken at random time intervals. The ratio of observations of a given activity to the total observations approximates the percentage of time that the process is in that state of activity. For example, if 500 instantaneous observations taken at random intervals over a few weeks show that a lathe operator was doing productive work in 365 observations and in the remaining 135 observations he was found 'idle' for miscellaneous reasons, then it can be taken that the operator remains idle $(135/500) \times 100 = 27\%$ Of the time. Obviously, the accuracy of the result depends on the number of observations. However, in most applications there is usually a limit beyond which greater accuracy of data is not economically worthwhile.

Use of Work Sampling for Standard Time Determination

Work sampling can be very useful for establishing time standards on both direct and indirect labor jobs. The procedure for conducting work sampling study for determining standard time of a job can be described step-wise.

Sampling Procedure:

Step 1. Define the problem. (i) Describe the job for which the standard time is to be determined. (ii) Unambiguously State and discriminate between the two classes of activities of operator on the job: what are the activities of job with which if operator is found engaged would entitle him to be in 'working' state. This would imply that when operator will be found engaged in any activity other than those would entitle him to be in "Not Working" state.

Step 2. Design the Sampling plan. (i) Estimate satisfactory number of observations to be made. (ii) Decide on the period of study, e.g. two days, one week, etc. (iii) Prepare detailed plan for taking the observations. This will include observation schedule, exact method of observing, design of observation sheet route to be followed, the particular person to be observed at the observation time, etc.

Step 3. Contact the person concerned and take them in confidence regarding conduct of the study.

Step 4. Collect the data at the pre-decided random times.

We will now briefly discuss some important issues involved in the procedure.

Number of Observations

As we know, result of study based on larger number of observations are more accurate, but taking more and more observation consume time and thus is costly. A cost-benefit trade-off has thus to be struck. In practice, the following methods are used for estimation of the number of observation to be made.

(i) **Based on judgment.** The study person can decide the necessary number of observations based on his judgment. The correctness of the number may be in doubt but estimate is often quick and adequate in many cases.

(ii) **Using cumulative plot of results.** As the study progresses the results (of the proportion of time devoted to the given activity, i.e. P_i from the cumulative number of observations are plotted at the end of each shift or day. A typical plot is shown in Figure4. Since the accuracy of the result improves with increasing number of observation, the study can be continued until the cumulative P_i appears to stabilize and collection of further data seems to have negligible effect on the value of P_i .

(iii) **Use of statistics.** In this method, by considering the important of the decision to be based on the results of study, a maximum tolerable sampling error in terms of confidence level and desired accuracy in the results is specified. A pilot study is then made in which a few observations are taken to obtain a preliminary estimate of P_i . The number of observations N necessary is then calculated using the following expression

$$S.P_i = x \sqrt{\frac{P_i(1-P_i)}{N}}$$

Where **S** = desired relative accuracy

P_i = estimate of proportion of time devoted to activity expressed as a decimal, e.g. 5 % = 0.05

x = a factor depending on the confidence level.

$x = 1, 2, 3$ for confidence levels of 68 %, 95 % and 99 % respectively.

N = total number of observations needed.

The number of observations estimated from the above relation using a value of P_i obtained from a preliminary study would be only a first estimate. In actual practice, as the work sampling study proceeds, say at the end of each day, a new calculation should be made by using increasingly reliable value of P_i obtained from the cumulative number of observations made.

Standard Time Determination

In this method of work measurement, the observed time for a given job is estimated as the working time divided by the number of units produced during that time.

$$OT = \frac{T \times \left(\frac{\eta_i}{\eta} \right)}{N}$$

Where **T** = Total study period

N = Number of units produced in study period

η = Total number of observations made in study period

η_i = Number of observations in which worker(s) was found in 'working' state

The normal time (NT) is found by multiplying the observed time by the average performing index (rating factor).

$$NT = OT \times \left(\frac{\bar{R}}{100} \right)$$

Where \bar{R} = Average rating factor = $\frac{\sum R}{n}$

Finally, the standard time is found by adding allowances to the normal time.

Simple problems involving the determination of standard time and compensation.

Example

A work sampling study was made of a cargo loading operation for the purpose of developing its standard time. The study was conducted for duration of minutes during which 3000, 1500 instantaneous observations were made at random intervals. The results of study indicated that the worker on the job was working 80 percent of the time and loaded 360 pieces of cargo during the study period. The work analyst rated the performance at 90 %. If the management wishes to permit a 13 % allowance for fatigue, delays and personal time, what is the standard time of this operation?

Ans:

Here, Total period = 1500 minutes
 Working fraction = 80 percent
 Average rating = 90 percent
 Number of units loaded = 360
 Allowances = 13 %

$$\begin{aligned} \text{Normal Time} &= \frac{\text{Total time} \times \text{Working fraction}}{\text{Number of units}} \times \text{Performance rating} \\ &= \frac{1500 \times 0.80}{360} \times 0.90 = 3.00 \text{ min.} \end{aligned}$$

$$\begin{aligned} \text{Standard Time} &= \text{Normal time} \times \frac{100}{100 - \% \text{ allowances}} \\ &= 3.00 \times \frac{100}{100 - 13} = 3.45 \text{ min.} \end{aligned}$$

Advantages and Disadvantages of Work Sampling in Comparison with Time Study.

Advantage

Economical

1. Many operators or activities are difficult or uneconomical to measure by time study can readily be measured by work sampling.
2. Two or more studies can be simultaneously made of several operators or machines by a single observer. Ordinarily a work study engineer can study only one operator at a time when continuous time study is made.
3. It usually requires fewer man-hours to make a work sampling study than to make a continuous time study. The cost may also be about a third of the cost of a continuous time study.
4. No stopwatch or other time measuring device is needed for work sampling studies.

5. It usually requires less time to calculate the results of work sampling study. Mark sensing cards may be used which can be fed directly to the computing machines to obtain the results just instantaneously.

Flexible

6. A work sampling study may be interrupted at any time without affecting the results.
7. Operators are not closely watched for long period of time. This decreases the chance of getting erroneous results for when a worker is observed continuously for a long period, it is probable that he will not follow his usual routine exactly during that period.

Less Erroneous

8. Observations may be taken over a period of days or weeks. This decreases the chance of day-to-day or week-to-week variations that may affect the results.

Operators Like It

9. Work sampling studies are preferred to continuous time study by the operators being studied. Some people do not like to be observed continuously for long periods of time.

Observers Like It

10. Work sampling studies are less fatiguing and less tedious to make on the part of time study engineer.

Applications

11. Work sampling is applicable to a wide variety of situations in manufacturing, distribution, or service industries.
12. Work sampling is useful when determine the nature of the distribution of work activities within a gang operation.

Disadvantage

1. Work sampling is not economical for the study of a single operator or operation or machine. Also, work-sampling study may be uneconomical for studying operators or machines located over wide areas.
2. Work sampling study does not provide elemental time data.
3. The operator may change his work pattern when he sees the observer. For instance, he may try to look productive and make the results of study erroneous.
4. No record is usually made of the method being used by the operator Therefore a new study has to be made when a method change occurs in any element of operation.
5. Compared to stop watch time study, the statistical approach of work sampling study is difficult to understand by workers.

UNIT – III

Production Planning and Control:–

Production Planning and Control Functions

All of the four basic phases of control of manufacture are easily identified in production planning and control. The plan for the processing of materials through the plant is established by the functions of process planning, loading, and scheduling. The function of dispatching puts the plan into effect; that is, operations are started in accordance with the plan. Actual performance is then compared to the planned performance, and, when required, corrective action is taken. In some instances re-planning is necessary to ensure the effective utilization of the manufacturing facilities and personnel. Let us examine more closely each of these functions

Process Planning (Routing)

The determination of where each operation on a component part, subassembly, or assembly is to be performed results in a route for the movement of a manufacturing lot through the factory. Prior determination of these routes is the job of the manufacturing engineering function.

Loading

Once the route has been established, the work required can be loaded against the selected machine or workstation. The total time required to perform the operation is computed by multiplying the unit operation times given on the standard process sheet by the number of parts to be processed. This total time is then added to the work already planned for the workstation. This is the function of loading, and it results in a tabulated list or chart showing the planned utilization of the machines or workstations in the plant.

Scheduling

Scheduling is the last of the planning functions. It determines when an operation is to be performed, or when work is to be completed; the difference lies in the detail of the scheduling procedure. In a centralized control situation - where all process planning, loading, and scheduling for the plant are done in a central office- the details of the schedule may specify the starting and finishing time for an operation. On the other hand, the central schedule may simply give a completion time for the work in a given department.

Combining Functions

While it is easy to define “where” as process planning, “how much work” as loading, and “when” as scheduling, in actual operations these three functions are often combined and performed concurrently. How far in advance routes, loads, and schedules should be established always presents an interesting problem. Obviously, it is desirable that a minimum of changes be made after schedules are established. This objective can be approached if the amount of work scheduled for the factory or department is equal to or slightly greater than the manufacturing cycle. For optimum control, it should never be less than the manufacturing cycle.

Dispatching

Authorizing the start of an operation on the shop floor is the function of dispatching. This function may be centralized or decentralized. Again using our machine-shop example, the departmental dispatcher would authorize the start of each of the three machine operations – three dispatch actions based on the foreman’s routing and scheduling of the work through his department. This is decentralized dispatching.

Reporting or Follow – up

The manufacturing activity of a plant is said to be “in control” when the actual performance is within the objectives of the planned performance. When jobs are started and completed on schedule, there should be very little, if any, concern about the meeting of commitments. Optimum operation of the plant, however, is attained only if the original plan has been carefully prepared to utilize the manufacturing facilities fully and effectively.

Corrective Action

This is the keystone of any production planning and control activity. A plant in which all manufacturing activity runs on schedule in all probability is not being scheduled to its optimum

productive capacity. With an optimum schedule, manufacturing delays are the rule, not the exception.

Re-planning

Re-planning is not corrective action. Re-planning revise routes, loads, and schedules; a new plan is developed. In manufacturing this is often required. Changes in market conditions, manufacturing methods, or many other factors affecting the plant will often indicate that a new manufacturing plan is needed.

Factors Affecting Production Planning and Control

The factors that affect the application of production planning and control to manufacturing are the same as the factors we have already discussed that affect inventory management and control. Let us briefly review these in relation to production planning and control.

Type of Product

Again, it is the complexity of the product that is important, not what the product is, except as this may in turn relate to the market being served. Production control procedures are much more complex and involve many more records in the manufacture of large steam turbine generator sets or locomotives to customer orders than in the production of large quantities of a standard product involving only a few component parts, such as electric blankets, steam irons, or similar small appliances.

Type of Manufacturing

This is probably the most influential factor in the control situation. For a large continuous manufacturing plant producing a standard product, we have already indicated that the routing was included in the planning of the plant layout.

Qualitative and quantitative techniques of forecasting –

Forecasting means peeping into the future. As future is unknown and is anybody's guess but the business leaders in the past have evolved certain systematic and scientific methods to know the future by scientific analysis based on facts and possible consequences. Thus, this systematic method of probing the future is called forecasting. In this way forecasting of sales refers to an act of making prediction about future sales followed by a detailed analysis of facts related to future situations and forces which may affect the business as a whole.

Foresight is not the whole of management, but at least it is an essential part of management and accordingly, to foresee in this context means both to assess the future and make provisions for it, that is forecasting is itself action already. Forecasting as a kind of future picture wherein proximate events are outlined with some distinctness, while remote events appear progressively less distinct and it entails the running of the business as foresee and provide means to run the business over a definite period.

As far as the marketing manager is concerned the sales forecast is an estimate of the amount of unit sales for a specified future period under the proposed marketing plan or program. It may also be defined as an estimate of sales in rupees of physical units for a specified future period under a proposed marketing plan or program and under an assumed set of economic and other force outside the organization for which the forecast is made.

When we consider the function of production and operations management, no doubt
Production and

Operation departments will produce goods as per the sales program given by the sales department, but it has to prepare forecast regarding machine capacity required, materials required and time required for production and so on. This needs the knowledge of what exactly happened in the production shop in previous periods. Making of a proper forecast requires the assessment of both controllable and uncontrollable factors (both economic and non economic) inside and outside the organization.

All business and industrial activities revolve around the sale and its future planning. To know what a business will do we must know its future sales. So, sales forecasting is the most important activity in the business because all other activities depend upon the sales of the

concern. Sales forecasting as a guiding factor for a firm because it enables the firm to concentrate its efforts to produce the required quantities, at the right time at reasonable price and of the right quality. Sales forecasting is the basis of planning the various activities i.e.; production activities, pricing policies, programme policies and strategies, personnel policies as to recruitment, transfer, promotion, training, wages etc.

The period of forecasting, that is the time range selected for forecasting depends on the purpose for which the forecast is made. The period may vary from one week to some years. Depending upon the period, the forecast can be termed as 'Short range forecasting', medium range forecasting' and 'Long range forecasting'.

'Short range forecasting period may be one week, two weeks or a couple of months. Medium range forecasting period may vary from 3 to 6 months. Long range forecasting period may vary from one year to any period. The objective of above said forecast is naturally different.

In general, short term forecasting will be of more useful in production planning. The manager who does short range forecast must see that they are very nearer to the accuracy. In long range forecast, the normal period used is generally 5 years. In some cases it may extends to 10 to 15 years also. The purpose of long range forecast is:

- (i) To work out expected capital expenditure for future developments or to acquire new facilities,
- (ii) To determine expected cash flow from sales,
- (iii) To plan for future manpower requirements,
- (iv) To plan for material requirement,
- (v) To plan for Research and Development. Here much importance is given to long range growth factor.

In case of medium range forecasting the period may extend over to one or two years. The purpose of this type of forecasting is:

- (i) To determine budgetary control over expenses,
- (ii) To determine dividend policy,
- (iii) To find and control maintenance expenses,
- (iv) To determine schedule of operations,
- (v) To plan for capacity adjustments.

In case of short-term forecast, which extends from few weeks to three or six months and the following purposes are generally served:

- (i) To estimate the inventory requirement,
- (ii) To provide transport facilities for finished goods,
- (iii) To decide work loads for men and machines,
- (iv) To find the working capital needed,
- (v) To set-up of production run for the products,
- (vi) To fix sales quota,
- (vii) To find the required overtime to meet the delivery promises.

Everyone who use the forecast for one purpose or the other expects that they need that forecast should be accurate. But it is practically impossible to forecast accurately. But decisions are made every day to run the business by using the best information available with them. Management scientists have developed various methods for forecasting. One has to decide which method has to be used to suit the information available with him and to suit his needs. The manager, who is concerned with forecasting, must have knowledge of factors influencing forecast. Various factors that influence the forecast are:

- (i) Environmental changes,
- (ii) Changes in the preference of the user,
- (iii) Number of competitive products,
- (iv) Disposable income of the consumer.

In forecasting the production important factors to be considered are:

- (i) Demand from the marketing department,
- (ii) Rate of labours absenteeism,
- (iii) Availability of materials,
- (iv) Available capacity of machines,
- (v) Maintenance schedules,
- (vi) Delivery date schedules.

Steps in forecasting

Whatever may be the method used for forecasting, the following steps are followed in forecasting.

(a) Determine the objective of forecast: What for you are making forecast? Is it for predicting the demand?

Is it to know the consumer's preferences? Is it to study the trend? You have to spell out clearly the use of forecast.

(b) Select the period over which the forecast will be made? Is it long-term forecast or medium-term forecast or short-term forecast? What are your information needs over that period?

(c) Select the method you want to use for making the forecast. This method depends on the period selected for the forecast and the information or data available on hand. It also depends on what you expect from the information you get from the forecast. Select appropriate method for making forecast.

(d) Gather information to be used in the forecast. The data you use for making forecasting to produce the result, which is of great use to you. The data may be collected by:

(i) Primary source: This data we will get from the records of the firm itself.

(ii) Secondary source: This is available from outside means, such as published data, magazines, educational institutions etc.

(e) Make the forecast: Using the data collected in the selected method of forecasting, the forecast is made.

Forecasting Methods:

Methods or techniques of sales forecasting: Different authorities on marketing and production have devised several methods or techniques of sales or demand forecasting. The sales forecasts may be result of what market people or buyers say about the product or they may be the result of statistical and quantitative techniques. The most common methods of sales forecasting are:

1. Survey of buyer's inventions or the user's expectation method: Under this system of sales forecasting actual users of the product of the concern are contacted directly and they are asked about their intention to buy the company's products in an expected given future usually a year. Total sales forecasts of the product then estimated on the basis of advice and willingness of various customers. This is most direct method of sales forecasting.

The chief advantages of this method are:

(i) Sales forecast under this method is based on information received or collected from the actual users whose buying actions will really decide the future demand. So, the estimates are correct.

(ii) It provides a subjective feel of the market and of the thinking behind the buying intention of the actual uses. It may help the development of a new product in the market.

(iii) This method is more appropriate where users of the product are numbered and a new product is to be introduced for which no previous records can be made available.

(iv) It is most suitable for short-run forecasting.

Collective opinion or sales force composite method: Under this method, views of salesmen, branch manager, area manager and sales manager are secured for the different segments of the market.

Salesmen, being close to actual users are required to estimate expected sales in their respective territories and sections. The estimates of individual salesmen are then consolidated to find out the total estimated sales for the coming session. These estimates are then further examined by the successive executive levels in the light of various factors like proposed changes in product design, advertising and selling prices, competition etc. before they are finally emerged for forecasting.

3. Group executive judgement or executive judgement method: This is a process of combining, averaging or evaluating, in some other way, the opinions and views of top executives. Opinions are sought from the executives of different fields i.e., marketing; finance; production etc. and forecasts are made.

4. Experts' opinions: Under this method, the organization collects opinions from specialists in the field outside the organization. Opinions of experts given in the newspapers and journals for the trade, wholesalers and distributors for company's products, agencies or professional experts are taken. By analyzing these opinions and views of experts, deductions are made for the company's sales, and sales forecasts are done.

5. Market test method: Under this method seller sells his product in a part of the market for sometimes and makes the assessment of sales for the full market on the bases of results of test sales. This method is quite appropriate when the product is quite new in the market or good estimators are not available or where buyers do not prepare their purchase plan.

6. Trend projection method: Under this method, a trend of company's or industry's sales is fixed with the help of historical data relating to sales which are collected, observed or recorded at successive intervals of time. Such data is generally referred to as time series. The change in values of sales is found out. The study may show that the sales sometimes are increasing and sometimes decreasing, but a general trend in the long run will be either upward or downward. It cannot be both ways. This trend is called secular trend. The sales forecasts with the help of this method are made on the assumption that the same trend will continue in the future. The method which is generally used in fitting the trend is the method of least squares or straight line trend method. With this method a straight line trend is obtained. This line is called 'line of best fit'. By using the formula of regression equation of Y on X, the future sales are projected.

Calculation of trend.

The trend can be calculated by the least square method as follows:

- (i) Find time deviations (X) of each period from a certain period and then find the sum of time deviation (ΣX).
- (ii) Square the time deviation of each period (X^2) and then find the sum of squares of each period (ΣX^2).
- (iii) Multiply time deviations with the sales of each period individually (XY) and add the product of the column to find (ΣXY).
- (iv) To find the trend (Y) this is equal to $a + bX$. The value of a and b may be determined by either of the following two ways:
 - (a) **Direct method.** This method is applicable only when $\Sigma X=0$. To make $\Sigma X=0$, it is necessary that the time deviations should be calculated exactly from the midpoint of the series. Then, the values of a and b will be calculated as follows:

$$a \text{ (average)} = \frac{\sum Y}{n} \text{ and } b \text{ (rate of growth)} = \frac{\sum XY}{\sum Y^2}$$

This method is simple and direct.

(b) **Indirect method.** This method is somewhat difficult. This method can be applied in both the cases where ΣX has any positive or negative values or ΣX is not equal to zero. The values of a and b are calculated by solving the following two equations:

$$\Sigma Y = na + b\Sigma X$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2$$

By calculating the values of a and b in the above manner, the sales can be forecasted for any future period by applying the formula $Y = a + bX$.

7. Moving average method: This is another statistical method to calculate the trend through moving averages. It can be calculated as follows:

An appropriate period is to be determined for which the moving average is calculated. While determining the period for moving averages, the normal cycle time of changes in the values of series should be considered so that short-term fluctuations are eliminated. As far as possible, the period for moving averages should be in odd numbers such as period of 3, 5 or 7 years. The period in even numbers will create a problem in centralizing the values of averages. The calculated values of moving averages present the basis for determining the expected amount of sale.

8. Criteria of a good forecasting method: It cannot be said which method of sales forecasting is the best because everyone has merits and demerits of its own. The suitability of a method depends on various factors such as nature of the product, available time and past records, wealth and energy, degree of accuracy and the forecaster etc. of an enterprise. However, in general, a good forecasting method must possess the following qualifications.

(i) **Accuracy:** Accuracy of the forecasting figures is the life blood of the business because many important plans and programmes, policies and strategies are prepared and followed on the basis of such estimates. If sales forecasts are wrong, the business man suffers a big loss. Hence, the method of forecasting to be applied must amount to maximum accuracy.

(ii) **Simplicity:** The method for forecasting should be very simple. If the method is difficult or technical, then there is every possibility of mistake. Some information are collected from outside and that will remain unanswered or inaccurate replies will be received, if the method is difficult. Management must also be able to understand and have confidence in the method.

(iii) **Economy:** The method to be used should be economical taking into account the importance of the accuracy of forecast. Costs must be weighed against the importance of the forecast to the operations of the business.

(iv) **Availability:** The method should be such for which the relevant information may be available immediately with reasonable accuracy. Moreover, the technique must give quick results and useful information to the management.

(v) **Stability:** The data of forecasting should be such wherein the future changes are expected to be minimum and are reliable for future planning for sometime.

(vi) **Utility:** The forecasting technique must be easily understandable and suitable to the management.

Routing

Under this, the operations, their path and sequence are established. To perform these operations the proper class of machines and personnel required are also worked out. The main aim of routing is to determine the best and cheapest sequence of operations and to ensure that this sequence is strictly followed. In small enterprises, this job is usually done by entrepreneur himself in a rather adhoc manner. Routing procedure involves following different activities.

(1) An analysis of the article to determine what to make and what to buy.

(2) To determine the quality and type of material

(3) Determining the manufacturing operations and their sequence.

(4) A determination of lot sizes

(5) Determination of scrap factors

(6) An analysis of cost of the article

(7) Organization of production control forms.

Loading:

The next step is the execution of the schedule plan as per the route chalked out it includes the assignment of the work to the operators at their machines or work places. So loading determines who will do the work as routing determines where and scheduling determines when it shall be done. Gantt Charts are most commonly used in small industries in order to determine the existing load and also to foresee how fast a job can be done. The usefulness of their technique lies in the fact that they compare what has been done and what ought to have been done.

Most of a small scale enterprise fail due to non-adherence to delivery schedules therefore they can be successful if they have ability to meet delivery order in time which no doubt depends upon production of quality goods in right time. It makes all the more important for entrepreneur to judge ahead of time what should be done, where and when thus to leave nothing to chance once the work has begun.

Scheduling: 'Scheduling' is the next important function of production planning and control after Routing'. It determines the starting and the completion timings for each of the operations with a view to engage every machine and operator of the system for the maximum possible time and; without imposing unnecessary burden over them. Scheduling is the determination of the time that should be inquired to perform each operation and also the time that should be required to perform the entire series as routed.

Scheduling involves establishing the amount of work to be done and the time when each element of the work will start or the order of the work. Scheduling technique is an important technique of determining the starting and the completion timings of each operation and that of the total manufacturing process so that the man and machines can be utilized to the maximum.

Scheduling depends upon a number of factors, e.g., routing, the method of production, quantity of production, transportation of raw materials, production capacity, the probable data of delivery specified by customers in their orders and the past records.

Relationship between 'Routing' and 'Scheduling'. 'Routing' and 'Scheduling' are independent and either of these activities cannot be undertaken independently. It is very difficult to prepare schedules without determining the routing of sequence of operations. Routing is the prerequisite of scheduling. Unless route or sequence of operations, tools, equipment and plants and the persons by when operations are to be performed, are established, the time taken by each operation, the idle time of men and machine and total time for the whole process cannot be ascertained in a convincing manner.

Conversely, scheduling is equally important for routing. It is quite difficult to route an item efficiently through a plant without consulting previously-designed schedules. The main aim of routing is to pass the item through the process of manufacture by a route which is the best and the most economical. And a route or sequence of operations may be considered best which utilizes the men, materials and machines to the maximum and which consumes the shortest time during the process of production. This information (time schedule of each operation) can be obtained from schedules. So, scheduling is necessary for effective routing. Thus, we can conclude that routing and scheduling are inter-related, inter-connected and inter-dependent activities of production planning and control.

Relationship between Routing and Scheduling: Both are interconnected as scheduling is difficult without routing and routing is also not effective without scheduling. Routing is a prerequisite for scheduling while time to be taken 'may form the basis of routing and that is fixed by scheduling.

Principles of Scheduling:

The principles of scheduling are:

- (a) **The principle of optimum task size:** Scheduling tends to achieve its maximum efficiency when the task sizes are small and all tasks are of the same order of magnitude.
- (b) **The principle of the optimum Production plan:** Scheduling tends to achieve its maximum efficiency when the work is planned, so that it imposes an equal/even load on all the plant.
- (c) **The principle of the optimum operation sequence:** Scheduling tends to achieve its maximum efficiency when the work is planned so that the work centers are normally used in the same sequence.

The first principle has a tendency when applied, not only give good results but also to be self-correcting if it is ignored. For example, if in a functional batch production machine shop the loads imposed by different operations vary greatly in length it is possible that it will be necessary to break many of the long operations into one or more small batches, in order to get the other orders completed by due date. In effect, this principle only repeats the known advantage of maintaining a high rate of stock turn over, and of single phase ordering.

The second principle merely states that the obvious fact that there will be less idle time and waiting time, if all the plant is evenly loaded by the production planners, then if some of the machines are over loaded perhaps because direct labour cost on them are lower and others are idle for part of the time due to shortage of work. The third principle says about principle of flow. Some times it is also true if we sequence some jobs, which need the same machine set up, at a time, this avoids machine ancillary time needed, in case, the jobs of the above type are done at different times. For example, consider drilling a 10 mm hole in five different jobs may be done at a time so that the set up time required for five jobs independently at different times are avoided.

Forms of Schedules:

Here we shall discuss the presentation of production schedules. Depending on the need and use, the Schedules can be prepared in different forms.

A Production Flow Program:

If a number of components or assemblies have to be manufactured for the final assembly line and those components are to be made concurrently, the production master flow program is prepared taking into account the sequence of operations and the time of starting and ending each component in order to comply with the required date of completion of the product. The necessary document for this is Operation Process Chart and the Sequence of Operation.

Scheduling Systems:

Scheduling Systems may be classified into four groups as shown below:

- (i) **Unit scheduling system:** This is used for scheduling when jobs are produced one by one and are of different a type that is for job production.
- (ii) **Batch scheduling system:** When jobs are produced to order, in batches, this is used.
- (iii) **Mass scheduling system:** When large number of items of similar type are produced that is in mass production, this is used.

Unit Scheduling System:

Here we have two types of scheduling, one is Project scheduling and the other is Job Scheduling.

Project Scheduling: Generally, a project consists of number of activities managed by different Apartments or individual supervisors. It can also be said as a complex output made up of many interdependent jobs.

Examples are: Railway coach building, Shipbuilding etc. The scheduling methods used are:

- (i) Project Evaluation and Review Technique (PERT),
- (ii) Critical Path Method (CPM),
- (iii) Graphical Evaluation and Review Technique (GERT).

We can also use Bar charts, GANTT charts, Milestone chart, but these are less superior to the above.

Job Shop Scheduling: In Job shop scheduling, we come across varieties of jobs to be processed on different types of machines. Separate records are to be maintained for each order. Only after receiving the order, one has to plan for production of the job. The routing is to be specified only after taking the order. Scheduling is done to see that the available resources are used optimally. The following are some of the methods used for scheduling. (i) Arrival pattern of the job, (ii) Processing pattern of the job, (iii) Depending on the type of machine used, (iv) Number of workers available in the shop, (v) Order of sequencing.

Arrival pattern of the job: This is done in two ways. Firstly, as and when the order is received, it is processed on the principle First in First Out (FIFO). Otherwise, if the orders are received from single customer at different point of time in a week/month, then the production manager pile up all orders and starts production depending on the delivery date and convenience (This situation is generally known as static situation).

Processing Pattern of the Job: As the layout of Job shops of Process type and there may be duplication of certain machines, the production planner, after receiving the order thinks of the various methods of converting the requirement of customer / order into a production plan to suit the available facilities.

Depending on the process required, there may be backtracking, which is unavoidable. When facilities are busily engaged, in process inventory may be a common problem.

Machine varieties available: Facilities available in the production shop will affect the scheduling. Here the size, capacity, precession and other factors of machines will have their influence on the scheduling.

Number of Men in the production shop: Many a time we see that the number of workers available in the job shops are very much limited, that is sometimes they are less in number than the machines in the shop (these shops are known as labour limited shop). Depending the availability of labour, the scheduling is to be done. In case the machines available are limited and have more men (known as machine limited shops), then availability of machine dictates the scheduling.

Sequencing rules for single facility: When we have a single facility, and the orders are in queue, then they are processed depending on the rules mentioned below:

(a) **First in first served or first in first out (FIFS/FIFO):** Here the jobs are processed as they come in. This is commonly observed queue discipline.

(b) **Shortest processing time (SPT):** The jobs having shortest processing time are processed first. This is just to avoid formation of queue. For example, when you go for Xeroxing a document, and other person comes for Xeroxing a book, then document is Xeroxed and then the book is taken for Xeroxing.

(c) **Minimum due date (MDD):** Here jobs are processed in ascending order of their available time before delivery date. By doing so, we can keep up the delivery promises. To meet the delivery promises, if necessary, overtime, sub contracting etc., may be used.

(d) **Last come first served or last in first out (LCFS/LIFO):** This generally happens in case of inventory stocking and using. When material piles up, the material at the top i.e., material last arrived is used first.

(e) **Static slack for remaining operations (SSRO):** Static slack is given by: (Due date – Remaining processing time/number of remaining operations). Here jobs are processed in ascending order of the operations.

(f) **Dynamic slack for remaining operations (DSRO):** Dynamic slack is given by: (Due date – expected time of remaining operations / number of remaining operations). Here the jobs are done in ascending order of the ratio dynamic slack.

Basic Scheduling Problems:

The production planner may face certain problems while preparing production plans or Schedules. Some important problems are discussed below:

- (a) Flow production scheduling for fluctuating demand (known smoothing problem),
- (b) Batch production scheduling, when products are manufactured consecutively,
- (c) The assignment problem,
- (d) Scheduling orders with random arrivals and
- (e) Product sequencing.

Dispatching:

Dispatching may be defined as setting production activities in motion through the release of orders work order, shop order and instructions in accordance with the previously planned time schedules and routings.

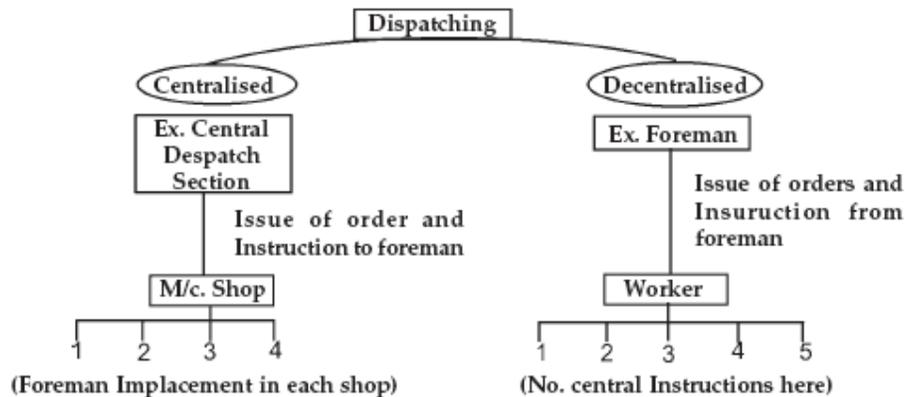


Fig. Dispatching

Dispatching also provides a means for comparing actual progress with planned production progress.

Dispatching functions include:

- a. Providing for movement of raw materials from stores to the first operation and from one operation to the next operation till all the operations are carried out.
- b. Collecting tools and fixtures from tool stores and issuing them to the user department or workers.
- c. Issuing job orders authorizing operations in accordance with dates and times as indicated in schedules or machine loading charts.
- d. Issue of drawings, specifications, route cards, material requisitions and tool requisitions to the user department.
- e. Obtaining inspection schedules and issuing them to the inspection section.
- f. Internal materials handling and movement of materials to the inspection area after completing the operation, moving the materials to the next operation centre after inspection and movement of completed parts to holding stores.
- g. Returning fixtures and tools to stores after use.

Materials Management

Introduction

Materials Management is simply the process by which an organization is supplied with the goods and services that it needs to achieve its objectives of buying, storage and movement of materials. Materials Management is related to planning, procuring, storing and providing the appropriate material of right quality, right quantity at right place in right time so as to co-ordinate and schedule the production activity in an integrative way for an industrial undertaking. Most industries buy materials, transport them in to the plant, change the materials in to parts, assemble parts in to finished products, sell and transport the product to the customer. All these activities of purchase of materials, flow of materials, manufacture them in to the product, supply and sell the product at the market requires various types of materials to manage and control their storage, flow and supply at various places. It is only possible by efficient materials management.

Definition

The International Federation of Purchasing and Materials Management accept the definition of materials management given below. According to it, materials management is a total concept having its definite organization to plan and control all types of materials, its supply, and its flow from raw stage to finished stage so as to deliver the product to customer as per his requirements in time. This involves materials planning, purchasing, receiving, storing, inventory control, scheduling, production, physical distribution and marketing. It also controls the materials handling and its traffic. The materials manager has to manage all these functions with proper authority and responsibility in the material management department.

Objectives and Functions of Materials Management

The objectives and functions of materials management can be categorized in two ways as follows:

(I) Primary objectives

(II) Secondary objectives

They are discussed below:

(I) Primary objectives

Which can be classified as:

(i) Efficient materials planning

(ii) Buying or Purchasing

(iii) Procuring and receiving

(iv) Storing and inventory control

(v) Supply and distribution of materials

(vi) Quality assurance

(vii) Good supplier and customer relationship

(viii) Improved departmental efficiency

(II) Secondary objectives

There can be several secondary objectives of materials management. Some of them are given below:

(i) Efficient production scheduling

(ii) To take make or buy decisions

(iii) Prepare specifications and standization of materials

(iv) To assist in product design and development

(v) Forecasting demand and quantity of materials requirements

(vi) Quality control of materials purchased

(vii) Material handling

(viii) Use of value analysis and value engineering

(ix) Developing skills of workers in materials management

(x) Smooth flow of materials in and out of the organization

To fulfill all these objectives, it is necessary to establish harmony and good co-ordination between all the employees of material management department and this department should have good co-ordination with the other departments of the organization to serve all production centers.

The basic objectives of management in an organization are:

- (1) Sales increase through sales promotion
- (2) Profit maximization
- (3) Improvement in customer services
- (4) Globalization of its product sales
- (5) Meet the technological changes
- (6) Good employer - employee relationship
- (7) Selection of alternative materials
- (8) Reduction in manufacturing and other cost.
- (9) Social objectives

In order to fulfill these basic objectives of management the objectives of materials management should be set in such a way that they should totally help to meet ultimate goals.

The functions of materials management are discussed below:

In order to fulfill the objectives of materials management as stated above to meet the basic objectives and goals, the functions of the materials management are also categorized as primary and secondary functions.

(I) Primary Functions

To meet the primary objectives, the primary functions of the materials management are given as follows:

(i) Materials Requirements Planning (MRP)

Planning of materials requirements in manufacturing is a necessary function in any organization, as inventory of materials involve about 60% of the total investment of the organization. The profit earned depends on the utilization of these materials and reducing the inventory of the materials.

The latest technique used is called *Just in Time (JIT)* is referred practically to no inventory. However, in the present situations in any of the organization particularly manufacturing organization, it is not absolutely possible to keep no inventory of materials required for production. The MRP is a technique used to plan the materials starting from the raw materials, finished parts, components, sub-assemblies and assemblies as per Bill of Materials (BOM) to procure or produce them to support a Master Production Schedule (MPS). It is used on computers productively by any company that uses a MPS to manufacture products that require assemblies, components and materials to produce the final products. The MPS is exploded using the bills of materials to determine requirements of lower-level assemblies, components, finished parts and raw materials. It plans orders to meet these needs.

(ii) Purchasing

All the organizations need an efficient and economic purchasing and procurement of its various supplies of materials from the suppliers. The materials management department has to perform this function of purchasing and procurement of materials very efficiently. Since 50% to 60% of sales turnover is spent on the purchase of various materials, the amount of profit earned on this sales very much depends how economically the materials are purchased and utilized in the organization. The profitability depends on the efficiency by which this particular function of purchasing and procuring the requisite materials at appropriate time will be done and its availability is assured.

The function of purchasing can be stated as follows:

- (1) The requisition of material is necessary by proper authority to initiate its purchase.
- (2) To select proper supplier for the materials requisitioned, before placing an order.

- (3) To negotiate about the price of the material from the supplier and it will be purchased at the cheapest price.
- (4) The quality of material must be assured and should not be compromised with the cost of the material.
- (5) The material should be purchased of right quantity and right quality at proper time at the cheapest cost.
- (6) To set the proper purchase policy and procedure.

(iii) Inventory Planning and Control

The modern concept of inventory planning is that the materials should be purchased and brought in the stores just before it enters the production or sold out so that inventory cost is negligible. The zero inventories are the ideal planning. There are three types of inventories.

(i) Raw materials

(ii) Purchased goods

(iii) Finished parts and components

The inventory control of these various materials lies with the materials management department, production department and sales department. Inventory at different levels is necessary to make sure about the availability of all these types of materials and goods and their proper flow from one facility to another at different levels of production centers in a manufacturing concern.

The storing of various types of materials and parts as inventory is therefore very essential before its delivery and use at different production centers. This involves inventory planning and control of materials in the stores department. Many a time, the supplier may not be in a position to supply the materials of the ordered quantity at the proper time. To maintain the continuity in production and line balance in assembly work, the various types of inventories are necessary to be maintained and kept in the stores. as shown in Figure 1 given below.

Inventory Inventory

Raw Materials Process Parts Proce

Fig. 1. Inventory of materials

The raw materials before being supplied to a production process, some of it is sent to store as inventory and rest is sent to production facility as per its requirements and in the same way, various parts manufactured and assembled as components and assemblies are also stored as finished parts inventories at the different places in the stores. The final products before being supplied to the customers are also stocked as inventory of the final products of the organization to meet the fluctuating demand and to regularize the supplies in the market.

Thus, the inventory control is a very important function of the materials management department. The various types of inventory models are developed for the different materials to economise the purchase, supply, inventory control and production control to analyze and optimize the costs involved in ordering, set-up and inventory carrying of materials required in the production.

(iv) Ascertaining and Maintaining the Flow and Supply of Materials

Distribution of materials requisitioned by the various production centers and other departments must be ascertained and its flow and continuity of supply must be maintained by the materials management department. Insufficient or zero inventories many times create the situations of stock-outs and leads to stoppage of production. Failure of materials handling devices is also responsible for disruption of material supplies. Alternatives or emergency supply systems can be used for assuring production lines to continue.

Uncertainty in demand and production quantity is the main factor. As the customer requirements as per his needs and liking, are changing very fast. The management has to maintain continuity in production to meet this uncertainty in demand and control the situation by proper flow of materials supply and distribution at various production facilities and other departments as per changes in production quantity.

(v) Quality Control of Materials

The quality of the product manufactured by the organization depends upon the quality of the materials used to manufacture that product. It is a very important and necessary function of materials management to purchase the right quality of materials. The inspection, quality control, simplification, specification, and standardization are the activities which are to be followed for the measurement of quality of the materials. The quality assurance is decided by inspection and checking. The various properties of materials as per their specifications and standard. The size and dimensional measurements within tolerance limits assures the interchangeability and reliability of components and parts.

Quality is largely determined by consumer taste and liking. The market is under buyer's control. Customer decides the quality of the product. Material quality control aims at delivering product at higher and higher quality at lower cost. The product will be specified not only by its dimensional accuracy but its quality standards, durability and dependability, high performance, reliability and aesthetic value. Each of this factor adds cost to the product. In order to achieve high quality, the materials input to the product should be of high quality, which will have higher cost. The performance decides the reliability, which is obtained through high quality production. The performance is checked by quality inspection and accuracy.

This also adds cost to the product. The quality of the materials also decides the selection of vendors and the relationship between buyers and suppliers. The specifications, size and quality of materials must be referred and if possible the standard should be followed for specifications and sizes. The types of tests required for assuring the quality should be specified and conducted to establish the standards.

(vi) Departmental Efficiency

The objective of this function is to ensure the efficiency of the system adopted. If the system and procedure adopted for materials management are inefficient or faulty, none of the objectives mentioned above can be fulfilled, however the procedure may be good. In order to maintain the things in proper way as per planning an efficient control is necessary in the department over each and every process. Management Information System (MIS) and feedback control at every stage of working must be adopted to control and make the management and employee work as efficiently as possible to achieve the best results.

(II) Secondary Functions

There can be number of secondary functions. Some of them are discussed below:

(i) Standardization and Simplification

The standards and specifications of various types of materials are fixed by design and technical department of the organization and they are followed by production department. Standards define the quality, reduction in sizes and variety, interchangeability of parts and products. It ensures efficient utilization of materials and reduces wastages. Standard materials are always available at reasonable cost. It also helps purchasing department in selection of materials and vendors. If less variety of items purchased and put in the stores the types of inventories will be reduced and in this way the cost of carrying the inventories in the stores will be reduced. The objective of this function will be to produce standard product reducing the overall cost of the product.

(ii) Design and Development of the Product

The variety in product and functionality are the important factors to promote the sales of a product. The new techniques of designing a product using Computer Aided Design (CAD) has made possible to develop variety of products at faster rate. The new technological development in manufacturing using Computer Aided Manufacturing (CAM) can produce variety of products at much faster rate with all types of flexibility in the manufacturing as compared to conventional methods.

Materials management department has to act according to use of such variety of materials to produce variety of parts and ensure the supply of such materials. It should also be decided how to purchase and produce such variety of products with flexibility and economic cost.

(iii) Make and Buy Decisions

These types of decisions are the policy decisions of the management. The capacity of the organization and the various facility developed by the organization to manufacture various items is the main objective of every organization. This is the important planning activity of every undertaking. But when a company grows fast, its sales increases at rapid rate then it becomes an important matter to decide whether the company should buy the parts and components or increase and establish its facilities to cope up with the increased demand and sales. This will be greatly concern to materials management department. It will help in selecting the suppliers to buy the items at reduced cost. The material evaluation, its availability, alternative materials selection, procurement and inventory control are the functions influence the make and buy decisions.

The make and buy decisions are largely based on cost economics and cost benefit analysis made by the organization using the existing production capacity of labor, skill and machines available with the factory and how best they can be utilized.

(iv) Coding and Classification of Materials

This is an important function of the materials management to help the production and purchasing department of every organization. It uses its own methods of classification of materials used to manufacture the product or a company selling various goods. ABC analysis is one of the simple and standard method used by most of the firms for classification and storing their variety of materials.

The materials are recognized to purchase and store as an inventory by its codes and nomenclatures. The various methods of coding are used by every organization to control the variety of materials and its quantity and price rates.

(v) Forecasting and Planning

Materials requirements planning is based on correct forecasting of sales and demand of the products in the market. The market fluctuations are to be observed to control production of the organization. The various methods of forecasting are available and the materials management department can choose the one which gives the best results to the company.

Forecast of future demand of sales sets the planning of materials supply. Analytical methods are adopted for systematic forecasting and planning to procure the various materials required for production.

In case of fluctuating demands, there can be uncertainties in supply as well. This can be overcome by maintaining the proper quantity in inventory of short supply materials at proper time. The different techniques available to use correct forecasting have to be utilized by materials manager to plan the procurement, purchase, supply, managing the outside and inside transport and storing of the materials to maintain the supply chain lines at every production facility to meet the changes in production quantity and schedule of production to meet the fluctuating demand of sales of products manufactured by the organization.

To fulfill the objectives and functions of materials management and control the activities of this department, they are thoroughly studied and analyzed. The topics for this study and analysis are given as follows:

- (1) Materials management organization
- (2) Materials requirements planning
- (3) Forecasting
- (4) Purchasing
- (5) Inventory control
- (6) Storing, warehouse planning and control
- (7) Value analysis

(8) Materials handling

(9) Just In Time

The main functions of materials management are summarized as follows:

(1) Materials planning as per production requirements for quantity and time

(2) Purchasing the required materials

(3) Make or Buy decisions

(4) Receipts and inspections of materials

(5) Storage, warehousing securities and preservation

(6) Distribution of materials

(7) Transportation should be expedited and must be economically done

(8) Inventory control

(9) Disposal of over stock, surplus, scrap and salvage of materials

(10) Developing new sources of supply at competitive way

(11) Ancillaries industrial development

(12) Indigenous source of supply for foreign materials

(13) Material cost control and cost reduction

(14) Co-ordination and co-operation with the other departments

(15) Research and developments in materials management and their use

Scope of Materials Management

Referring to the various functions of materials management stated above the materials management co-ordinates various departments of manufacturing concern. Since the cost involved in manufacturing has maximum investment in the materials. It is about 55% to 65% of the sales value as has been investigated by the Directorate of Industrial Statistics during 1954-57 in India. As soon as materials are purchased and brought by the organization, its value goes on increasing as the other costs as required for ordering the materials, carrying the materials in inventory, its maintenance and handling charges must be assigned to the cost of materials before it enters in to a product or transformed in to some other form. In order to economize all the costs of materials management company has to adopt definite method of deciding the quantity of materials to be ordered, quantity to be stored as inventory and work in process inventory. In order to reduce the material cost and all other costs stated above, there has to be some efficient and effective materials management techniques, which must be dynamic to adjust with changing demand and production.

Integrated Materials Management Concept

Materials management concept is to manage resources in an integrative way for national economic development. This is possible with the development Management Information System (MIS), technological innovations and selection of economic and newly-developed materials for manufacture. It is the management's responsibility to develop the materials management system, which will find the ways and means for most efficient and most effective use of its resources using new technological processes, methods and ideas. The various resources to be fully utilized are men, money and materials and therefore there is importance of materials management. This will be further clear from the examples given below in the table about the expenditure incurred in the materials resource.

The integration of materials management functions is necessary in the following ways:

(1) Materials management will take decisions for purchase of materials.

(2) The centralization of authority is necessary.

(3) It will co-ordinate all the functions.

(4) Speedy and accurate decisions are needed.

(5) Data analysis through Electronic Data Processing (EDP) and use of computers is necessary.

(6) Opportunity for growth must be emphasized.

Types of Materials

The various types of materials to be managed are:

(i) *Purchased materials*: They are raw materials, components, spare parts, oils, grease, cotton waste, consumables and tools.

(ii) *Work in process (WIP) materials*: These are semi-finished and finished parts and components lying on the shop floor.

(iii) *Finished goods*: These are the final products either waiting to be assembled in the assembly lines or in stores which are stocked for final delivery waiting to sell.

The various costs involved in these materials are basic price, purchasing costs, inventory carrying cost, transportation cost, materials handling cost, office cost, packing cost, marketing cost, obsolescence and wastages.

Materials Management Organization

The major resources in any organization to manage are the materials out of seven main resources required to run any organization. They are management, materials, money, man power, machines, methods and matrix or facilities which include systems, plants, location and buildings etc. The purpose of materials management organization in any industry is to plan the materials requirements for the production of goods and services. The structure of the organization must be such so as to have the efficient management of materials controlling its flow, conservation and utilization. Its objective is to use judiciously and economically. The product must be produced from the available materials purchased at the economic price and bring together under one organizational component sharing responsibilities of all the aspects affecting flow, conservation, utilization, quality and cost of materials. Materials management include inventory management, purchase management, value analysis, store keeping, maintenance and upkeep of the inventories in hand and in process.

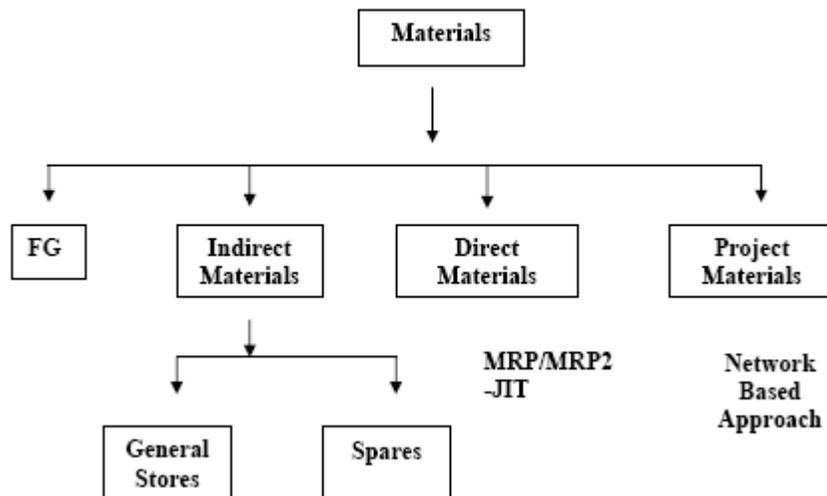
Introduction to inventory control

Inventory is a modern trend. For example, why does every car or a truck carry a spare tyre? It is because, in case of any puncture, the rider can change the tyre and immediately be on his way. He need not have to be stranded for a more stretched time. To avoid similar circumstances in business, companies carry inventory both for raw materials and finished goods.

We can say that Inventories are one of the main ingredients for any physical distribution system. We cannot distribute any product without any inventory. However, costs and investments are involved in inventories. They also directly influence the movement and transportation and cost. If inventory policy of a company dictates maintenance of large stocks, then transportation characteristic will be FTL (Full truck Load) shipments. This would result in economies of scale. The logistics manager is responsible for all these costs. Responsibility lies in him for making decisions concerning the size, depth or location of these inventories, the lot size, route and mode of transport. His primary objective should be in optimizing distribution costs. He has to find an economical balance between transportation and inventory cost where inventories represent an important alternative to creating time and place utility in the product.

Inventory management can be defined as the sum total of those related activities essential for the procurement, storage, sale, disposal or use of material. This can be understood by answering the following questions -when is a refrigerator not a refrigerator? In terms of physical distribution, a refrigerator is not a refrigerator when it is in Delhi, whereas when the demand is in Chandigarh. Further more, if the color required is grey and the refrigerator is blue then also the refrigerator is not a refrigerator. To conclude, utilities are created in goods when the right product is available at the right place, at the right time, at the right quantity and is available to the right customer. Inventory management deals itself with all these problems, placing importance on the quantities of goods needed.

2. Role of Inventory Control:



- Replenishment systems
- ROL system
- Periodic review system
- Selective control methods

$$\text{ROI} = \frac{\text{PROFIT}}{\text{TOTAL ASSETS (FA+CA)}}$$

- **Materials account for nearly 50% of total costs**
- **Inventory accounts for nearly 75% of CA**

Achieving the objectives of inventory control will result in more return on capital which is the prime objective of an organization, whether commercial or industrial. The formula given above is useful in arriving at the return of investment.

Another measure of healthiness of inventory control is Inventory Turnover Ratio (ITR). It is the ratio of total sales during specific time period (generally 1 year) to average inventory on hand during that time period.

Inventory Turnover ratio (ITR) (Finished Goods) = **Annual Sales/Average Inventory**

Inventory Turnover Ratio (ITR) (Raw Material) = **Annual Consumption/Average inventory**

Functions of Inventory

Inventories have four functions. They are:

Minimize costs at acceptable inventory levels: Replacing inventories in exceptionally small quantities result in low investments but high ordering costs. Thus, a point has to be set where the total inventory carrying cost is bare minimum but the level of inventory is such that it does not effect the production or customer base.

Provide desired customer service level: Inventories offer service in terms of satisfying customer demand. Inventory influences the time and costs of service. The location of inventory determines the time in which the customer will be served while a company policies concerning the economic order quantity, safety stocks, placement procedures and time will determine the cost at which the customer will be served.

Couple successive operations or functions: The decoupling effect of inventories is apparent throughout manufacturing and distributions systems. Normally in the absence of inventories in a

system, a demand by a customer triggers a chain reaction of demand at each preceding level, i.e. manufacturing and purchasing. But the customer does not have time or patience to wait for the chain reaction.

A small inventory requires frequent response rather than instant response from the transport system, where as, a large inventory reduces the need for frequent response and cost of transport system. The decoupling effect of inventories allows a physical distribution manager to choose amongst various inventory management policies.

Stabilize production and the labor force, thereby trying to reduce capital requirements:

This function of inventories is more associated to the manufacturing process, though it influences the distribution function as well. If an inventory management system takes responsibility of finished goods storage, then it has to provide storage facilities for higher levels of inventories. For example, seasonal products in many cases are produced all around the year to decrease investment in capital equipment. The stocks which come into existence are called anticipation stocks. But to produce or not to produce anticipation stocks is a manufacturing decision rather than a distribution decision.

Types of inventory

- Raw Material Inventory
- WIP Inventory
- Finished Goods Inventory
- MRO Inventories.

Raw Material Inventory

The materials, from which the final product of the company is made, are the raw materials. The material does not include any material that supports production; these materials are called indirect materials. But raw material is limited to the direct material (or) component that actually becomes a part of the final product. The steel used for automobile production is good example of a raw material kept in mind, though that the raw material of one industry is usually the finished product of another. Some of the raw materials may be available only seasonally, like cotton, sugar cane etc. There are certain raw materials which are governed by government control and quota system, like newsprint, coke etc.

The size of the raw material inventory is dependent upon factors such as

- internal lead time for purchase,
 - supplier lead time,
 - vendor relations,
 - availability of raw materials,
- government import policy in the case of imported material,
- the annual consumption of the materials and
 - the criticality of the material.

Some of the examples of raw material inventory are steel, wood, cloth or other materials used to make components of the finished product.

The reasons for keeping this inventory are:

I. Seasonal factors of availability and price advantage.

II. As protective buffer against:

- a. Delays in supply
- b. Change in production rates due to market fluctuations for the finished products, etc.

WIP Inventory (Work-In-Process Inventory)

All materials that have been transformed from their raw materials stage by some manufacturing process but are not final products are work in-process goods. Sometimes, what may appear to be

a final product is still really an in-process good if the final production step is a packaging one. It is in-process until it is in the form that can leave the plant. WIP can be found on the conveyors, trucks, pallets, in and around the machines and in temporary areas of storage waiting to be worked upon or assembled.

In building a ship or boiler the raw material is held as in-process stock till the complete ship is made. This is true in most of the heavy Engineering industries like cement plant, chemical plant. Some time they dispatch sector by sector to the site to reduce the in-process inventory. In continuous process industries the amount of inprocess held is optimum, which cannot be reduced or increased like in petroleum refining, cement manufacturing and chemical industries. Whereas in medium size industries where batch production is predominantly adopted, the in-process inventory is very high. After each production process the materials wait for the next operation.

The size of the inventory is dependent on the production cycle time, the percentage of machine utilization, the make/buy decision of the company, and the management policy for decoupling the various stages of manufacturing.

The reason for keeping In-Process inventory is

- As liquid stock to cater for variety and shorten the manufacturing cycle.
- As protective buffer against production breakdowns, rejections etc.
- For economic lot production.

Finished Goods Inventory

Finished goods inventory consists of all the stock that is ready for dispatch. In a bottling plant for example, the finished products are the bottles of beverages that are in their cartons or cases and are ready for shipment. This finished goods inventory acts as a buffer between the production department and the marketing department. Higher the stock of finished goods, then the cost of inventory is high. If the stock level is low or nil then the customer service will be affected. This will damage the good will of the customer about the company and the product. The purpose of this inventory is to reach the market by constant supply through distribution channels. This is controlled by the marketing department. The stock that is to be held at the warehouses, with the distributors and with retailers will be different depending upon the sales rate.

In pharmaceutical industries, the finished product stock will be very high at the distributors and retailers level as they have to stock all types and brand of medicine with the risk of expiry dates. In case of daily newspapers there should be absolutely nil finished stock as its life is only one day.

The size of the finished goods inventory also depends on

- the ability of the marketing department to push the products,
- the company's ability to stick to the delivery schedule of the client,
- the shelf life and the warehousing capacity.

The other reasons for holding this inventory are

- To protective buffer against sales rate changes.
- To absorb economic production lots.
- To stabilize the level of production and employment when the sale is of a seasonal variety.

MRO Inventories

Maintenance, repairs and operating supplies which are consumed during the production process and generally do not form part of the product itself (e.g. oils and lubricants, machinery and plant spares, tools and fixtures, etc) are referred to as MRO inventories

Mechanics of Inventory Control

Inventory control consists of finding answers to three questions

1. Should this item be stocked at all?
2. If so, when to order it?
3. How much to order?

Though these are the questions the inventory control tries to answer more stress is upon the last two questions. This is so because, what to stock is the question of sales forecasting for the target market. No item, not even the cheapest item, should be stocked without careful review. This should be a continuous process as the environmental which dictates supply of inventory and the demand environment keep changing continuously.

In many cases, managers answer these questions by following a rule of thumb on hunch basis (take decision based on gut feeling or experience). More likely than not, such decisions without proper evaluation prove to be wrong.

Suppose, a manager based on his hunch may decide to buy 5000 items of a product in stock once a month. This is so because the item costs only 10 paise. Error could be

- Increased order and acquisition cost
- Increased cost of transportation and packaging
- Increased receiving and inspection cost.

ABC analysis.

ABC Inventory Control

ABC analysis or Pareto's law is a well-known principle that is widely used for decision making and management control in many areas of management. Most researchers and practitioners are well aware of ABC analysis. However, textbooks and research articles are very brief and cryptic on how to use ABC analysis in practice. Moreover, textbooks in production management and logistics/distribution management are somewhat contradictory on how ABC analysis can be applied in the management and control of inventories. While logistics/distribution management textbooks suggest that the fast moving A items should be widely distributed (thus providing more availability or service level), production/operations management textbooks seem to suggest the exact opposite. They suggest that since the high dollar usage, A items account for a significant percentage of the inventory costs; the inventories of A items should be tightly controlled! This paper seeks to resolve and provide an explanation for this apparent contradiction. Thereafter, a framework is developed for choosing an inventory strategy based on ABC analysis.

ABC analysis is the process of dividing items in to three classes according to their dollar usage so that managers can focus on items that have the highest dollar value.

Class "A" items typically represent only 20% of the items but account for 80 % of the dollar usage. Class "B" items account for another 30% of the items but 15% of dollar usage. Finally, 50% of the items fall in class "C", representing a mere 5 % of the dollar usage. (Figure1)

- "A" - items are the highest priority, the tightest control, frequent deliveries, close follow-up, and accurate records. Planning and Scheduling these parts utilize MRP (Material Requirements Planning), DRP (Distribution Requirements Planning, or EOQ (Economic Order Quantity) or other lot sizing techniques such as Lot for Lot. 10 % of the "A" items volume accounts for 70% of the total inventory value.
- "B" - items are the priority when low or out of stock. Normal control is used and good

- records are maintained. EOQ and other lot sizing methods can be used effectively with these items. “B” items account for 20% of the total inventory value, and 20% of the inventory
- “C” - items are the lowest priority, simplest method of control. Min/Max used for ordering. These parts are usually expensed, as there are no records for them. These parts represent 10% of the total value, and 70% of the volume.

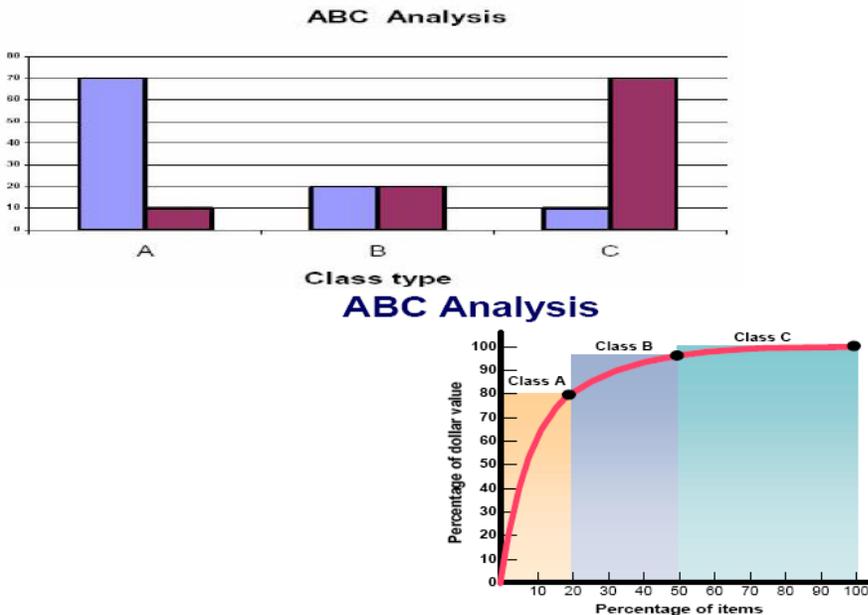


Fig 1 – ABC analysis

Managing Inventories by ABC:

ABC analysis is the method of classifying items involved in a decision situation on the basis of their relative importance. Its classification may be on the basis of monetary value, availability of resources, variations in lead-time, part criticality to the running of a facility, new customer parts unique to that product, and others.

Cycle inventory can be managed through ABC analysis:

“A” value items have to be counted more frequently i.e., once in a week to do accurate monitoring of these items which has more impact on the inventory value. “B” value items can be counted once in a month because they are moderate value items which have less impact on the inventory value. “C” items have to be counted once in three months or six months because they are least consumed value items and has very less impact on the inventory value.

Obsolescence budgeting also takes the management of ABC analysis into consideration.

“A” items have the most impact on the budget, if it is determined to be obsolete and scrapped from inventory. These parts may fool the reviewer because the “A” parts may not have a use for several years, but due to its critical importance may be needed at a later date. The slow moving activity report would not detect this need. Management and storeroom management need to consider all aspects of the parts before it is scrapped to obsolescence. ABC analysis puts a perspective that enhances this decision-making.

Other use of ABC analysis is in the reorganization of the storeroom.

Yearly, a review of parts storage areas needs to take place by the storeroom manager. In this analysis, ABC coding should be considered so that the “A” parts are continually being moved to the lower or easier access areas. ‘B’ items are to be moved to middle areas, and “C” items placed in all other areas of the stores.

UNIT – IV

Basic Concept of Management

INTRODUCTION

The history of management goes back to the dawn of human civilization, when human beings started group activities for the attainment of some common objectives. Whenever a group is formed and a group activity is organized to achieve certain common objectives, management is needed to direct, co-ordinate and integrate the individual activities of a group and secure team work to accomplish organizational objectives. The need for efficient management is highly felt in business activities. The objectives of all business are attained by utilizing the scarce resources like men, materials, machines, money etc. The basic economic objectives of business activity are profit maximization or continuous growth and survival. It is only efficient management which helps in achieving these objectives economically by effective utilization of the scarce resources.

Management is a universal process in all organised economic activities. It is found in every walk of life where the economical and intelligent application of scarce resources are involved. It is not merely restricted to shop, factory or office. It is necessary for a business firm, Government enterprises, education and health services, military organisations, trade associations and so on. In fact management is an operative force in all complex organisations trying to achieve some stated objectives.

It can be generalized that no enterprise can enjoy a successful existence and survival without the competent management. The slow rate of economic growth of under-developed countries is due to the poor management. Peter Drucker has rightly remarked that there are no under-developed countries, there are under managed countries. According to Kolin Clark, an eminent economist, the low rate of economic growth of under-developed countries is not due to the dearth of capital, but it is due to the dearth of the management talents.

DEFINITIONS OF MANAGEMENT

Management has been defined by different thinkers in a number of ways. For our understanding management may be viewed as what manager does in a formal organisation to achieve the objectives. Some of the important definitions of management are as under :

1. Management has been called by Mary Parker Follet – ‘the art of getting things done through other people.’ This definition throws light on the fact that managers achieve the organisational goals by enabling others to perform rather than performing the task themselves.

Management, in fact, encompasses a wide variety of activities that no one single definition can capture all the facets of management, given its dynamic nature.

2. "Management may be defined as the art of applying the economic principles that underline the control of men and materials in the enterprise under consideration" — Kimball and Kimball
3. "Management is the force that integrates men and physical plant into an effective operating unit" - — Keith and Gubelline.
4. "Management is principally a task of planning, co-ordinating, motivating and controlling the efforts of others towards a specific objectives". — James Lundy.
5. As Appley L. in his book has written—"Management is the attainment of pre-established goals by the direction of human performance along pre-established lines." According to Appley L. management is essentially personnel management. We do not build automobiles, airplanes, refrigerators, radio's etc. we build men and women and these human resources build products. Human resources are our great assets. They have

unlimited potential. Hence, it is but natural that management must give special attention to the development of human resources.

6. P. Drucker in his book practice of management has defined, "Management is a multi-purpose organ that manages a business, manages a manager and manages workers and work".

Drucker stresses three jobs of management — (i) Managing a business; (ii) Managing manager and; (iii) Managing workers and work. Even if one is omitted, we would not have management any more and we also would not have a business enterprise or an industrial society. According to Drucker, the manager has to balance and harmonise three major functions of the business enterprise. Hence a manager is a dynamic and life-giving element in every business. Without efficient management we cannot secure the best allocation and utilization of human, material and financial resources.

7. "Management is knowing exactly what you want men to do, and then seeing that they do it the best and cheapest ways" -F. W. Taylor.

8. "Management is defined as the creation and maintenance of an internal environment in an enterprise where individuals, working together in groups, can perform efficiently and effectively towards the attainment of group goals" — Koontz & O' Donell.

According to this definition, management is an art of creating favourable performance environment enabling the group to attain slated objectives and management is the body of organised knowledge, i.e. Science which underlies the art.

9. Quoting from American Management Association — "Management is guiding human and physical resources into dynamic organisation units which attain their objectives to the satisfaction of those served and with high degree of morale and sense of attainment on the part of those rendering service".

10. According to Henri Fayol the father of modern management thought, "Management is to forecast and to plan, to organise, to command, to co-ordinate and to control". It attempts to describe management in terms of what a manager does and not what management is?

11. The definition given by James A.F. Stoner covers all the important facets of management.

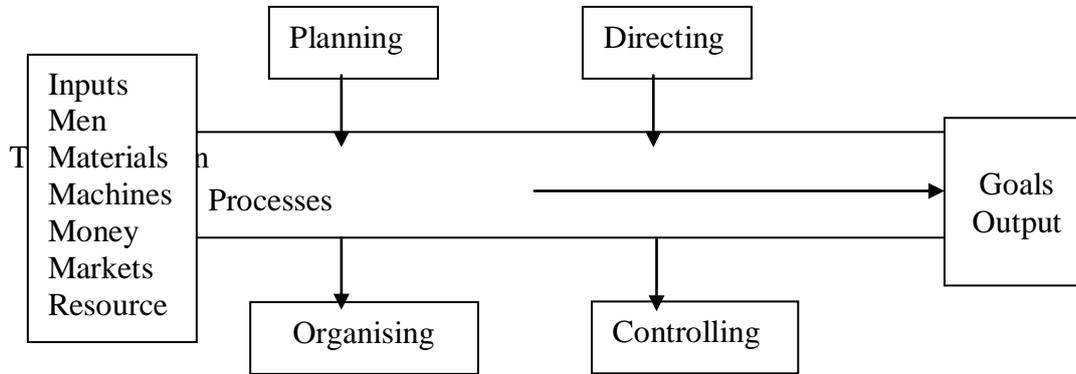
According to him, "Management is the process of planning, organising, leading and controlling the efforts of organisation members and of using all other organisational resources to achieve stated organisational goals". The definition suggests :

- i) Management is a continuous process.
 - ii) Several inter-related activities have to be performed by managers irrespective of their levels to achieve the desired goals.
 - iii) Managers use the resources of the organisation, both physical as well as human, to achieve the goals.
 - vi) Management aims at achieving the organisations goals by ensuring effective use of resources. It is evident that the emphasis is on achieving the objectives by using the inputs like materials, machinery, money and the services of men.
12. A precise definition of management can be stated as : "Management is a social process involving co-ordination of human and material resources through the functions of planning, organizing, staffing, leading and controlling in order to accomplish stated objectives".

There are five parts to a definition of management as a social process:

- i) the co-ordination of resources :

- ii) second, the performance of managerial functions as a means of achieving co-ordination;
- iii) third, establishing the objective or purpose of management process, i.e. it must be purposeful managerial activity;
- iv) fourth aspect is that management is a social process i.e. it is the art of getting things done through other people; and
- v) the fifth is its cyclical nature i.e. an ongoing (continuous) process which represents planning — action — control — replanning cycle.



Basic
Resources Fundamental Output
(Input) Management Stated
Functions Objectives

Fig 7.1 Process of Management

CHARACTERISTICS OF MANAGEMENT

The important characteristics of management are as follows:

1. **Management is a purposeful activity:** management basically deals with the attainment of some clearly defined objectives. objectives differ from organisation to organisation. In business the basic economic objective is to earn maximum profits while in service organization like hospital, the basic objective is to provide better service. Management coordinates the efforts of the workers to achieve the objectives of the organisation.
2. **It is an Efficient management of Economic Resources.** Management is one of the important factors of production together with land, labour and capital. Management is an operative force which assembles and integrates other factors of production, namely men, machines, materials and money.
3. **Management is a distinct process.** Management is a distinct process consisting of planning, organising, staffing, directing and controlling.
4. **Management is universal.** It is found in every walk of life where the economical and intelligent application of scarce resources are involved. The principles and techniques of management are universally applicable to all group activities performed at any level of organisation.
5. **As a Team of Managers and System of Authority.** Management as a team of managers represents a system of authority - a hierarchy of command and control. Managers at different levels possess varying degrees of authority. Authority enables the managers to perform their functions effectively.
6. **Co-ordination is the soul of management.** Management is necessary in the group activities. Various human beings organised in formal groups are endeavouring to achieve the common organisational objectives. So, various departments in the organisation must

work in harmony with one another. In the absence of co-ordination of efforts of different groups, there will be conflicts and chaos.

7. Management is dynamic. Management is applied to human groups. Human groups work in society. The ever changing social environment directly and indirectly affect the group activities. Thus changing environment provide a challenge to management. Efficient management cannot remain static. It must adopt itself to changing conditions.

8. Management is decision marking. The managers are decision makers; e.g. the marketing manager decides about how to market, where to market etc. A finance manager takes decision about how much funds will be needed, how to collect funds, how to distribute profit etc. Snehcountless number of decisions based upon data and analysis constitute management.

9. Management is a profession. Management is not only a science but also an art. As an art it refers to innate qualities of managers. As an artist, the manager has to depend on his own experience. Intuition and judgment, while making decision on taking action. He has to handle the persons tactfully. (Manage - Men - Tactfully). As a scientist, he relies upon the existing theory and philosophy of management and develops new knowledge, new principles, applies scientific attitude and method in problem solving. Dean Stanley observed that at present management is 90% art and 10% science. But in the course of time the percent of science will increase. However it should be noted that science will never eliminate the art part of the management. Born managers can still become better managers if they receive scientific training. In modern times, management is rapidly emerging as a profession. Management Consultancy Services are amply available now-a-days.

DIFFERENCE AND RELATIONSHIP BETWEEN ADMINISTRATION, MANAGEMENT AND ORGANISATION

The following table illustrates a clear distinction between Administration, Management and Organisation:

Sl.No	Administration	Management	Organisation
1.	It is the process of determining the objectives to be achieved.	It is process of planning the objectives laid down by the administration	It is process of dividing the work into different tasks and duties as planned
2.	It lays down the policies and principles.	It executes the policies and programmes.	It organizes the work.
3.	It prepares the framework under which one is asked to work and execute.	It supervises and controls the execution of assigned work.	It draws out the line of authority and determines the line of action.
4.	It provides: i) direction (ii) guidance, and (iii) leadership	It co-ordinate activities	It delegates the authority and fixes responsibility.
5.	It is first and provides guide lines to the management and	It comes second follows the admimstration and derives strength from administration.	It occupies the third place and solely responsible for what the management has

	organisation.		planned and administration has set.
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LEVELS OF MANAGEMENT

Levels of management, in fact refers to a line of separation between different positions drawn with a view to distinguish each other in respect of their duties, responsibilities, rights and authorities.

The three levels of management that are commonly found in an organisation are :

- (a) Top Management
- (b) Middle Management
- (c) Lowest or Supervisory Management

Top Management. Top Management constitutes the highest level in the management hierarchy. This is the policy making level in any organisation. This level consists of small group of executives. Board of Directors, Chairman, Managing Director, Personnel Manager, Chief Executive etc. Top Management is responsible for the overall management of the organisation. They define the aim of the company, establish the primary objectives, policies and strategies to be pursued to achieve these objectives. They also formulate the plans of organisation and procedure, inaugurate the board programme, and approve specific major projects in the programme. They provide direction to the organisation by guiding the organisations interactions with its environment.

Middle Order Management. Middle order management occupies a central place in the hierarchy. It is concerned with execution of the detailed policies and plans determined by top management (Administration) through the framework of organisation. Middle order management is answerable to top management. Its main functions are : (i) to plan (ii) to guide (iii) to supervise (iv) to co-ordinate (v) to exercise control over the lower level management. It often functions as a link between top management and lower level management.

Lower level or Supervisory Management. This is the lowest level in the hierarchy of management. Managers at this level functions under the control and direction of the middle order management. Their functions are also to plan, to guide, to supervise, and to exercise control, but all these functions are performed to get work done from the operating staff. This levels of management takes orders from the middle order and explains them to the workers at operating level. In fact this level of management accredited with the responsibility of getting the work done and is made accountable to those who occupy the middle order management. This level includes Foreman, Supervisor, Superintendent, Inspector etc.

The following graphical accounts make the above hierarchy more clear:

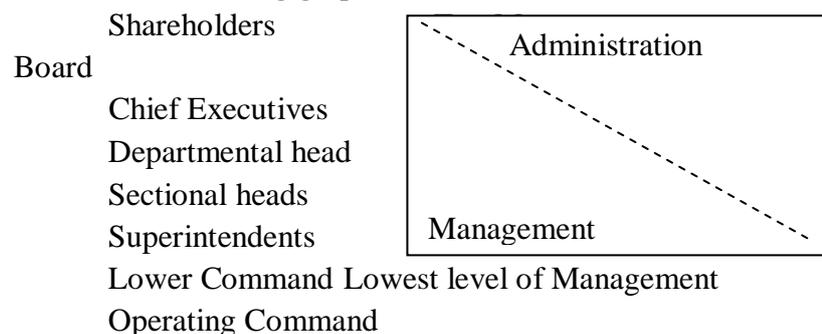


Fig- 7.2. Levels of Management.

Sl.No	Level	Represented by	Function
1.	Top Management	a. Board of Directors b. Managing Directors c. Chief Executives d. General Manager e. Secretary	a. Determine the objectives b. Establishing Policies c. Monitoring performance d. Judging the results
2.	Upper Middle Management	a. Production or Works Manager b. Finance Manager c. Personnel Manager d. Materials Manager e. R & D Manager	a. Establishment of organisation b. Selection training/placement of staff c. Assigning duties to subordinates d. Design operating policies and operating routines e. Exercise control over the subordinates.
3.	Middle Management	a. Superintendents b. Departmental heads	a. To plan details of operation b. To co-operate with top management for the smooth functioning of organisation. c. To active co-ordination between various departments d. Development of manpower for the organisation by imparting training.
4.	Lower Management	a. Foreman b. Supervisors	a. To act as a link between management and the workers b. Direct Supervision of the workers c. Arrangement of material, tools, facilities etc. for production.
5.	Working	a. Workers b. Service Staff c. Security Staff	a. Carry out the work assigned to them

MANAGERIAL SKILLS

Managerial skills is the ability of a manager to make a smooth functioning team of people working under him. Management job is different from other jobs. It involves obligation to make effective utilization of human and material resources. It requires sound judgement to handle complex situations. Further, the nature of the job becomes increasingly complex at each higher level because of the increase in the scope of authority and responsibility. Thus the skills required in management are different in nature at different management levels. Each higher level requires increased knowledge, broader perspective and greater skills. Manager has to reconcile, co-ordinate and appraise the various view points and talents of people working under him towards the organization goals.

The skills required of a successful manager, whether he is working in a business organisation, an educational institute or a hospital can be classified as under:

1. Technical Skills

2. Conceptual Skills

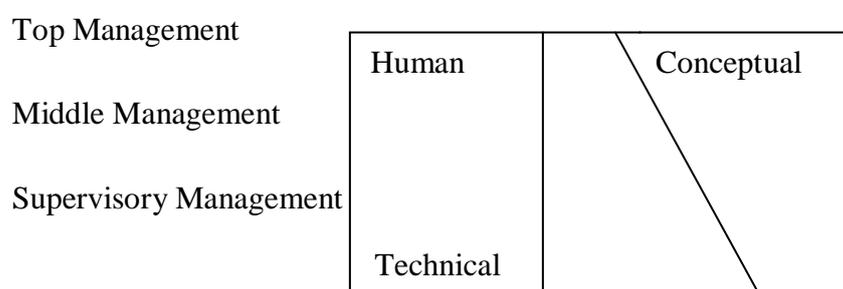
- (a) Decision making skills (b) Organisational skills

3 Human Relation Skills

- (a) Communication skills
(b) Motivating skills
(c) Leadership skills

Technical Skills

Technical skills refers to the ability to use methods, processes, tools, equipment, techniques and knowledge of a specialized field. It is primarily concerned with the ways of doing things. It refers to the proficiency in handling methods, techniques and related to a specific field of activity. Technical skills are most important for lower level managers, because by nature their job involves supervision of the workers on the shop floor. Effective supervision, guidance, direction and co-ordination of the work performed by the sub-ordinates, therefore depends on the technical skills possessed by the lower level managers, Any supervisor without a sound knowledge of the job cannot make an effective supervisor. Such supervisors are not respected by the workers at the shop floor. The relative importance of the technical skills as compared to the other skills diminished as one moves up to a higher levels of management. Fig 7.3 illustrates the managerial skills required at different levels of management.



Conceptual Skills

Conceptual skill is the ability to see the organisation as a whole, to recognize inter-relationships among different functions of the business and external forces and to guide effectively the organisational efforts. It is easier to learn technical skill than the conceptual skill. Conceptual skill extend to visualizing the relation of the organisation to industry, to the community and to the political, economic and social forces of the nation as a whole and even to forces which operate beyond the national boundries. It is the creative force within the organisation which is concerned with design and problem solving. A high degree of conceptual skill helps in analysing the environment and in identifying the opportunities and threats.

(a) **Decision making skills.** Decision making skill is the ability of a person to take timely and accurate decisions. This requires mental ability, sound knowledge and presence, of mind.

(b) **Organisational skills.** This helps in manpower planning i.e. for selecting people for different type of activities. It means placing right men for the right job.

Human Relation Skills

Human skills are primarily concerned with persons as contrasted with 'things'. Human skill refers to the ability to work effectively with others and build co-operative group relations to achieve organisational objectives. It is the ability to work with, understand and motivate people. He understands why people behave as they do and is able to make his own behaviour understandable to them. He can foresee their reactions to possible courses of action and is able to take their altitudes into account.

a) **Communication Skills.** It is the ability to pass on information to other improper, insufficient and poorly expressed information can create confusion and annoy the subordinates.

b) **Motivating Skills.** Motivating skill inspires people to do what the manager wants them to do. The manager may use positive or negative motivational methods. Positive motivational methods include. Reward, praise etc. whereas negative motivational methods involves punishment, threat etc.

(c) **Leadership Skills.** It enables the manager to lead the people working under him. It is the ability to inspire confidence and trust in the sub-ordinates in order to have maximum co-operation from them for getting the work done.

Note:

1. Human skills (Inter-personal relations) are important at all levels of management.
2. Technical skills are most important at the lower levels of management.
3. Conceptual skills are more important at the higher level of management.

The three types of skills are not mutually exclusive. Management job always requires all the three skills but in different proportions depending upon the level of management as shown in Fig. 7.3. Technical skill requirement is greater at the lower level of management because it is there where the productive process and operations are carried out. The need for conceptual skill is greatest at the top level of management.

Based upon the differences in the type of skills required, organisation assess the training needs of the managers. Accordingly, appropriate training methods or modules are designed to equip them with the skill required at the respective level

According to Fayol, the manager should possess the following qualities to carry out his job successfully :

- i) Physical — health, vigour, address.
- ii) Mental ability — to understand and learn, judgement, mental vigour and adaptability.
- iii) Morale — energy, firmness, willingness to accept responsibility, initiative, loyalty, tact, dignity.
- iv) Educational — general acquaintance with matters not belonging exclusively to the function performed.
- v) Technical — peculiar to the function.
- vi) Experience — arising from the work proper.

Financial Management

INTRODUCTION

Every business enterprise irrespective of its nature and scale of business needs finance (funds) to carry out its activities and accomplish certain business objectives. No business venture can succeed unless it has enough money to take advantage of any opportunities that may arise. Finance is the life-blood of any business.

The management of finance therefore plays a key role in the anticipation of financial needs, acquiring financial resources and allocating funds in the business. In fact it determines the success or failure of any business activity. The economic objectives of a business organisation are profitability, growth and survival. The attainment of these objectives largely depends upon the efficient management of finance.

Financial management basically deals with procurement of funds needed by the enterprise on the most favourable terms in the light of its objectives. It is not only concerned with effective procurement of funds, but also on the efficient utilization of funds.

DEFINITION

The finance function is concerned with the process of acquiring and efficiently utilizing the funds of a business system, with the objective of maximising the value of the firm. Financial management involves the application of general management principles to the finance function.

According to Hoagland, “Financial management deals with how the corporation obtains the funds and how it uses them.”

According to Mock, Schultz and Shuckect at— “The financial management refers to the application of skills in the manipulation, use and control of funds.

Financial management may also be defined as that part of management, which is concerned mainly with raising the funds for the enterprise in the most economical manner, utilising those funds as profitably as possible for a given risk level, planning future investments and controlling current performance and future developments through financial accounting, cost accounting, budgeting, financial statistics and other means.

FUNCTIONS OF FINANCIAL MANAGEMENT

The financial management being a strategic and key area of management involves variety of functions. From the viewpoint of effective management of finance, the finance functions can be categorised as :

- (i) Executive finance functions.
- (ii) Routine finance functions.

Executive Finance Function

1. Determining Financial Needs. The anticipation of the total financial needs of the organisation is also called as ‘Capitalisation decision’. It means determining the total financial requirements of an organisation in terms of long-term and short-term requirements. This is a key decision which decides the size of the organisation and the scale of operations. Sometimes the top management prescribes the maximum limit on the total funds to be raised from various sources. The total financial requirements (capitalization) should be anticipated very carefully, otherwise it is likely that the organisation may face a situation of over-capitalization (i.e. availability of more funds with little chances of their profitable investment) or under-capitalization (i.e. sacrifice of profitable channels of investments due to inadequate funds).

2. Determining Capital Structure and Sources of Funds. The capital structure decides the blending of the owned and borrowed funds in the total financial requirements. It also implies determination of the sources, timing and procedure to obtain funds which an enterprise needs for its long-term and short-term operations. The terms and conditions of the different financial resources vary significantly depending upon the financial image of the enterprise. The financial management should have full knowledge of the different sources of funds along with their advantages and limitations to make use of them in the best interest of the enterprise. The funds may be raised by different types of securities and debentures, or they could be borrowed from financial institutions or bank.

3. Investment Decision (Allocating Funds). Allocating funds in a business means investing them in the different components of fixed and current assets. The investment in fixed and current assets must yield reasonable returns. The returns from the business operations using fixed and current assets must be sufficiently high to meet the cost of raising funds. Assets are

balanced by weighing their profitability against their liquidity. Profitability depends upon factors such as cost control, pricing, forecasting future profits, and measuring the cost of capital. Liquidity means convertibility to cash.

4. Management of Fixed Assets. The investment in fixed assets like land, building, machinery, equipment, furniture, fixture etc. constitutes 60% to 80% of total investments. It involves long-term commitment of funds for their purchase/replacement. This needs careful decisions after evaluating their utility and productive capacity. The investment in fixed asset is governed by the top level policies like owning the asset, to hire or to get it on lease, to make or buy the components etc. It also formulates the appropriate depreciation policies for the replacement of fixed assets.

5. Working Capital Management. Working capital is required for the day-to-day business activities of the enterprise. It is the life-blood of an enterprise which ensures smooth functioning. The important components of the working capital are inventories, receivables, and cash balances, which keeps on circulating in an enterprise. The decision on inventory levels of raw-materials/components and finished goods ensures that production and sales do not suffer for want of raw materials/finished products and at the same time excessive stock may not result in increased capital cost for carrying the excessive inventory. Similarly, the levels of receivables is dictated by the credit policy followed by the management. The maintenance of the cash balance is the result of the preference of management towards the profitability or maintenance of liquidity.

6. Control Over Financial Activities. Controlling as a management function brings effectiveness in the operational performance, and it presupposes planning and budgeting. Generally, the following tools are employed in controlling the financial activities :

(a) Standard Costing. The actual cost is compared with the standard cost to locate inefficiencies and trace out the reasons for it.

(b) Budgetary Control. It is exercised through preparing various types of budgets. Capital budgeting, cash budgeting and various types of operating budgets.

(c) Financial Analysis. Financial analysis has to be carried out by making use of financial ratios to analyse the financial status and activities of the enterprise. Financial ratios help in measuring the liquidity, profitability, solvency, turnover of assets, etc. of the business.

(d) Break Even Analysis (Cost-volume-profit Analysis). This analysis is used to study the effect of changes in selling price, volume of production, variable and fixed costs or a combination of these factors on the profits for selecting these factors such that profit is maximised.

7. Management of Earning. Out of the total earnings available for the equity shareholders, how much should be retained in the business for reinvestment is an important executive decision. It is popularly known as dividend policies. The dividend decision also affects the market price of the equity shares in the stock market. The dividend policies should be formulated in such a manner so as to maximize the value of the firm by due consideration to the profitability and other financial considerations such as shareholders' reactions, requirement of additional capital, cost of capital, investment opportunities, accumulated surplus etc

Routine Finance Functions. There are certain routine functions which are falling within the jurisdiction of the financial management. Generally, these functions are delegated to the subordinate staff in the finance department. Some of the important routine functions are :

(a) Control on cash.

(b) Custody and safeguard of documents.

(c) Record keeping.

(d) Management reporting etc.

Objectives of Financial Management. The objectives of financial management may be such that they should be beneficial to the owners, management, employees and the customers. These objectives can be achieved by maximizing the value of the firm. Some of the important objectives of the financial management are:

1. Increase in Profits. A firm should increase its revenues in order to maximize its value. The profits of the firm are maximized, when the firm is in equilibrium. At this stage, the average cost is minimum and the marginal cost and marginal revenues are equal.

2. Reduction in Cost. A firm should make efforts to reduce the cost of capital and to launch economy drive in its operation.

CAPITAL

In order to start and run a business i.e. to produce and sell the goods or services, money has to be invested. The money invested in the business in order to yield an income is known as capital. Capital is needed for the following purposes :

1. Purchasing fixed assets (building, equipment, machinery, tools, furniture etc.).
2. Purchase of raw-materials and other supplies.
3. To meet the day to day expenditure such as wages of workers, selling and distribution expenses, equipment and plant maintenance costs etc.

Importance and Scope of Capital: Capital plays a vital role in the modern productive system. Capital is the life blood of any business. Production without capital is not possible. Nature cannot furnish goods and materials to man unless he has the tools and machinery, for mining, farming, foresting, fishing etc. With the growth of technology and specialisation, capital has to play a vital role. Productivity of the modern economy is mainly due to the extensive use of capital, i.e. machinery, tools or implements in the productive system.

Capital is one of the important factors of production. It plays a strategic role in raising productivity. Economic development is not possible without the making and using of machinery, construction of irrigation works, the production of agricultural tools and implements, building of dams, bridges and factories, railways, airports, ships, harbours etc. which are all capital.

Another important economic role of capital formation is the creation of employment opportunities in the country. Capital formation creates employment at two stages. First, when the capital is produced some workers have to be employed to make capital like machinery, factories, equipments, irrigation works etc. Secondly, more men have to be employed when capital has to be used for producing further goods. Thus we see that the employment opportunities will increase with the increase in capital formation. If the population grows faster than the increase in the stock of capital then it will result in unemployment. The rate of capital formation must be kept sufficiently high so that the employment opportunities are enlarged. In India, the stock of capital has not been growing at a fast enough rate so as to keep pace with the growth of population.

CLASSIFICATION OF CAPITAL

Capital may be classified as :

1. Fixed capital, or Block capital, and
2. Working capital

Fixed Capital : The funds required for acquisition of the fixed assets, such as land, building, equipment etc. that are to be used over and over again for a long period is known as fixed capital. It cannot be disposed off without breaking the business.

Fixed capital is required for the following items:

1. Land
2. Building and other installation
 3. Power and electric supply installation
 4. Water supply and drainage fittings
 5. Machinery, material handling equipment,
 6. Tools, jigs, fixtures,
 7. Administrative office and equipment
 8. Furniture
 9. Patents etc.

Firms engaged in commerce, trade agency and banking etc. need very little fixed investment. But manufacturers of heavy and capital goods need major part of their capital in fixed assets.

WORKING CAPITAL

Working capital is required to meet the expenditure for day to day working of the business. It includes:

1. The cost of raw materials, purchased parts, supplies, material in process and finished goods.
2. Wages and salary bills (cost of direct labour, indirect labour).
3. Cost of maintenance and service activities, utilities and fuel, property taxes and insurance.
4. Cost of sales activities such as advertising promotion, shipping services and credit extension to customers.

Components of Working Capital:

The components of working capital are:

1. Inventories including;
 - (a) Raw material (b) Work in process (c) Finished goods and (d) Stores and spares
2. Debtors which include,
 - (a) Bills receivable (b) Sundry Debtors
3. Cash and bank balances and
4. Advances to suppliers of raw materials.

These components in aggregate represent gross working capital and the net working capital is equal to. Gross working capital- (Sunday creditors + advances from customers + outstanding expenses)

The current assets are the assets which can be converted into cash within an accounting year and include cash, short term securities debtors, and bills receivable and stock (inventories). Net working capital can be positive or negative. A positive net working capital results when current assets exceeds current liabilities. A negative net working occurs when current liabilities are in excess of current assets

The gross and net working capital concepts are the two important facets of the working capital management. The gross working capital concept focuses attention on two aspects of current asset management (a) Optimum investment in current assets and (b) Financing of current assets. The networking capital indicates; (a) liquidity position of the firm and (b) the extent to which working capital needs may be financed by permanent sources of funds.

NEED FOR WORKING CAPITAL

Working capital is that capital which is required to ensure smooth and effluent business operations without interruptions. It is required to meet day-to-day business activities of an enterprise. The object of any business is to earn profit. The main factor affecting the profit is the magnitude of sales of the business. However, the sales cannot be converted into cash immediately. There is a time lag between the sales of goods and realisation of cash. Therefore,

working capital is needed in the form of current assets to fill up this time lag. The working capital is constantly circulating and is being turned over continuously. It is therefore also known as circulating capital. The working capital cycle converting the sales into cash is shown in Fig. 11.1.

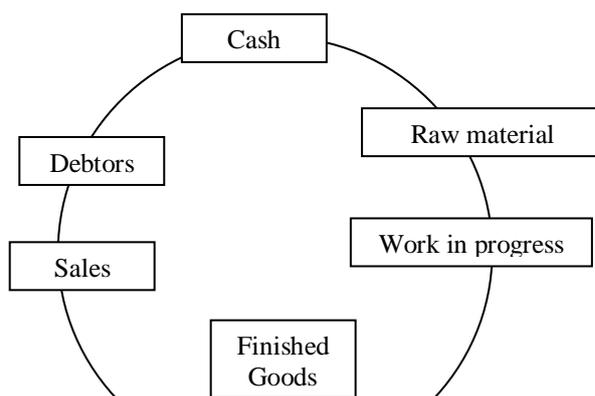


Fig. 11.1. Working capital cycle.

If the organisation has certain amount of cash, it will be required for purchasing the raw materials. Then the organisation has to spend some amount for labour and factory overheads to convert the raw-materials in work in progress, and ultimately finished goods. The finished goods when sold on credit basis get converted in the form of sundry debtors. Sundry debtors are converted to cash only after the expiry of credit period. The cycle repeats itself again and again, thus, there is a cycle in which the originally available cash is converted in the form of cash again but only after following the stages of raw material, work in progress, finished goods and sundry debtors. Thus, there is a time gap for the original cash to get converted in the form of cash again. Working capital is needed to fulfil the requirements of funds during this time gap, and the quantum of working capital needs varies as per the length of this time gap. Thus some amount of funds is blocked in raw materials, working in progress, finished goods, sundry debtors and to day to day cash requirement. However, some part of these current assets may be financed by the current liability.

ASSESSMENT OF WORKING CAPITAL

The assessment of correct amount of working capital is extremely important to run the business successfully with reasonable amount of profit. Both overestimation as well as underestimation of working capital is harmful to the business. Overestimation of the requirement will result in blockage of scarce funds in idle assets and reduction of profitability of the firm.

Similarly, underestimation of working capital will result in shortage of funds and will deprive the firm from many profitable opportunities. Because it may cause interruption in production.

Shortage of funds may also affect the reputation of the firm due to its inability to meet the demand of the customers in time.

Disadvantages of Excessive Working Capital:

1. There is an unnecessary accumulation of inventories resulting in inventory mishandling, wastage, obsolescence, theft and other losses.
2. It results in lower return on investments because the capital is not being used efficiently for the operations.
3. It results in lowering the efficiency of management.

4. It results in losing control over inventory turnover ratios which are used in conducting an efficient business.
5. It results **defective** credit policy and slack collection period resulting in higher incidence of bad debts. Thus adversely affecting profits.

Disadvantages of inadequate working capital :

1. Because of non-availability of working capital some profitable projects cannot be undertaken.
2. It becomes difficult to implement operating plans and achieve the profit objectives of the business.
3. The man and machines may remain idle due to lack of working capital, thus there is inefficient utilization of available fixed assets, resulting reduction in productivity.
4. Operating inefficiencies may result due to difficulties in meeting day to day commitments.
5. The organization loses its reputation as it is not in a position to honour its short term obligation (meeting delivery promises).
6. It cannot avail savings resulting from bulk purchasing of raw materials

The following aspects should be considered while estimating the working capital required to run the business profitably.

Raw material and stores/spares etc. The need to stock raw material is affected by

- (a) Nature of raw material
- (b) Storage facilities available
- (c) Lead time
- (d) Expectations of changes in price levels
- (e) System of procurement i.e. inventory ordering system used by the firm
- (f) Seasonality in availability and
- (g) Adoption of new technology.

In the case of the already existing units, the past record serves as guide for estimating the working capital requirement for the next year.

(ii) **Cycle time** : The cycle time i.e. the average time required to produce one unit remains more or less constant for a particular industry unless there is a change in technology or the method of production. During this period, certain amount of material is blocked in various stages. Industries having less cycle time will need less amount of working capital as compared to those with cycle time.

- (i) **Finished Goods** : The need to stock finished goods arises because of factors like nature of market, availability of transport facilities, type of demand for goods, quantity and regularity orders received etc.
- (ii) **Expenses** : It is good to treat one month's manufacturing and administrative expenses as payable in advance (reserve funds). This will serve as a cushion against any uncertainties and such provision will further strengthen the liquidity position of the firm.

The physical quantities representing consumption/sale of the component during the period are then converted into monetary values for assessment of working capital requirements.

FACTORS AFFECTING WORKING CAPITAL

The working capital requirement of industries vary from one unit to another and from one type of unit to another type. The important factors which should be considered while determining the working capital are :

1. Length of period of manufacture
2. Turn over of inventories
3. Terms of purchase and sales
4. Size (volume) of the business
5. Seasonal variations
6. Importance of labour
7. Business Cycle
8. Banking facilities.

1. **Length of period of Manufacture.** A factory using simple short period process of production require a small amount of working capital. Whereas a factory which needs a long period of manufacture will need large amount of working capital for the large amount of raw material, wage payment and other incidental expenses. Moreover, it has to wait for a long period till the finished product is ready for sale. Thus large amount of capital is tied up in the process of manufacture. Example, ship building industry.
2. **Turnover of Inventories.** Turnover is the ratio of annual gross sale to the average inventories. If the inventories are small and their turn-over is quick, (products are sold quickly) the unit will require a smaller amount of capital. For example, a retail stores deals with product which has a large demand and which can be sold as quickly as they are stocked, will need a less working capital. On the other hand, a firm having large inventory and slow turnover will need more amount of working capital. For example, a firm dealing with products having irregular and slow demand will need more working capital.
3. **Terms of Purchase and Sales.** The amount of working capital varies directly with the use of credit. A firm which purchases its requirements on cash will need less working capital than the firm which purchases on credit. Similarly, a firm which sells its products on cash will need less working capital than that selling the products on credit.
4. **Size of the business.** The amount of working capital depends directly upon the volume of business. The bigger the size of firm the larger the amount of working capital required and vice versa.
5. **Seasonal Variations.** Industries producing seasonal goods such as coolers, umbrellas, rain coats, fans etc. require large amount of working capital during the off season when the goods are produced. During the season the goods are sold and less amount of working capital is required.
6. **Importance of labour.** Small scale and cottage industries are labour intensive units and therefore require a large amount of working capital.
7. **Business Cycle.** At the peak of the business cycle, the turnover is quick, the products are sold quickly as they are produced and hence smaller amount of working capital is necessary.
8. **Banking facilities.** If firm has good banking connections, it may have minimum margin of regular working capital over current liabilities.
9. **Nature of Business.** Working capital also depends upon the nature of business. There are certain businesses which require large amount of fixed capital than the working capital e.g. railways, state transport etc. whereas trading companies need more amount of working capital than the fixed capital.

CAPITALISATION

Meaning of Capitalisation. Capitalisation is a process of determining the amount of capital required as well as the capital structure of a company. It is one of the most difficult task for the promoter, since the estimate of capital requirement depends upon many uncertain factors and unforeseen contingencies of a concern (that has not yet started functioning). The total amount of capital raised through long term sources such as shares, bonds, debentures, debt, etc, represents capitalisation. The success or failure of the enterprise depends upon financial planning (amount of capitalisation).

Basis of Capitalisation:

The following methods are generally used to determine the amount of capitalisation of a newly promoted company :

- (a) The cost method.
- (b) The earning method.

The cost method is most commonly used in many project financing cases. In this method, the total capital is estimated by aggregating the cost of fixed assets, permanent working capital, preliminary expenses and other organisation expenses and possible initial losses etc.

In earning methods two factors are taken into consideration:

- i). The expected earnings and
- ii). The fair rate of return for capital invested in the particular enterprise. For example, if the fair rate of return for a particular kind of business is 25 percent and the expected earnings of that business is Rs 2,00,000 ; then the total capitalisation would be Rs. 8,00,000 i.e.

$$\begin{aligned} \text{Total capitalisation} &= \frac{\text{Expected earning}}{\text{Rate of Return}} \times 100 \\ &= \frac{2,00,000}{25} \times 100 = \text{Rs. } 8,00,000 \end{aligned}$$

Over Capitalisation: A firm is said to be over-capitalised when its earnings are not adequate enough to yield a fair return on the amount of stock and shares and bonds issued. In other words, a company is over-capitalised when its actual profits are inadequate to pay the dividends and interest at proper rates.

This state of affairs may occur when the amount of shares, debentures issued is much in excess of actual requirements and the rate of profit, i.e. dividend rate will be too low. This means the funds invested in the concern are not profitably employed and the enterprise cannot pay fair return on its capital investment. However, over capitalisation does not mean excess of capital; in actual practice, an over capitalised concern may face the problem of shortage of funds.

Causes of Over Capitalisation:

- (i) Over estimation of earning capacity.
- (ii) Promotion with inflated assets.
- (iii) Defective depreciation policy.
- (iv) Liberal dividend policy.
- (v) High cost of leverage.
- (vi) High promotion expenses.
- (vii) Excessive taxation policy.

Disadvantages of Over-Capitalisation:

- (i) Over-capitalised company cannot pay good dividends because of poor earnings.

- (ii) The market value of shares will decline and hence it becomes difficult to raise further capital required for extension and improvement.
- (iii) The interest on borrowing will be very high and future borrowing would be very difficult.
- (iv) There will be loss of capital and loss of income to the shareholders, (v) It is a wastage (improper application) of country's resources.
- (v) Due to low profits, welfare facilities and good wages cannot be given to the workers which further increases inefficiency.
- (vi) (vii) Because of the higher rates, poor quality, and low share value the company will have poor reputation in the public.

Remedies of Over - Capitalisation- The over capitalised company should resort to ploughing back of earning and the stock outstanding may be reduced (e.g. redeemable preference shares) par value of stock may be reduced and some adjustment may be made in debt capital.

Under - Capitalisation. Under capitalisation occurs when the earnings of the concern on total capital are exceptionally high in relation to return enjoyed by similarly situated concerns in the same field. It may also occur when the company suffers from shortage of capital to run the business. In other words, the actual capitalisation is lower than proper capitalisation that is warranted by its earning capacity.

Causes of Under Capitalisation :

- (i) Under estimation of earning.
- (ii) Conservative assets management.
- (iii) Underestimation of capital requirements,
- (iv) Conservative dividend policy.
- (v) High level of efficiency and unexpected increase in earnings.
- (vi) Promotion of business during depression, and
- (vii) Trading on their equity.

Effects of Under Capitalisation

- i) Earning per share and, therefore, dividend per share will increase.
- ii) The market value of share will increase.
- iii) Conservative asset management policy will lead to undervaluation of assets and this will result in more secret profits.
- iv) High earnings will tempt the workers to ask for more share in profits.
- v) For removing under capitalisation, capital has to be borrowed at high rates from other sources. The money borrowed at high rate of interest is always a source of trouble as it affects adversely on industrial growth, it tends to increase the price of the product and reduces profit.

Remedies. The under capitalised concerns may issue bonus shares or undertake additional issue of shares and debentures to increase the total capital. The existing shares may be split up and their par value may be increased.

Try to make the purchases on long term credit, and sell the product quickly and collect their money promptly i.e. efforts should be made to increase working capital. Over-capitalisation and under-capitalisation both are harmful to the financial position of an enterprise. While calculating the requirements of long term funds it is therefore essential to see that the capitalisation is fair or an ideal one.

SOURCES OF FINANCE

Business enterprises raise the funds from various sources and invest them in various types of fixed and current assets for the purpose of conducting business operations and earn profits out of them. Each source possesses different types of characteristics in terms of cost and contractual conditions. The fundamental consideration in the financial decision is the 'cost of capital' and that in the investment decision is the 'rate of return on investments'. The profitability of the business operations can be maximised through widening the gap between the cost of capital and the rate of return i.e. the cost of capital should be minimized and the rate of return should be maximised.

Classification of Sources of Finance:

On the basis of periodicity i.e., the time limit within which the funds can be used in the business ; the sources of finance can be classified as:

- i) Long term finance/funds
- ii) Short term finance, and
- (iii) Medium term finance.

Long term funds. The funds which are raised for more than ten years are called as long-term funds. They are required to finance the fixed assets like land, building, machinery, equipments etc. The important characteristics of long term funds are :

- (i) The investments of these funds more or less of a permanent nature.
- (ii) These funds consist of owner's contribution in the form of equity shares and supplemented by the long-term borrowings in the form of debentures or long term loans
- (iii) The industries employing sophisticated technology would need more long term funds, while trading business would require less amount of long term funds.
- (iv) The degree of business risk tends to be higher in the investment of long-term funds.

Short term funds. Short term funds are required to meet the working capital needs like investment in inventories debtors bank balance, cash on hand, marketable securities etc. The financial needs which are required upto one year are treated as short-term funds.

Characteristics of Short Term Funds are

- (i) These are required for short term period i. e. upto one year.
- (ii) Short term funds are required to meet the day-to-day requirements of the business.
- (iii) They are required to finance the working capital needs.
- (iii) Short term funds enjoy greater degree of liquidity as compared to long term funds.
- (v) The relative proportion of short term funds varies from industry to industry and from time to time. In trading companies, the need of short-term funds will be greater as compared to manufacturing industries.

Medium term fund: The funds which are raised for more than one year and employed in the business for ten year, are usually treated as medium term finance. However, there is no perfect line of demarcation between various categories of funds.

Raising of Finance: The small scale industries have little problems of finance as compared to large scale industries. The individual investment is the main source of finance for small scale industries (individual ownership and partnership enterprises). The large scale industries are mainly run by joint stock companies and they feel large problems of financing. The main sources of finance are follows;

Source of Finance for Fixed Capital

- | | |
|-------------------------|--------------------------------------|
| 1. Shares | 2. Debentures |
| 3. Public Deposits | 4. Loans from Financial Institutions |
| 5. Managing Agents etc. | |

Source of Finance for Working Capital

Working capitals is financed for

A. Regular works, through

1. Shares
2. Debentures
3. Ploughing back of earning

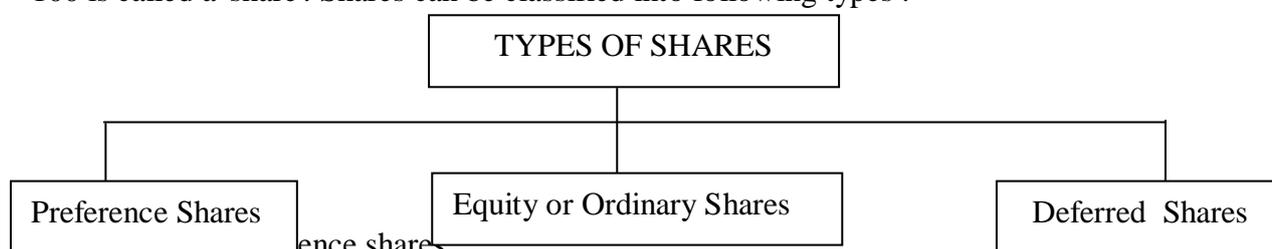
B. Seasonal working capital, through

4. Loan from Banks
5. Managing Agents
6. Public deposits
7. Financial Institutions

SHARES

A big amount of funds can be collected by selling shares to the public. Shares are issued for raising funds either when starting a business or when it is decided to expand or improve the existing business. The shareholders are paid dividend every year depending upon the performance of the industry.

Share is a basic form in which a company can raise finance from own sources. A share in a company is one of the units into which the total requirement of capital is divided. If the requirement of the capital is Rs 10,00,000, and it is divided into 10,000 units, each unit of Rs. 100 is called a 'share'. Shares can be classified into following types :



2. Non-cumulative
3. Participating
4. Redeemable
5. Convertible.

Fig. 11.2. Types of shares

Preference Shares:

Preference shares are those which carry a preference in regard to:

- (i) Payment of dividend so long as the company is in existence, and
- (ii) Return of capital in case of winding up of the business

The preference shares as the name implies have the right to be paid first before paying any dividend on other shares. The rate of dividend on preference shares is fixed.

Characteristics of preference shares:

- i) They are the part of ownership funds and so they do not put any restrictions on the use of funds like debentures or term loans.
- ii) They enjoy preference in getting dividends.
- iii) The rate of dividend is fixed at the time of issue.
- iv) Generally the preference shares do not enjoy voice in the management of the company except in the matters affecting their interest.
- v) The dividends on preference shares is paid out of the profits of the company.

Types of Preference Shares.

1. Cumulative preference shares. In case of these shares, the shareholders are entitled to receive a fixed dividend even for the years when there is no profit. The dividend on these shares gets accumulated for the years in which they have been paid. The accumulated arrears of the dividends are paid in the-subsequent years when the company gets enough profit to pay them before the dividends are paid to equity shareholders.

2. Non-cumulative shares. In this case the shareholders will get dividend only for the years when the company has made enough profit to pay them. In case of these shares the arrears of dividend do not accumulate. The dividends are lapsed in lean years

3. Participating; preference shares. In case of participating preference shares, they get the dividend at the fixed prescribed rate But in addition to the same, they have a right to participate in the excess profit of the company as well with the equity shareholders. These types of preference shareholders can also participate in the excess assets of the company in case of winding up. In case of non-participating preference shares, they cannot have a claim in the excess profits or excess assets of the companys. It should be noted that according lo the control of capital issues, the participating preference shares are not permitted to be issued in India.

4. Convertible preference shares. The convertible preference shareholders are granted an option to convert their preference shares into equity shares according to the terms of the issue. In case of non-convertible preference shareholders, they do not enjoy a right to convert their preference shares into equity shares.

5. Redeemable preference shares. In case of redeemable preference shares, these shares can be repaid by the company during its lifetime, as per the terms of issue, either after a specified period is over or whenever the company so chooses alter giving proper notice. In case of non-redeemable preference shares, these shares can he repaid only on the winding up of the company.

It should he noted that preference shares have never remained a popular form of security in Indian capital market. The main reasons are that they possess the income weakness of creditor ship securities without the safety of returns and the risk of ownership securities without sharing the fortune in case of large earnings.

Equity Shares (Ordinary Shares)

The equity share capital represents the backbone of company's financial structure. The word equity means the ownership interest of shareholders as measured by capital and reserves. An equity shareholder is the absolute owner of the company. Ho can share in the profit earned by the company (in the form of dividend) and also in the residual assets of the company.

The dividend on equity shares is paid only after the payment of fixed dividend on preference shares. There is no limit of dividend in case of ordinary shares. They may get very high dividend in prosperous years of the company. It there is a loss then equity shareholders do not get any dividend. The fortune of the equity shareholders is tied up with the success of the company. If the company fails, they are greatest losers in the deal. Conversely, if it succeeds, they are sharing windfall profits. They provide the permanent funds in the business. They are not permitted to withdraw their equity capital during the existence of the company. they participate management of the company through their voting rights.

Characteristics of Equity Shares:

1. Permanent capital. Equity shares provide the permanent capital to the company. It is not repayable during the lifetime of the company hut only on winding up. However, statutory right has been given to the equity shareholders to transfer the shares to another person.

2. Dividend. The equity shareholders get dividend only after the payment of dividend is made to preference shareholders. Even though, the company has sufficient income, it is not obligatory for it to pay the dividend to the equity shareholders.

3. Claims on assets. Equity shareholders can have the claim on the assets of the company in the event of winding up but only after the claims of all the creditors and preference shareholders are settled.

4. Control. Equity shareholder enjoys supreme control on the operations of the company through voting powers. The voting right of the shareholder is in proportion to his share in the capital of the company.

5. Pre-emptive rights. Equity shareholders cannot compel the company to pay the dividend but they enjoy the right to maintain proportionate interest in profits, assets and control of the company. As such, if the company wants to issue new equity shares, it is under legal obligation to offer these shares to the existing shareholders first, before going to the open market. This right of the equity shareholders is called 'Preemptive right'.

6. Value of shares. The value of equity share changes according to the present and prospective earning of the company. The value of the equity share is reflected in the prevailing market price of the equity shares at the stock exchange.

Deferred Shares. As the name suggests these shares have their claim to get dividend last of all. They are few in numbers. These shares are issued to founders or promoters of the company.

Dividend on deferred shares is paid in the last, i.e. first of all dividend on preference shares is paid then comes the turn of ordinary shares to get the dividend. Whatever is left of the total profit after preference shareholders and ordinary shareholders have been paid is distributed among the deferred shareholders. Generally these shareholders may get lion's share of the profits.

DEBENTURES

A debenture is a loan to the company at fixed rate of interest, like shares, the company invites the members of the public, to buy debentures. The terms and conditions of issue of debentures are written on the back of the document, unlike shareholders the debenture holders do not take any risk. Profit or no-profit, they must get their interest. They are the creditors of the company. Debenture holders cannot claim the ownership and they are to be paid interest only. The debentures are redeemable after a fixed time which may be five years or more.

Debenture financing is cheap as compared to equity and preference shares. However, they cannot be raised indiscriminantly. They can be issued within the prescribed limits of debt-equity ratio. The interest is paid to the debenture holders at a fixed rate and at fixed intervals and that too before any dividend is paid to shareholders. At the time of winding up of the company, the claims of debenture holders are paid in full before any amount is paid to shareholders.

Kinds of debentures. The various kinds of debentures which a company can issue as follows:

(1) Registered Vs. Bearer Debentures. The names of registered debenture holders are registered with the company. The interest is paid to the registered debenture holders. Such debentures can be transferred to another person only through the company.

The names of the bearer debenture holders are not registered with the company. They can be freely transferred to any body. Generally, the interest coupons are attached to the debenture certificates which are lodged with the company for the claim, of debenture

(2) Secured Vs. Unsecured. Secured debentures, are also called as mortgage debentures. Secured debenture is those which are secured by some charge on the assets of the company. They are empowered to sell such assets for the recovery of their claims in case any default is made by the issuing company.

The unsecured or simple debenture are not secured by any charge on the assets of company. However, their claim is settled before any payments are made to preference and equity shareholders.

(3) Redeemable Vs. Non-redeemable. Redeemable debentures are redeemed at the end of certain stipulated period say 10 or 12 years. The non-redeemable debentures are not redeemable during the existence of the company. This, like equity shares, they provide the permanent finance. As per the controls on capital issue, such debentures are not issued in India.

(4) Convertible Vs. Non-convertible Debentures. As the name suggests, convertible debentures can be converted into equity shares at the option of the debenture-holder as per the conditions of the issue. The time of conversion, conversion price and the proportion of the conversion are stipulated at the time of issue.

Nowadays convertible debentures and convertible bonds have become a popular security in India. Non-convertible debenture holders do not enjoy the right to convert their debentures into equity shares.

Characteristics of Debentures:

- (i) The debenture holders receive interest at a fixed rate. They hold a priority of claim over that of shareholders.
- (ii) Profit or no-profit the debenture holders must receive their interest. In case of non-payment of the interest due to them, they can take legal action as the company is under contractual obligation to pay the same.
- (iii) The debenture holders are the creditors and in case of winding up of the company, they hold priority of claim to assets over that of shareholders.
- (iv) They do not enjoy the control over the affairs of the company. They do not have voting power. However, in the event of non-payment of interest or principle amount, they can interfere in the working of the company by taking a legal action.
- (v) The face value of debenture is higher as compared to equity shares.
- (vi) It is a cheaper source of fund: ts compared to other sources.
- (vii) The interest paid on debenture is considered as the deductible business expense for tax purposes.

DIFFERENCE BETWEEN PREFERENCE SHARES AND EQUITY SHARES

1. They have first claim to get dividend.	1. Equity shares have second claim to receive dividend.
2. They get fixed dividend per annum.	2. The dividend paid on equity shares is variable, it depends upon profit earned.
3. Preference shareholders do not have Voting right.	3. They enjoy voting right.
4. The face value of each share is relatively high say Rs. 100.	4. The face value is relatively low say Rs. 10.00.
5. Redeemable after fixed period.	5. Ir-redeemable represents permanent capital.
6. Small risk of investing	6. Relatively high risk of investing.

DIFFERENCE BETWEEN DEBENTURES AND SHARES

Debentures	Shares
<ol style="list-style-type: none"> 1. A debenture holder is a creditor only and has no control over the affairs of the Company. 2. A fixed rate of interest is paid on debentures. 3. Interest is paid whether the company runs in profit or loss. 4. A debenture holder gets his money back after the stated number of years. 5. A debenture holder does not enjoy any right of voting. 6. Debentures can be issued at a discount without any legal restriction. 7. In the event of liquidation of the company, a debenture holder will get his money before the share holder gets something 	<ol style="list-style-type: none"> 1. A shareholder is an owner of the company i.e. he has ownership interest in the company 2. Dividend is paid on shares out of the profit 3. It is based upon the type of share whether the annual dividend is paid or not (depending upon profit/loss incurred by the company). 4. Money of the shareholder is not refunded to him by the company. 5. While equity shareholders are allowed to vote and attend company's meeting 6. While shares can be so issued only subject to certain conditions as laid down in section 79 of the Companies Act.

Cost Accounting and Control

COST ESTIMATING

Cost estimating may be defined as the process of determining the probable cost of the product before the start of its manufacture.

Cost estimation takes into consideration all expenditures involved in design and manufacturing, with all related service facilities such as pattern making, tool making as well as a portion of the general administrative and selling expenses.

Cost estimating involves the knowledge of following factors for calculating the probable cost of the product :

- (i) Design time.
- (ii) Amount of material required.
- (iii) Cost of material required.
- (iv) Production lime required,
- (v) Labour charges.
- (vi) Cost of machinery, overheads and other expenses.
- (vii) Use of previous estimates of comparable parts etc.
- (viii) Probable future changes in unit prices for materials, labour or expenses when the proposed product is manufactured at a future date.

(ix) Effect of volume of production on costing rates.

(x) Effect of changes in facilities on costing rates.

Objective of Estimating:

The main objectives of estimating are :

(i) To establish the selling price of a product for a quotation or contract, so as to ensure reasonable profit to the company.

(ii) To ascertain whether the proposed product can be manufactured and marketed profitably.

(iii) To determine whether the part or assembly can be manufactured economically in the plant itself or to be purchased from outside (Make or Buy decision).

(iv) To determine the most economical process, tooling or material to manufacture the product.

(v) To establish the standard of performance that may be used to control costs.

(vi) To prepare production budget.

(vii) To evaluate alternate designs of product.

(viii) Initiate means of cost reduction in existing production facilities by using new materials which result in saving due to lower scrap, losses and which create saving due to revisions in methods of tooling, and processing.

(ix) To determine standard cost which represents the best estimate that can be made of what cost should be for material, labour and overhead after eliminating inefficiencies and waste.

ELEMENTS OF COST

The total cost of manufacturing produce consists of :

1. Cost of material
2. Cost of labour.
3. Expenses.

Cost of Material

It is the cost of materials required for the manufacturing of the product. It consists of :

- a) Cost of direct materials.
- b) Cost of indirect materials.

Cost of direct materials

It is the cost, of materials which are processed through various stages to form the main product or a component part of the product. The cost of direct materials includes the purchase as well as incidental charges (expenses) such as freight, insurance loading expenses, octroi, import duties etc. Example: m.s. bar used to manufacture spindles. High speed steel used to manufacture cutter, C.I. used to manufacture pulleys etc.

Cost of indirect materials :

It is the cost of materials which are essentially needed in various shops for helping the direct materials to be converted into finished product.

The examples of indirect materials are grease, lubricating oil used to lubricate the equipments; coolants used to cool the job and the tool, cotton waste and kerosene used for cleaning equipments, screws, nails etc.

Cost of Labour:

- (a) Cost of direct labour.
- (b) Cost of indirect labour.

Cost of direct labour:

Direct labour cost consists of wages paid to the workers directly engaged in the manufacturing of the product. It also includes the wages paid to the workers engaged in handling the product inside the department. Examples: wages paid to the machinist, turner, and black smith welder, moulder etc.

Cost of indirect labour:

The wages paid to the labour who helps the productive labour in performing their duties is known as indirect labour cost. It cannot be charged directly to a particular job, but are charged on the number of products produced in the plant during a particular period.

Examples. Wages paid to the supervisor, inspector, time keeper, sweeper, watchmen, and helper etc.

Expenses:

Apart from the direct material cost and direct labour cost in each factory there are several other expenditures, which are known as expenses. The cost of indirect materials and indirect labour is also included in the expenses. Expenses can be classified as:

1. Direct Expenses.
2. Indirect Expenses (Overhead costs.)

Direct expenses are those which can be charged directly to a particular job and are done for that specific job only.

Examples:

1. Cost of preparing designs, drawings for the manufacture of a particular product.
2. Cost of experimental work done specifically for a particular product.
3. Cost of procuring or manufacturing special types of jigs and fixtures for the manufacture of a particular product.
4. Cost of special type of patterns, moulding flasks, dies etc.
5. Cost of hiring special tools or equipments for particular product.
6. Cost of consultancy charges for design and manufacture of a specific product.

Indirect expenses:

Indirect expenses are those which cannot be charged directly to a particular product manufactured. All expenses other than the direct material cost, direct labour cost and direct expenses are indirect expenses.

These expenses are also called as overhead costs or on costs.

Indirect expenses or overheads are classified into four groups :

1. Factory expenses.
2. Administrative expenses.
3. Selling expenses.
4. Distribution expenses.

Factory Expenses:

It includes all indirect expenses which are incurred in connection with manufacture of the products, right from the receipt of the work order till it is completed and ready for dispatch.

Examples:

1. Expenses incurred on indirect materials like lubricating oils, grease, coolants, cotton waste, polishing materials etc.
2. Expenses incurred on indirect labour, i.e. salaries of supervisors, inspectors, sweepers, watchman, time-keeper, helper etc.
3. Expenses incurred on labour welfare activities.
4. Cost of fuel and power, internal transport etc.
5. Expenses incurred on repairs and maintenance of plant and machinery etc.

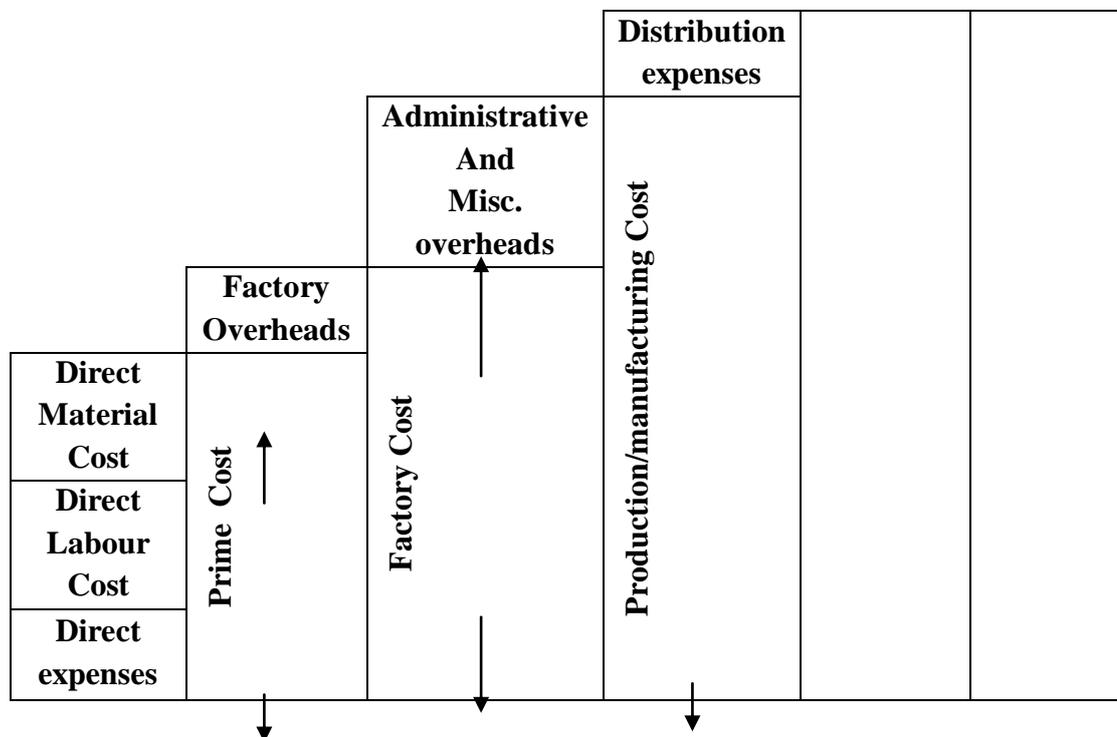


Fig.No 13.1 Ladder of cost (Development of selling price of a product).

NATURE OF COSTS

(1) **Fixed Costs.** Fixed costs are those which tend to remain constant irrespective of the volume of production. These costs are not affected whether the production is large, smaller or standstill.

Examples of fixed costs are:

- Salaries of higher officers
- Administrative expenses
- Rent and establishment charges
- Depreciation of plant, building and equipment.

(2) **Variable Costs.** Variable costs are those which vary directly with the quantity produced. Prime cost is also called as variable cost. Since, it is clear that if more things are to be produced, more raw material, more direct labour and more direct expenses will be required. Variable costs are the functions of output. Higher the output, larger the variable cost. These become zero when the production is suspended.

TYPES OF COSTS

1) **Pre-determined Cost.** Pre-determined cost is that cost which is computed in advance production on the basis of specification of all the factors affecting cost. It is the estimated cost before the actual production is started.

Standard cost. Standard cost is a pre-determined or budgeted cost which is calculated from management's standards of efficient operation and relevant necessary expenditure. Standard costs are built upon theoretical desired standard that is capable of attainment under practical operations. The standard should neither be unattainable nor should be that which can be without any effort.

The standard are decided by using past experience and by taking the help of experiments or previous fixed norms (e.g. using Time Study or by adopting standard data work study).

Standard cost represents the estimate that can be made of what cost should be for material, labour, and overheads after eliminating inefficiencies and waste. The actual cost is compared with standard cost and the discrepancies or deviations if any are found out and if the actual cost is more than standard cost corrective measures are taken to reduce the cost of production

Advantages of standard cost;

- i) It provides a check on various expenses and serves as a tool for cost control.
- ii) It detects if there is a wastage of material, labour etc.
- iii) It helps in budgetary control.
- iv) It helps in price determination.
- v) It is a measure for arriving at efficiency of the entire organization.

Marginal costs. These represent the increase or decrease in the costs variation in the number of units in a given volume of production. These are helpful to management in deciding the profitable volume of production or a minimum volume of production which will not yield any loss.

Differential Costs. These are useful in estimating the effects of changes in sales volume upon profits and deciding whether to purchase or manufacturing certain items (make or buy). These can be expressed as the ratio of a small change in the production cost due to small change in the volume of production.

If it is assumed that fixed that costs remain unchanged by increasing or decrease the output, the marginal cost and differential cost will consist of variable costs only.

Controllable and Un – controllable Costs. The costs which are influenced by the action of a given member of an enterprise are called controllable costs, which the costs which are not influenced are the uncontrollable costs.

Sunk Cost. The proportions of the undepreciated balance those cannot be recovered are known as “sunk costs”

Break-Even Analysis

ASSUMPTIONS IN BREAK-EVEN ANALYSIS

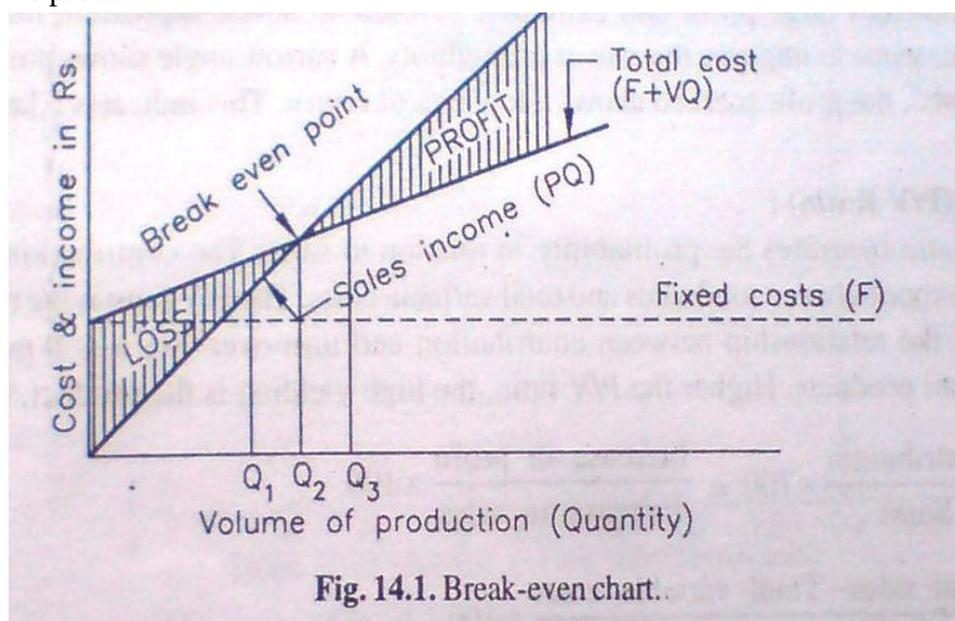
The following assumptions are made while plotting a break-even chart :

1. The total cost of production can be divided into two categories— (a) Fixed cost, (b) Variable cost.
2. Fixed cost remains constant i.e. it is independent of the quantity produced and includes executive salaries, rent of building, depreciation of plant and equipment etc.
3. The variable cost varies directly and proportionately with the volume of production. If V = Variable cost per unit and Q is the quantity produced, variable cost = $V \times Q$.
4. The selling price does not change with change in the volume of sales. If P is the selling price per unit. The total sales income = $P \times Q$.
5. The firm deals with only one product, or the sales mix remains unchanged.
6. There is a perfect synchronization between production and sales. This assumes that everything produced is sold and there is no change in the inventory of finished goods.
7. Productivity per worker and efficiency of plant, etc., remains mostly unchanged.

Any change in any one of the above factors will affect the break even point and the profits will be affected by factors other than volume. Hence, the result of the break-even analysis should be interpreted subject to the limitations of the above assumptions.

PLOTTING THE BREAK-EVEN CHART

1. The cost and the sales income (revenue) in rupees are plotted along the vertical axis
2. The quantity (volume of production) is plotted along the horizontal axis
3. Fixed cost is represented by a straight line parallel to the horizontal axis
4. The variable costs are superimposed upon the horizontal line representing the fixed cost. This top line then represents the total cost line.'
5. The sales income line passes through the origin.
6. The point of intersection of the sales income line and the total cost line represents the break even point.
7. The shaded area between the total cost line and the sales income line on the left hand side of B E P. indicates loss; whereas the shaded area on the right hand side of B.E.P. shows profit.



Break-even point:

The point of intersection of the total cost line and the income line is called as the break-even point. The break-even point is that junction where income and costs are exactly in balance. Thus there is neither profit nor loss for that particular volume of production. Break-even point indicates minimum operating level below which it is dangerous to fall. As the performance reaches towards this non-profit point, corrective measures should be taken to cut down the cost, (increase output or raise selling price.) The spread to the right of BEP shows the profit potential while to the left represents the loss potential BEP is also called as the "no-profit-no-loss point."

Margin of Safety:

Margin of safety is the distance between the break-even point and the output being produced.

A large margin of safety indicates that the business can earn profit even if there is a great reduction in output. If the margin of safety is relatively small then it indicates that the profit will be considerably small even if there is a small drop in output. A low margin of safety level indicates high fixed costs and profits are not possible unless the output level is sufficient enough to absorb fixed costs.

Margin of safety is generally expressed as :

- (a) Ratio of budgeted sales to sales at BEP.

- (b) Ratio of actual sales to sales at BEP.
- (c) Percentage of budget to BEP.
- (d) Percentage of budget to actual sales at BEP.
- (e) Percentage of the difference between actual sales and break-even sales to budgeted sales.

In case unsatisfactory margin of safety the following measures should be taken:

- a. Increase in the sale price.
- b. Reduction in fixed costs.
- c. Reduction in variable costs.
- d. Stop production of non-profitable items and pay more attention towards profitable items.

Mathematically

$$\begin{aligned} \text{Margin of Safety} &= \frac{\text{Sales} - \text{Sales at BEP}}{\text{Sales}} \times 100 - \\ &= \frac{\text{Profit} \times \text{Sales}}{\text{Sales} - \text{Variable cost}} \end{aligned}$$

Angle of Incidence:

The angle between the sales income line and the total cost line is called as angle of incidence. A large of incidence indicates large profit and extremely favorable business position management aims to widen the angle of incidence to improve the rate of profitability. A narrow angle shows that even though fixed overheads are recovered, the profit accrued shows a low rate of return. This indicates a large part of variable cost in total cost.

Profit Volume (P/V Ratio) :

Profit volume ratio measures the profitability in relation to sales. The contribution at given output is defined to be the difference between total sales and total variable costs. The P/V ratio is the ratio of contribution sales. It represents the relationship between contribution and turn-over. So, it is a measure to compare profitability of different products. Higher the P/V ratio, the high yielding is the product. Mathematically,

$$\begin{aligned} \text{PV ratio} &= \frac{\text{Contribution}}{\text{Sales}} \times 100 = \frac{\text{increase in profit}}{\text{Increase in sales}} \times 100 \\ &= \frac{\text{Total sales} - \text{Total variable cost}}{\text{Total sales}} \times 100 \\ &= \frac{S - V}{S} = 100 \\ \text{Or} &= \frac{\text{Fixed cost} + \text{Profit}}{\text{Sales}} = 100 \\ &= \frac{\text{Price per unit} - \text{Cost per unit}}{\text{price per unit}} \end{aligned}$$

Uses of P/V ratio. The P/V ratio can be used to study a variety of problems viz :

- (i) determination of B.E.P.
- (ii) to know profit for given sales volume.
- (iii) to know sales volume for achieving some desired profit.

P/V ratio can be increased by:

- (a) Increasing the selling price.
- (b) Changing the mix of sales.
- (c) Reduction in variable costs.

DEMONSTRATION OF BREAK-EVEN CHART

The break-even chart can be demonstrated by the following example.

Sales at Rs. 10/unit	5000	10000	15000	20000
Fixed cost (Rs.)	60000	60000	60000	60000
Variable costs	- Rs. 6 per unit			

The data can be shown graphically as follows:

Fig . 14.2 Break-even chart

Fig, 14.3 Effect of increase or decrease in fixed cost on B.E.F

MANAGERIAL USES OF BREAK-EVEN CHART

Management can employ break-even chart to project the cost and income picture under various anticipated future conditions and for alternative business programmes.

Hence, the chart is useful to the management.

1. To show the relative importance of different classes of costs, how they vary with volume of production, and how they may be controlled.
2. To show the impact of changes in sales volume on profits.
3. To predict the effect of price and cost changes on the break-even point.
4. To show the gain needed in sales volume (or productivity) to maintain profits when prices or costs change in a specific way e.g. when price decline but wages and cost of material do not.
5. To select the proper size plant or to predict the effect of changes in plant size or modernization of plant on the break even point. Therefore through break-even chart management can estimate what of investment in plant capacity is economically justified for the projected volume of sales.
6. To compare the profitability of two or more firms.

LIMITATIONS OF BREAK-EVEN CHART ANALYSIS

1. In practice all the costs are not always either fixed costs or variable costs. There are some semi-variable overhead costs,
2. In the long run all costs are variable, so the break-even analysis holds good only for short run requirements.

3. Break even analysis assumes, that profits are a function of output ignoring the fact that they are also affected by technological changes, improved management, improvement in quality, versatility etc.
4. It is suitable only when the firm produces one type of product.

CALCULATION OF BREAK-EVEN POINT

The break-even point can be calculated in terms of physical units and in terms of sales turnover.

(1) In terms of Physical units:

The number of units produced (volume of production) to achieve the break even point can be calculated by the formula

$$\text{B.E.F.} = \frac{F}{SP - VC} \text{ or } \frac{FC}{C}$$

Where, FC = Fixed cost

VC = Variable cost per unit

SP = Sales price per unit

C = Contribution per unit (C = SP - VC)

Example: if

Total fixed Cost = Rs. 20,000 = FC

Unit variable cost = Rs. 4 = VC

Unit sales price = Rs. 8 = SP

$$\text{Then B.E.P.} = \frac{20,000}{8 - 4} = 5,000 \text{ Units.}$$

(ii) In terms of rupees of sales revenue

$$\text{B.E.P.} = \frac{FC \times SP}{SP - VC} = \frac{FC}{1 - \frac{VC}{SP}} \text{ Rs.}$$

$$= 8 \times \frac{20,000}{8 - 4} = 40,000 \text{ FC x SP}$$

iii) If a banker proves term loan to an industrial unit, the formula for B.E.P from banker's point of view may be as follows :

$$\text{B.E.F.} = \frac{\text{Fixed cost} - \text{Depreciation} + \text{Annual instalment of term loan}}{\text{Sales price per unit} - \text{Variable cost per unit}}$$

Calculation of safety margin

$$\text{Safety Margin} = \frac{(\text{Sales} - \text{Sales at B.E.P.}) \times 100}{\text{Sales}} = \frac{\text{Profit} \times \text{Sales}}{\text{Sales} - \text{Variable cost}}$$

$$= \frac{(1500 - 1000)}{1500} \times 100 = 33.33\%$$

The banker can estimate the repayment capacity of the concern through the comparison of projected marketing conditions of the firm with the volume of sales needed to attain target profit. Break-even analysis may be utilized to determine the volume of sales needed to achieve target profit.

$$\text{Target Sales volume} = \frac{\text{Fixed cost} + \text{Target profit}}{\text{Contribution margin per unit}}$$

Example: With the following information calculate the target sales for Rs. 6,000 profit.

Fixed overheads - Rs. 30,000

Selling price/unit - Rs 100

Variable overheads - Rs. 40

$$\begin{aligned} \text{Target Sales volume} &= \frac{\text{Fixed cost} + \text{Target profit}}{\text{Contribution margin per unit}} \\ &= \frac{30,000 + 6000}{100 - 40} = \frac{36000}{60} \\ &= 600 \text{ units} \end{aligned}$$

Sales of at least 600 units to accomplish the target profit.

SOLVED EXAMPLES

1. Following details are available

	Sales	Profit	Rs.	Rs.
Period I	2,00,000	20,000		
Period II	3,00,000			40,000

Find out break-even sales; and P/V ratio.

Solution.

$$\begin{aligned} \text{Now, we know that P/V ratio} &= \frac{\text{Increase in profit}}{\text{Increase in sales}} \times 100 \\ &= \frac{40,000 - 20,000}{3,00,000 - 2,00,000} \times 100 = 20\% \end{aligned}$$

$$\text{Margin of safety} = \frac{\text{Profit}}{\text{P/V ratio}}$$

$$\text{For period I, Margin of safety} = \frac{20000}{20\%} = 1,00,000$$

Break-even sales – Margin of safety

$$\begin{aligned} \text{Considering period I Break Sales} &= 2,00,000 - 1,00,000 \\ &= 1,00,000 \text{ units} \end{aligned}$$

2. The following figures relates to a small manufacturing company :

Sales (Rs)	6,00,000
Variable cost (Rs.)	4,50,000

Fixed cost (Rs.) 45,000
 Calculate (i) B.E.P. (ii) P/V ratio

Solution.

$$\begin{aligned} \text{Now (i) P/V ratio} &= \frac{S - V}{S} \times 100 = \frac{6,00,000 - 450,000}{6,00,000} \times 100 \\ &= \frac{150,000}{6,00,000} \times 100 = 25\% \\ \text{ii) B.E.P.} &= \frac{\text{Fixed Costs}}{\text{P/V Ratio}} = \frac{4,50,000}{0.25} = 1,80,000 \end{aligned}$$

3. A factory, producing only one item, which it sells for Rs. 12.50 per unit has a fixed cost equal to Rs. 60,000 and variable cost Rs. 7.50 per unit.

Find out : (i) The number of units to be produced to break even.

(ii) No. of units to be produced to earn a profit of Rs. 12,000

(iii) The profit, if 25,000 units are produced and sold.

Solution. New, FC = Rs. 60,000

SP = Rs. 12.50

VC = Rs. 7.50

$$\text{i) B.E.P.} = \frac{Fc}{Sp - Vc} = \frac{60,000}{12.50 - 7.50} = 12,000 \text{ units}$$

ii) Let, q be the number of units produced for a profit of Rs. 12,000. Then total sales income (Revenue) = price / Unit $\times q = 12.50$

Total cost = Fixed cost + (Variable cost/unit) \times Output
 $= 60,000 + 7.50 \times q$

Profit = Sales income - Total cost

$$12,000 = 12.50q - 60,000 - 7.50 \times q$$

i.e. $72,000 = 5 \times q$ or $q = 14,400$ units

iii) Profit = Sales income - Total cost

$$\begin{aligned} &= 12.50 \times 25,000 - (60,000 + 7.50 \times 25,000) \\ &= 25,000 (12.50 - 7.50) - 60,000 \\ &= 125,000 - 60,000 \\ &= \text{Rs. } 65,000 \end{aligned}$$

4. Following details are available :

Actual sales = Rs. 30,000

Break-even sales = Rs. 15,000

Fixed cost = 6,000

Find out the profit at actual sales.

'Solution.

At BEF contribution = Fixed cost

$$\text{New, P/V ratio} = \frac{\text{Contribution}}{\text{sales}} \times 100 = \frac{6,000}{15,000} \times 100 = 40\%$$

At actual sales of Rs. 30,000

$$\text{P/V ratio} = \frac{\text{Contribution}}{\text{sales}}$$

$$40\% = \frac{\text{Contribution}}{30,000}$$

i.e. contribution = 30,000 x 40% = Rs 12,000

we know that contribution- Fixed cost = profit

Thus, profit = 12000 – 6,000 = Rs. 6,000.

5. The following figures relate to a small manufacturing concern:

Sales = Rs 50, 00, 000

P/V Ratio= 50%

Margin of safety =40 %

Find out the B.E.P. and Profit

$$\text{Solution. B.E.P} = \text{Rs } 50, 00,000 - \text{Rs. } 50,00 000 \times \frac{40}{100}$$

$$= \text{Rs. } 30, 00, 000$$

We know that,

$$\text{Margin of safety} = \frac{\text{profit}}{\text{P/V Ratio}}$$

$$\text{i.e. } 20, 00, 000 = \frac{\text{profit}}{50\%}$$

Therefore, profit = 20,00, 000 x 50%

$$= \text{Rs. } 10, 00, 000$$

6. The fixed costs for the year 1984 -85 are Rs. 1,00,000. The estimated sales are Rs. 3, 00,000. The variable cost per unit for the single product made is Rs. 5.00. If each unit sells at Rs. 30 and the number of units involved coincides with the expected volume of output, construct the break-even chart:

i) Determine B.E.P.

ii) Determine the profit at a turn-over of Rs. 1, 80,000.

iii) Find the margin of safety.

iv) Measure the angle of incidence.

Solution. Sales income = 3, 00,000

Fixed cost = Rs. 1, 00,000

Variable cost = Rs. 5

Selling price/unit = Rs. 30

$$\text{Number of units sold} = \frac{3,00,000}{30} = 10,000$$

Procedure to plot break-even chart

1. Draw the fixed cost line AB at Rs. 1, 00,000 on the graph paper (take suitable scale).

2. Variable cost = No. of units X Variable Cost per unit = 10,000 X 5 = Rs. 50,000.

3. Draw variable cost line (AC) above fixed cost line total cost = Fixed cost + Variable cost.

4. Sales income is zero at 0 units and it is Rs. 3, 00,000 at 10,000 units. Hence, draw the sales income line (OD) passing through these two points.

Fig. 14.6.

i) The B.E.P. is represented by point E = 4600 units or Rs. 4600 X 30 = Rs. 1, 38,000.

ii) The company should produce and sell more than 4600 units to seek profit.

iii) No. of units sold at a turn-over of Rs. 1, 80,000 = 1, 80,000/30 = 6,000.

Profit earned is as shown in graph = Rs.

iv) The margin of safety at 10,000 units has been marked in the graph and it is equal to Total sales - Sales at B.E.P.

= Rs. 3, 00,000 - 1, 38,000

= Rs. 1, 62,000.

$$\text{Margin of Safety in percentage} = \frac{\text{Margin of Safety}}{\text{Total Sales}} \times 100 = \frac{1,62,000}{3,00,000} \times 100 = 54\%$$

7. The fixed costs for the years 1 987-90 are Rs. 8,00,000, variable cost per unit is Rs. 30.

The estimated sales for the period are valued at Rs. 24, 00,000. Each unit sells at Rs. 180.

Determine :

(i) B.E.P.

(ii) Rs. 1 8,00,000 will be the likely sales turn-over for the next budget period, calculate the estimated contribution and profit.

(iii) If a profit target of Rs. 9, 50,000 has been budget, compute the turn-over required.

Solution.

$$\text{B.E.P.} = \frac{FP}{1 - \frac{VP}{SP}} = \frac{800,000}{1 - \frac{30}{180}} = \text{Rs. } 960,000$$

$$(iii) \quad \text{Sales} = \frac{FC + \text{Profit}}{1 - \frac{VP}{SP}} = \frac{800,000}{1 - \frac{30}{180}} = \text{Profit}$$

$$18,00,000 = \frac{800,000 + \text{Profit}}{\frac{5}{6}}$$

$$\text{Sales} = \frac{\text{Fixed cost} + \text{Profit}}{1 - V/S}$$

$$= 8 \frac{800,000 + 950,000}{1 - 1/6} = \text{Rs. } 21,00,000$$

UNIT – V

MARKETING MANAGEMENT

INTRODUCTION

Marketing has become such an integral part of life that we cannot imagine even a day without experiencing the process or the product of marketing. The marketing process has become a vital ingredient to success in business organizations. Marketing is indeed an ancient art, it has been practiced in one form or the other since the days of Adam and Eve. Its emergence as a management discipline, however, is of relatively recent origin. It has gained a great deal of importance within this relatively short period and today, most management thinkers and practitioners all over world, regard as the most important of all management functions of any business.

EVOLUTION OF MARKETING

The evolution of marketing took place in the following main stages:

1. The stage of Economic self-sufficiency.
2. The Barter system.
3. Money system.
4. The stage of early capitalism.
5. Industrial revolution.
6. The emergence of marketing.

In the earliest stage of economic development there were small family units carrying out all the work to satisfy their limited needs for foods, clothing and shelter. There was no exchange at all.

Soon it was realised that some people are able to turn out certain goods quickly than others. This led to economic specialization. Gradually not only individuals but the whole tribes and communities turned to specialization. The family or tribe engaged in a particular trade and entered into bartering relationship with others for the goods it did not produce. Those who were in possession of surplus bartered (exchanged) their goods which they did not produce themselves.

The economic goods exchanged under barter system created certain difficulties. They were not always of equal values. The various difficulties of barter system were the common measure of value, double coincidence, difficulties of storage and carrying goods from place to place in search of interested parties. The solution came through the development of a common medium of exchange in the form of money, pricing became the mechanism of exchange process.

The next stage was the capitalism. The early capitalists organized workers into productive units and sought markets to trade their output. A merchant class arose which facilitated the distribution of goods in large towns. There was no serious effort to study the needs of consumers. The concept of marketing under early capitalism was that of business activities specially involved in searching for customers or markets and moving goods from producer to consumers for the purpose of the sellers gain.

Manufacture, new modes of transportation and methods of communication brought about drastic changes in the physical and economic environment of man. Mass production became the order of the day. A large variety of low priced goods become available in great abundance. The ever increasing number and size of the industries generated the phenomenon of competition. The

situation demanded a conscious effort on the part of the enterprises to ensure that their products were preferred to those of their competitors.

The size and character of markets in many countries of the world changed enormously after the Second World War.

A great variety of new products and services were made available because of development of large number of mass scale enterprises.

The selling of the products and service become usually difficult because of the high intensity of competition. Abundant choices were made available to customers and the customers began to place of unique importance. The industrial firms realised that the customer who purchased their product once, should come back to them again and again whenever needs the product. The firms should also ensure that the product is made available at a place convenient to the customer. In addition, the firms should make their products available at the most economical prices.

Definitions of Marketing

Marketing is the performance of the business activities that direct the flow of goods and services from the producer to the consumer end user. It is the process of getting right product to the right place in the right quantity at the right price and right time.

Marketing is the economic process by which goods and service are exchanged between the producer and the consumer and their values determined in terms of money prices.

Marketing activities are concerned with the demand stimulating and demand fulfilling efforts of the enterprises.

Marketing is a total system of interacting business activities designed to plan, promote and distribute need-satisfying products and services to existing and potential consumers.

Marketing starts with the identification of a specific need on the part of the consumer and ends with the satisfaction of that need.

Simply to produce the products is not enough. The product must be transported, stored, priced, advertised and sold before the satisfaction of the human needs and wants is accomplished.

When a person buys a shirt, it obviously means he pays money for it in exchange. Marketing is made up of such exchange process or transactions between two or more parties. Money could be exchanged for goods/ products like soaps or services like a medical consultation. Sometimes another product or service could be paid in return for product or service. A marketer's job is to create and maintain these exchanges or transactions on a long –term basis so that a good relationship is built up between the two parties.

MODERN CONCEPT OF MARKETING

Now-a-days more stress is given on the marketing concept. The modern concept of marketing gives emphasis on consumer needs and the freedom of consumer to choose. The marketing department becomes the main management force in a company. Most companies realise that production is no longer a problem, having the technical ability is not enough, marketing the product is very important.

The basic features of the modern concept of marketing are:

- (a) Customer orientation
- (b) Integrated marketing, and
- (c) Profitable sales through customer's satisfaction.

Customer orientation. The company should become completely consumer-oriented. The need for a customer orientation has been expressed aptly by Charles.

G.Mortimer. according to him:

Look at the company through the customer's eyes. The customer is at the top of the organization chart. We are not the boss; the customer is. What the consumer wants the consumer gets. The firm should produce what the customer want and not what they can sell. The businessman should always be in search of such needs of customers which are not known to them. The needs for pressure cooker, cooking gas, television, refrigerators were not thought by the customers. The invention of such items is the result of customer-oriented attitude of the businessman. Consumer research should be carried on to study the new and changing needs of the consumers so that the firm may cope with them.

For effective customer orientation, the firm should decide:

- (i) the basic needs of customers.
- (ii) market segments, it can serve better, taking into account its limited resources.
- (iii) colour, size, and design of design of the product it can choose to satisfy the specific needs of specific customers.

Integrated marketing. The second pillar of marketing concept is integrated marketing. It Should be remembered that “the purpose of the company is to create customer”. Integrated marketing means:

- (i) The various departments in company must recognise that the action they take, may have a profound effect on the company's ability to create and retain customers. Some means must be developed to co-ordinate the impacts of all the departments of the firm on the customer.
- (ii) It also means that within the marketing function proper there is intelligent adaptation and coordination of the four P's of produce, price, place and promotion to built strong exchange relationships with customers.

Customer Satisfaction. The third important pillar of marketing concept is the customer satisfaction. The objective of the company should be to achieve the satisfaction of customers. The concept of seller's market which was in existence in the past has been converted into buyer's market. A person buying a product has to be satisfied with his choice. He has to be happy about the performance, features and price of the product. For example, a toilet soap has to cleanse, de-odorise, disinfect and so on but that is not enough. The soap has also to make the person feel beautiful, self – confident and provide a host of other image related values.

The aim of the firm should be to earn more profits through satisfaction of the customers. Thus with the customers foremost in mind, before starting the production, the firm must answer such questions as:

- i) Is there a need or demand for the products that firm is capable of producing?
- ii) What characteristics of attributes should the product possess?
- iii) How the product selected for manufacture differs from similar and competing products?
- iv) What styles, colours, models, size etc. Should be produced, to achieve the satisfaction of customers?
- v) What channels of distribution are best?
- vi) What price policy will most maximize profit?

vii) What type of people or market segments will the product most appeal to ?

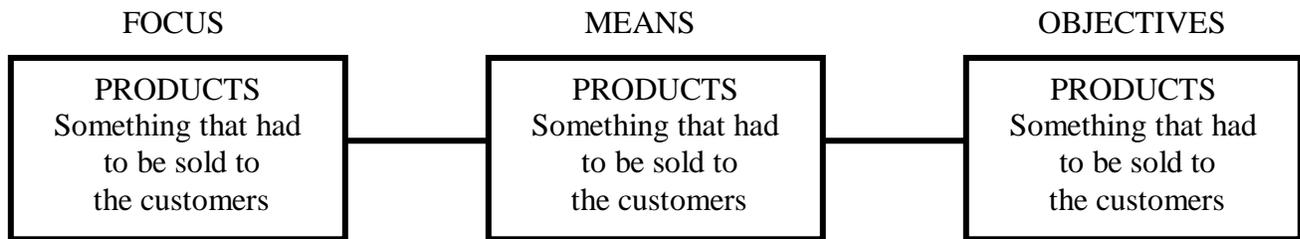
Benefits of modern marketing concept

Benefits of new market – oriented approach are:

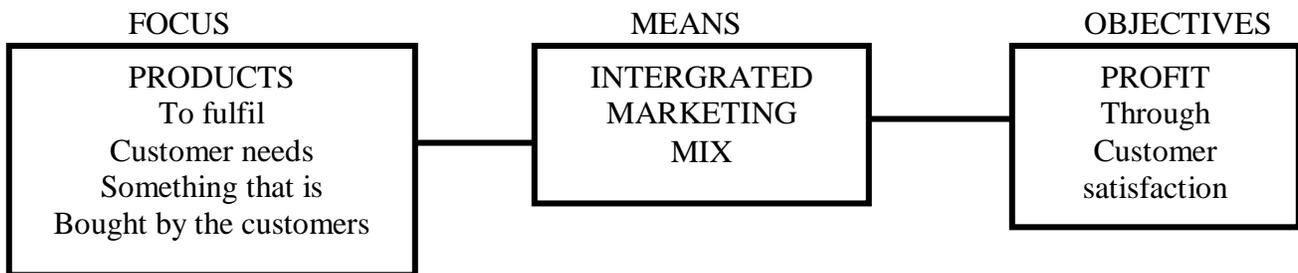
- 1) Consumer needs, wants and desires receive top consideration in all business activities.
- 2) Greater attention is given to the product planning and development so that the merchandising can become more effective.
- 3) The supply is adjusted to changing demands of quality, quantity brand, model etc.
- 4) Interests of the enterprise and society can be harmonized as profit through service is emphasized.
- 5) Marketing system based on the marketing concept assures integrated view of business operations.
- 6) Marketing research is considered as an integral part of marketing process and it is a managerial tool in decision- making in the field of marketing.

SELLING CONCEPT Vs MARKETING CONCEPT

<i>Selling</i>	<i>Marketing</i>
1. Product enjoys the supreme importance. 2. Emphasis on company (sellers) needs. 3. Company oriented selling efforts. 4. Goods are already produced and then sold at profit. 5. Selling aims at terms objectives. 6. Top priority is given to sales volume rather than profits-increasing sales.	1. Customer enjoys unique importance 2. Emphasis on market customer' need. 3. Market oriented selling efforts. 4. Customer demand determines production; Supply is adjusted to demand. 5. Marketing aims at long terms objectives. 6. Top priority is given to profitable volume of sales and market share at fair prices and reason- able risk.



The Selling Concept



The Marketing Concept
Sales and marketing concept (difference)

THE NATURE OF MARKETING

Marketing is the process which provides the dynamic bridge between the producers of products/goods, services and ideas and their users or consumers. Marketing established that vital link and forms the testing ground for acceptance or rejection of products, services or ideas by the users or consumers.

Marketing is often confused with just selling but it is a lot more than that. Marketing is finding out what customers need and delivering the products to their satisfaction. While selling concentrates on pushing the product to the customer, marketing deals with pulling the customer to the product by making it more relevant and satisfying. Thus selling satisfies the needs of the seller while marketing satisfies the needs of the buyer.

Marketing is not merely advertising. Often, due to high visibility of advertising, we may tend to think it is synonymous with marketing. If this were true, all advertised products should succeed in the market place. Good advertising contributes to marketing but does not substitute for the whole marketing process which also includes appropriate product designing, pricing and placing or providing accessibility.

MARKETING FUNCTIONS

Marketing adds value to the product by the specific functions it performs. The following chart describes the classification of marketing functions:

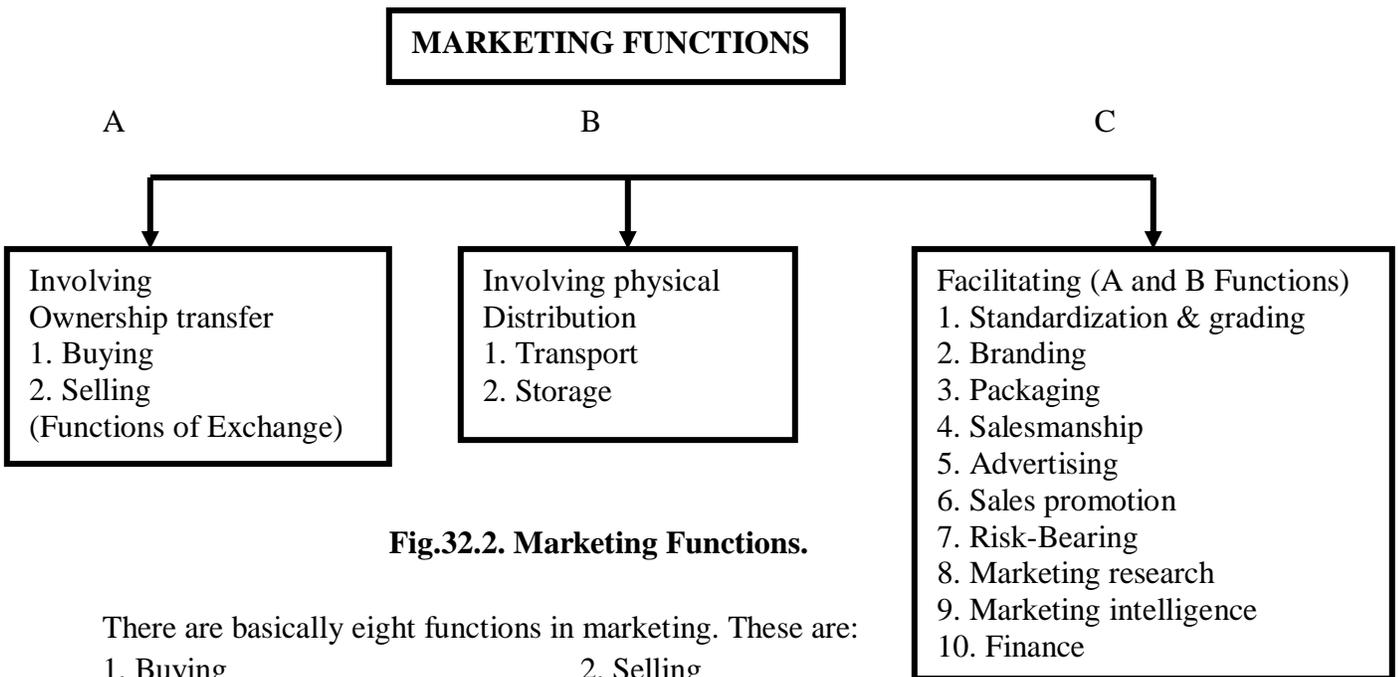


Fig.32.2. Marketing Functions.

There are basically eight functions in marketing. These are:

- | | |
|--------------------------------|------------------------|
| 1. Buying | 2. Selling |
| 3. Transporting | 4. Storage |
| 5. Standardisation and grading | 6. Financing |
| 7. Risk-bearing and | 8. Market information. |

Under selling we can include branding, packaging, personal salesmanship, advertising and sales promotion.

1. **Buying.** Buying involves both the marketing and the customers. The marketing manager must know about the type of customers, their consuming habits, demand and buying pattern. For the consumers, the buying function includes a consideration of price, quantity, kind and style.

2. **Selling.** Selling creates a demand for a product. Selling function involves:

- a) Product planning and development,
- b) Finding out or location buyers,
- c) Demand creation through salesmanship, advertising and sales promotion,
- d) Negotiation of terms of sales, such as price, quantity, quality etc.
- e) Sale contract leading to transfer of title and possession of goods.

3. **Transporting.** Transporting involves the creation of place utility. In order to have goods must first be transported from the place they are produced to the place where they are needed.

4. **Storage.** It is concerned with storing finished products properly without any damage, until they are dispatched to customers. It is also concerned with maintaining stock of raw materials, components etc. to meet production schedules. The levels of inventory are frequently per-determined to meet the changing needs of customers.

5. **Standardization and Grading.** Standardization involves the maintenance of uniform size and quality standards throughout the country. Standardization assures quality. It promotes uniform size and products. In buying a light bulb for example, few of us have any doubts as to whether that bulb will fit or how much light it will flourish. Products are produced in different grades to fulfil the needs of various types of customers. Grading means separating or inspecting products according to established standards. Grading provides a basic for comparison of similar products. Grading is particularly important in agricultural products, milk, cotton, wheat etc.

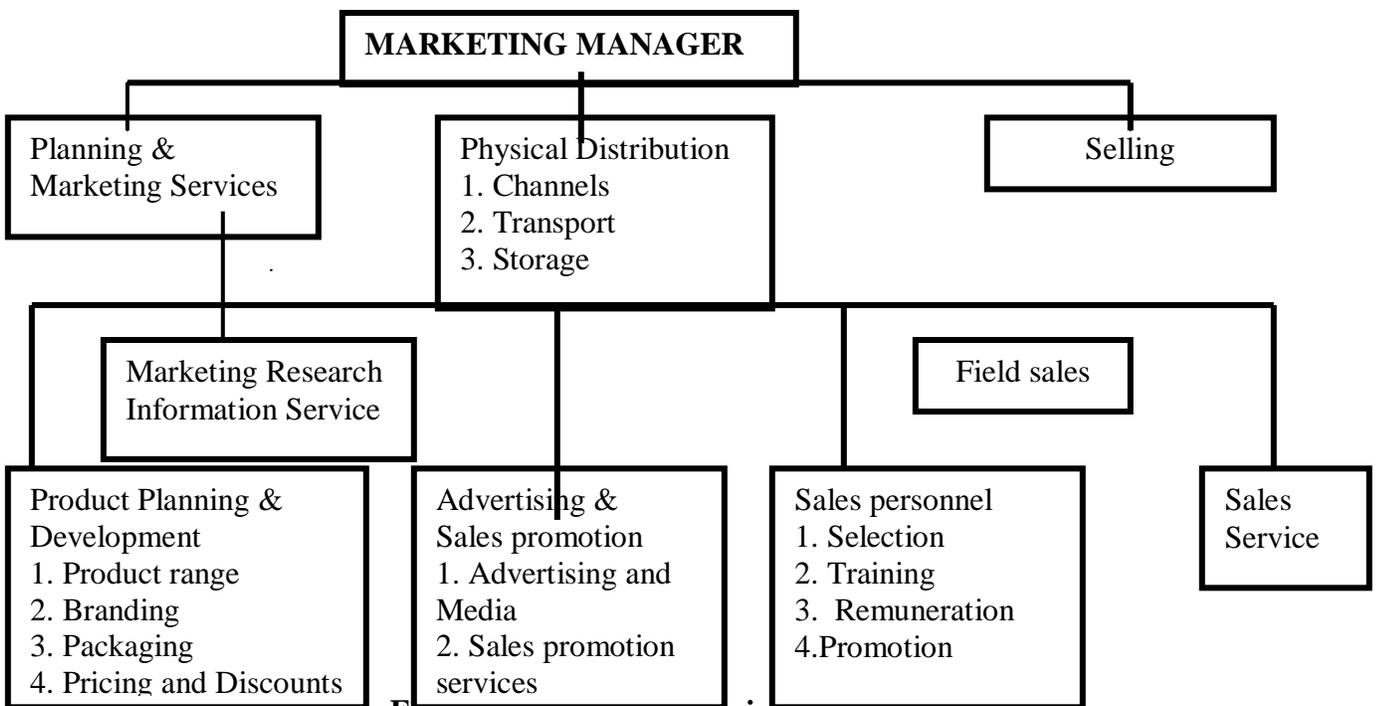


Fig.52.2. Marketing organization.

7. **Financing.** Finance is the life blood of business. Value of goods is expressed money and it is denoted by price to be paid by buyer to seller. Credit is necessary in marketing. It plays an important role in retail trade particularly in the sale of costly consumer goods.

8. Marketing information. The marketing personnel must study the trends in market demand, supply, prices and related market information. The knowledge about the latest market information may help the firm to reduce risk of loss in purchasing, in pricing, in forecasting market demand and in facing competition in the market securing and using market information is a mark good marketing management.

Organization for marketing

The marketing department can be organized around the product to be sold. It may also be organized by function e.g. market research, advertising and sales promotion, pricing, and sales management. Functional organization is suitable when one or few closely related products are to be sold. When the firm has a national

Market and regional marketing problems demand special attention, organization by territory may be preferred.

Fig. 32.3 shows a typical marketing organization having a customer oriented approach.

CONSUMER BEHAVIOUR AND DIFFERENT MODELS

Consumer is the central point and all the marketing activities revolve around him. Manufacturer produces what the customer wants. As the consumer's behavior differs from person to person. Consumer purchases an article as a result of certain mental and economic forces creating desires and wants which they understand can be satisfied by the articles offered for purchase. Thus producer should identify the motives/stimuli which prompt them to purchase so that he can offer a complete article satisfying their needs. This is the buying motive that prompts the purchaser. Such buying motive may be safety, desire for money, vanity, pride, fashion, passion, sex or affection or comfort.

Consumer behaves in a particular manner as directed by his inner desire/motive. The market has to study and analyse the consumer behaviour to maximize sales and thereby profits.

Studying consumer behaviour a basic requirement of marketing:

- what motivates the buyer?
- what induces him to buy?
- why does he buy a specific brand from a particular shop?
- why does he shift his preferences from one shop to another or from one brand to another?
- how does he react to a new product introduced in the market?
- what are the stages he travels through before he makes the decisions to buy?

These are some of the questions that are of prime interest to the marketing man. Because, it is around these questions that the product and production strategies of the marketing man ultimately revolve. In all his marketing strategies and plans, he makes assumptions as to how the buyers would behave and respond to his marketing programmes. Knowledge of the buyer and his buyer motives and buying habits, is thus a fundamental necessity for the marketing man.

A number of factors influence consumer/buyer behaviour. Consumer's tastes and choices may change with changing needs, environment and situations. An ongoing study of consumers and their buying behaviour can provide vital information to marketers for repeating product successes

and getting consumers to continue to appreciate their products. Marketing inputs have to be altered to keep pace with changes in consumer behaviour.

Some of the important factors which influence consumer behaviour are:

- (i) Marketing Inputs. (Information from a variety of sources). Product, price, place and sales promotion information.
- (ii) Socio-cultural factors. Culture, reference groups, family.
- (iii) Psychological factors. Perception, learning, motivation, self-concepts, attitudes.
- (iv) Situational factors. Users, usage occasions, availability of finance, availability of products.
- (v) Religion and language, concern about status etc.

Different Models of Consumer Behaviour

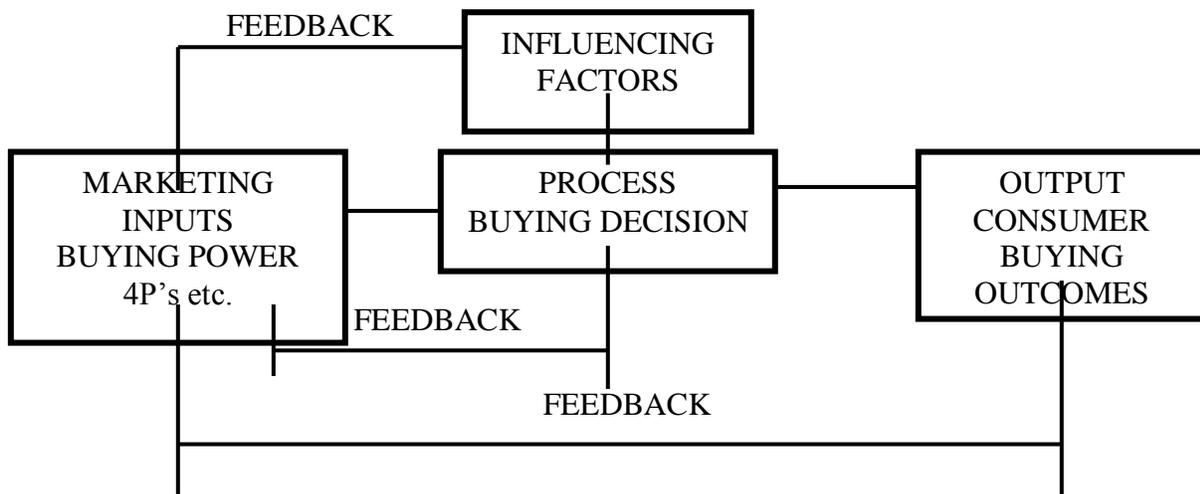
All major social sciences like Economics, psychology, Sociology and Anthropology have influenced consumer behaviour studies. The influence of these social sciences/factors on consumer behaviour has made marketing experts to prepare certain models for explaining consumer behaviour.

- 1. Buyer behaviour model under system approach.
- 2. Economic model.
- 3. Learning model.
- 4. Psycho-analytical model.
- 5. The sociological model.
- 6. The Nicosia model.
- 7. The Howard-Sheth model.

1. Buyer behaviour model under system’s approach. According to system approach of buyer behaviour, we have:

- (i) Inputs (ii) Processing (iii) Output (iv) Feedback loop.

The objective is, of course, expected satisfaction of the buyer from the product or service. The inputs include buying power, marketing mix (4P’s) and other factors. Outputs are buyer’s attitudes, opinions, fillings and preferences as affected by buying process.



2. The Economic Model (Buying Power). According to the economic model of consumer behaviour the consumer is a rational man and his buying decisions are governed by the concept of utility. Under a set of given economic conditions, the buyer behave in a similar fashion. Their every buying decision is a logical process with the ultimate intention of obtaining optimum value for the money they spend. Price is regarded as the strongest motivation for the 'economic man'. if he has certain amount of purchasing power, a set of needs to be met and a set of priorities to choose from, he will allocate the amount over the set of products in a very rational manner with the intention of maximizing the utility or benefits. According to this model :

- (i) The lower the price of the product the larger will be its side.
- (ii) The higher the purchasing power the higher will be quantity of purchase.
- (iii) The lower the price of substitute product, the lower will be the sales of original product.
- (iv) Higher the proportional expenditure the higher will be the sales.

3. Learning mode. (The pavlovian stimulus response theory). According to the learning model which is based on stimulus response theory, consumer behaviour can be influenced by influenced by manipulating the drives, stimuli and responses of the buyer. The model rests on man's ability at learning, forgetting and discriminating. Learning causes change in behaviour of an individual. Buying behaviour is critically affected by learning experiences or the buyers. The learning process involves three steps

- a) A dive, a strong: internal stimulus to satisfy need.
- b) Cues-weak stimuli, cues determine whether buyer will purchase product or not and
- c) Response: the action of an individual to a drive or cue.

Once the need for a product is identified for a prospective customer then advertising through media can act as a drive to make a decision regarding purchase of product, a response.

4. The Psycho-analytical (Psychology Model). According to psychologists every one has need that require satisfaction. Needs are created by people's culture and for its fulfillment needs force him to work. Maslow's theory of motivation seeks to explain why people are driven by particular needs at particular times. According to Maslow, human are arranged in hierarchy, from the most pressing to the least pressing. Thus the lower level needs have priority over higher level needs.

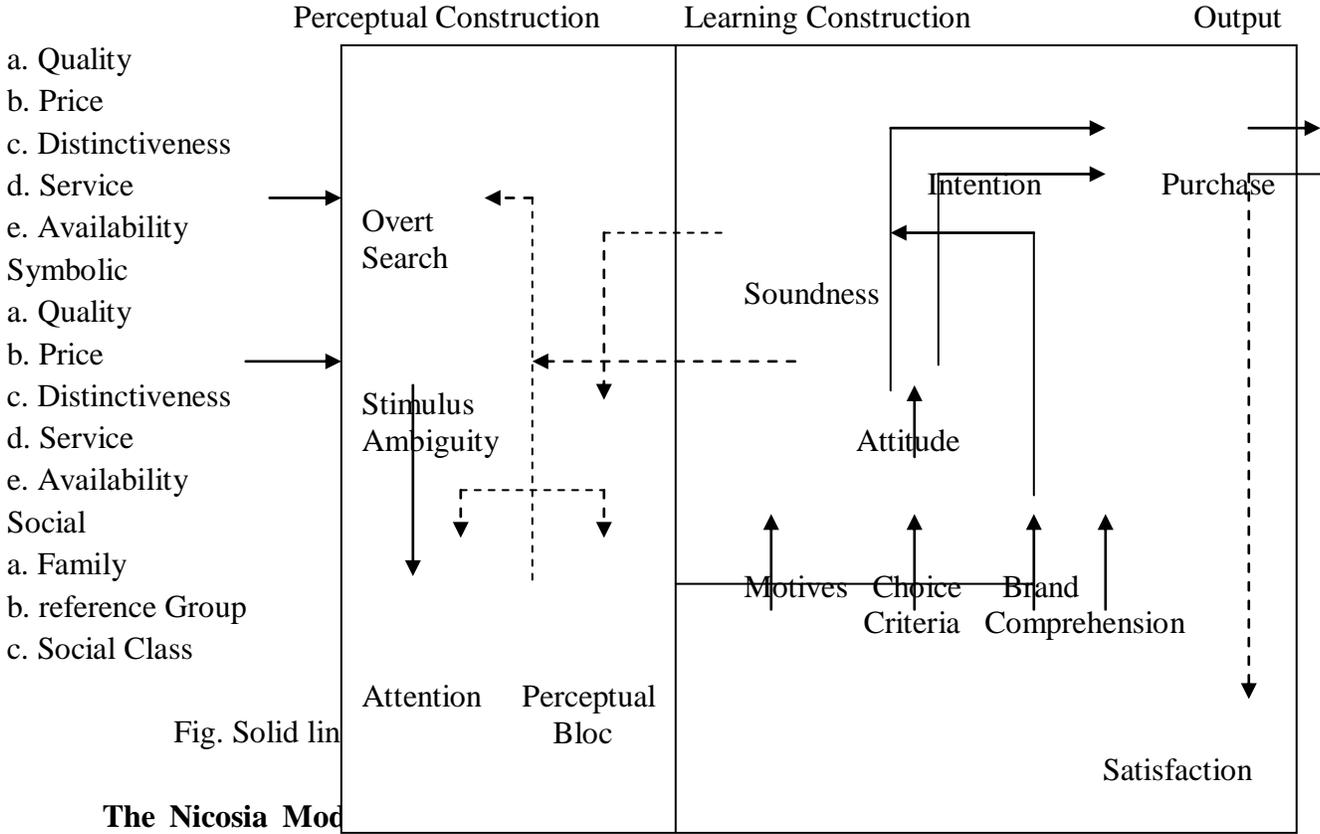
5. The sociological Model. According to sociological model, the individual consumer is influenced by intimate group as well as by social classes. His buying decisions are not totally governed by economic factors or psychological factors but his desires to emulate, follow and fit in with his surroundings.

According to sociological models the buying decisions of an individual are governed by social status of an individual.

He belongs to a family, he works for a certain firm, he may be a member of a professional forum, he may belong to a particular political group, or a cultural group. There is a constant interaction between the individual and the organizations to which he belongs. And all these interactions leave some imprint on him influencing him in his day –to-day life and consequently, his buying behaviour.

The Howard- Sheth Model. The logic of the model runs like this: There are inputs in the form of stimuli. There are outputs beginning with attention to a given stimulus and ending with purchase. In between the inputs and the outputs there are variables affecting perception and learning. These variables are termed 'hypothetical' since they cannot be measured at the time of occurrence.

Stirrelus Disply



The Nicosia Model

category called the system models, where the human being is analyzed as a system with stimuli as input to the system and behaviour as the output of the system.

Nicosia Model tries to establish the linkages between a firm and a consumer- how the activities at the firm influence the predisposition of the consumer towards the product. Depending on the situation, he develops a certain attitude towards the product. If these step have a positive impact on him, it may result in a decision to buy.

The Nicosia Model groups these activities into four basic fields. Field one has two subfields- the firm's attributes and the consumer's attributes. An advertising message from the firm reaches the consumer's attributes. Depending on the way the message is received by the consumer, a certain attribute may develop and this becomes the input for field two.

Field two is the area of search and evaluation of the advertised product and other alternatives. If this process results in a motivation to buy, it becomes the input for Field Three. Three consists of the act of purpose. And Field four consists of the purchased item. There is an output from Field Four- feed back of sales results to the firm.

Over the years, several other models have also been developed, with the intention of explaining buyer behaviour. All these models have certain merits as well as limitations. They do not fully explain the complex subject of buyer behaviour. Nor do they establish a straight input-output equation on buyer behaviour. They merely explain the undercurrents of human behaviour from different and premises. But these models will certainly be helpful in gaining at least a partial insight into buyer behaviour.

PRODUCT MIX AND PRODUCT LINE

A firm may begin to produce and market one product but, over a period of time, it may decide to produce similar or different types of products for example, it is logical for a detergent manufacturing company to make different forms of detergents like powers and bars. Later, having gained sufficient experience in marketing these types of products, the company may start manufacturing toilet soaps, shampoos and so on (Ex. HLL, P and G Nirma etc.).

The reasons why firms produce different products could be as follows:

1. If the firm is making seasonal product, during off-season it may produce similar other products so as to generate revenue throughout the year.
2. A one-product firm faces dangers because of the effects of the product life cycle when that product reaches the decline stage.
3. A multi product firm can use the resources more effectively.
4. Production and marketing costs can be spread over a wider product range.
5. A line-balancing problem in mass production industries may necessitate the firm to produce another product to utilize idle capacities of some of the machines and balance the line.

Product line and product mix are two commonly used expressions for denoting the range and variety of the product of a multi-product firm. The entire collection of products offered for sale by a firm is called a product mix. A product mix can consist of many product lines.

A group of related products which satisfy a common need is called a product line. The length of the product line denotes the number of items/products in the line. The width of the product mix denotes the number of product lines in the product mix.

Taking Hindustan lever, for example, bathing soap constitutes one product line of the company, detergents constitute another, tooth paste yet another line. It has many more product lines like this. In the product line of bathing soap, H.L. Ltd., has several products like Lux, Lifebuoy, Pears, Rexona, Liril etc. in the product line of detergents it has Surf, Surf Ultra, Rin, Wheel etc.

The product lines of Godrej would include toilet soaps, type-writers, beverages, shaving cream, hairdye, locks, steel furniture, cordless phones, and refrigerators and so on. A toilet soap product line of Godrej consists of Cinthol, Ganga, Marvel, Crowning Glory, etc.

All the product lines of Godrej together constitute the product mix of Godrej.

CHANNELS OF DISTRIBUTION

Channels of distribution. When the product is finally ready for the market, it has to be determined what methods and routes will be used to bring the product to the market, i.e., to ultimate consumers and industrial users. A channel of distribution for a product is the route taken by the products/goods as they move from the organization/producer to the ultimate consumer or user.

Producers normally distribute the product directly but use a number of marketing intermediaries for taking their products to users. Marketing intermediaries bear a variety of names such as : sole-selling agents, marketers, wholesalers, distributors, stockiest, retailers, authorised representatives, brokers/commission agents etc. all such intermediaries constitute the distribution channel. The depots/show-rooms and other direct selling methods also form a part of distribution channel.

According to American Marketing Association, “A channel of distribution, or marketing channel, is the structure of intra-company organisation units and extra-company agents and dealers, wholesale and retail through which a commodity, product or service is marketed”.

Cundiff E.W. and Still R.S. define a marketing channel as “a path traced in the direct or indirect transfer of title to a product, as it moves from a producer to ultimate consumers or industrial users”.

Thus it is clear that every marketing channel contains one or more of the transfer points at each of which there is either an institution or a final buyer of the product.

Functions of channels of distribution

The following are some of the functions performed by different channels distribution.

1. Help in Production Function. The producer can concentrate on production function leaving the marketing problem to middlemen who specialize in the profession. Required for organising marketing, could profitably be used in production where the rate of return is greater.

2. Matching Demand and Supply. The chief function of intermediaries is to combine the assortments products and components of different manufacturers into suitable assortments convenient to final users. According to Alderson “the goal of marketing of segments of supply and demand”. They break up the and meet the small-size needs of individual consumers.

3. Provide distribution efficiency to manufacturers. In the first place, distribution channels bring together the makers and the users in an efficient and economic manner. It will not be practical for any manufacturer to organise a network of his own selling points throughout the market and sell his products directly to consumers totally avoiding outside distribution channels. Just like mass manufacturing, mass distribution too needs large resources in terms of money, materials and men. No manufacturer can easily command such resources profitably.

4. Channels provide salesmanship. Distribution channels in particular assist in establishing new products in the market. Dealer-recommended selling is common in many consumer Products. The dealers promote the purchase through their word-of-mouth communication. They also provide pre-sale and after-sale service to consumers. They are in constant contact with customers and provide feedback to the producers about the reactions of the customer.

5. Channels help Merchandise the products. Through merchandising, distribution channels help reinforce/create the awareness about the product among the customers. When a customer visits a retail shop, his attention can be concentrated by an attractive display of new product/brand, increasing his awareness of the product and his interest in the product.

Channels help in implementing the pricing mechanism. In pricing the product, the producer should invite suggestion from the middlemen who are very close to the ultimate users. They assist in arriving at the price level that is acceptable to the maker as well as the user.

Financing the producer. Middleman collect huge orders and purchase products in bulk from the manufacturers in cash. Some of the intermediaries, particularly wholesalers/stockists, often give substantive amount to the producers as deposits, alternatively they pay cash to lift the product. The manufacturer gets his money long before the product reaches the actual users. This enables the producers to undertake large-scale production and adopt better techniques of production.

Marketing intermediaries also look after a good part of the physical distribution functions like transportation, warehousing, sub-distribution and inventory management. In addition, they look after financing of goods, credit transactions, negotiations with buyers etc.

Routinisation of sales. Channels of distribution routinise the sales of the products. Once the round for reaching the fixed, the problem of selling the product is automatically solved.

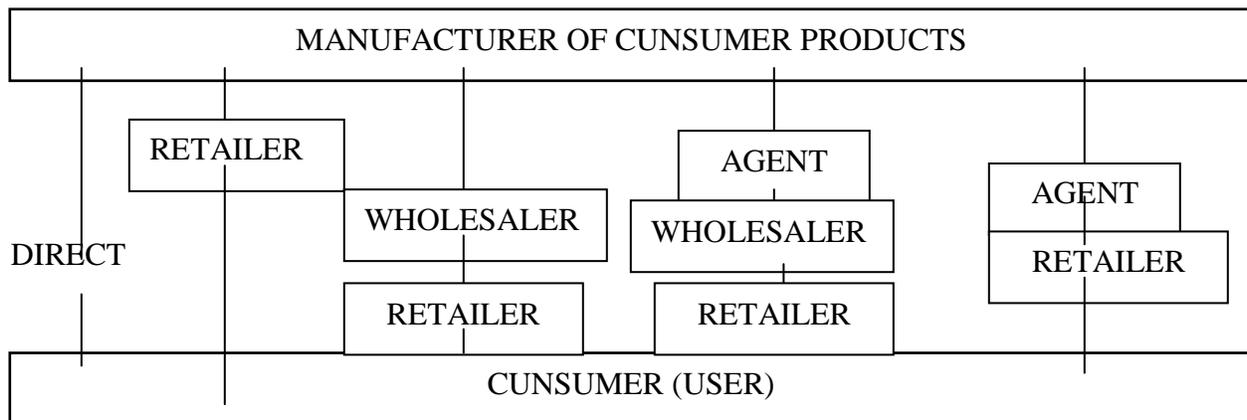
They also accept the responsibility of transfer of technology. They case of agricultural inputs is a good example. The intermediaries in this business act as ‘change agents’ among the farmers and generate demand for new products.

Different Channels of Distribution

(a) **Channels of distribution for consumer goods.** Consumer goods may be used as the additional generally through channels, in each of which the sales office or sales branch may be used as the additional alternative by the manufacturer. There are five principle channels of distribution:

- i) Direct distribution from manufacture to ultimate consumer.
- ii) Manufacturer to retailer to consumer, where goods may be purchased directly from manufacturers or retail stores may be opened by manufacturer.
- iii) Manufacturer to wholesaler to retailer to consumer.
- iv) Manufacturer to agent to wholesaler to retailer to consumer
- v) Manufacturer to agent to retailer to consumer

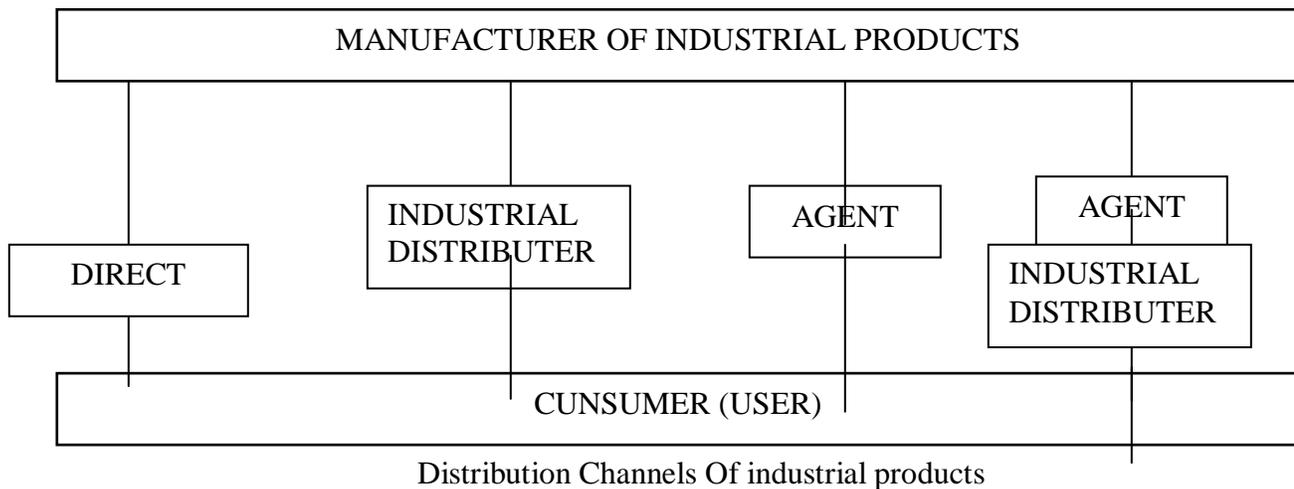
The manufacturer may use one of these channels or a combination of them. The question has to be settled by marketing research regarding which method to adopt and how to measure its effectiveness. Management must periodically reappraise its channels of distribution and adjust the outlets to suit changes in business and economic conditions.



Distribution channels of consumer goods

(b) **Channels of distribution for industrial goods:** Industrial goods are distributed by manufacturer through four channels, although he may also use his sales branch or sales office for the same.

- i) Manufacturer to industrial user. Large installations like generators, boilers, plants etc. are sold through this direct channel.
- ii) Manufacturer to industrial distributor to user. Operating supplied and small accessory equipment, such as building materials, construction equipment, air –conditioning equipments etc. are sold through this channel.
- iii) **Manufacturer to agent to user.** This channel is often used when a new product is introduced, or a new market is entered.
- iv) Manufacturer to agent to industrial distributor to user.



SALES PROMOTION

In modern business world, sales promotion is considered as an instrument to lubricate the marketing efforts. Sales promotion is essentially a direct and immediate inducement that adds an extra value to the product so that it prompts the dealers, distributors or ultimate consumers to buy the product. Sales promotion activities are complementary to advertising and personal selling efforts.

According to the American Marketing Association, “In a specific sense, sales promotion includes those sales activities that supplement both personal selling and advertising and co-ordinate them and help to make them effective such as displays, shows and expositions, demonstrations and other non-recurrent selling efforts not in the ordinary routine”.

Examples of sales promotion are free product samples, premiums and trade shows. For many organizations, including the marketers of foods, toys and clothing, store displays are important sales promotion devices. Displays expose promotion messages to consumers at the time and place of purchase. Numerous consumer products are purchased in stores that use self – service selling methods. Marketers of such items need effective displays in order to distinguish their offerings from those of other firms. Sales promotion is a vital link between advertising and field selling. It aims at stimulating consumer purchasing at the point of sale and dealers effectiveness at the retail channel of distribution.

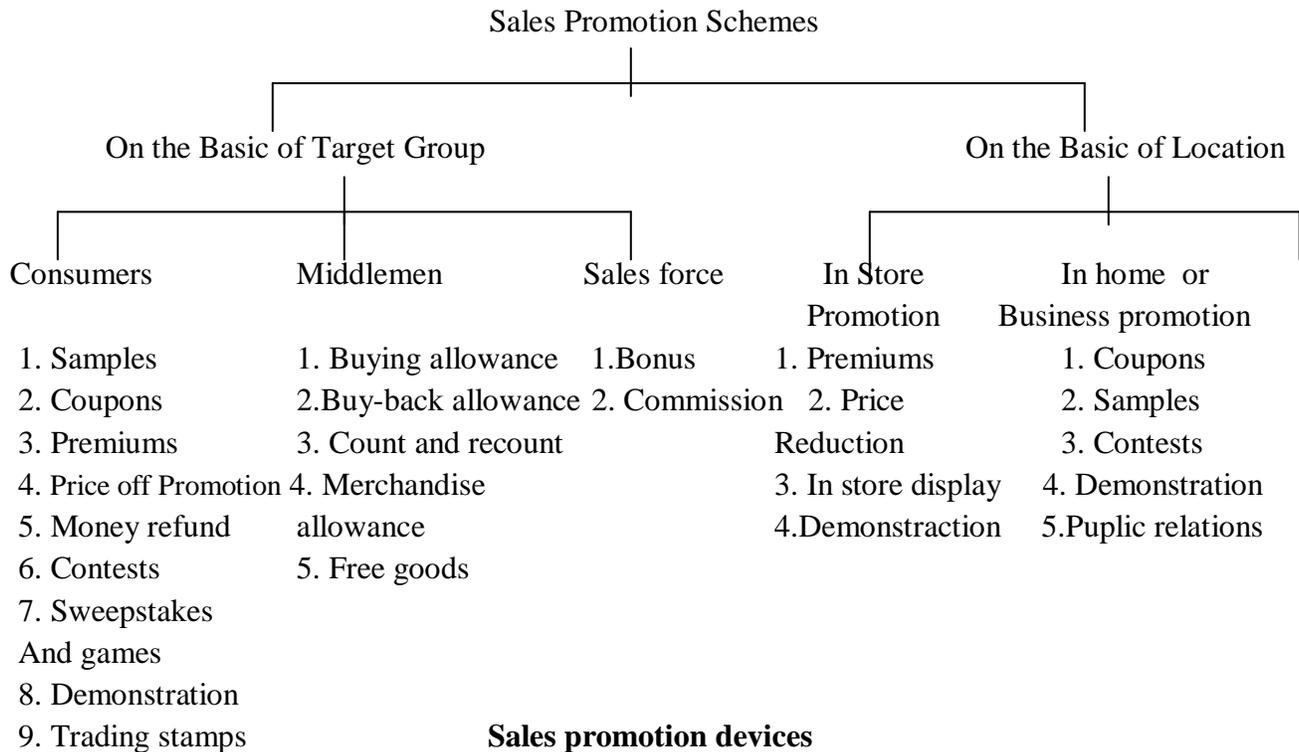
Sales promotion differs from advertising in the following ways:

- Whereas advertising is mostly an indirect and subtle approach towards persuading consumers to buy a product, sales promotion is a direct and almost open inducement to consumers to immediately try the product.
- While advertising normally has long-term objectives like building brand awareness or building consumer loyalty or responding a brand, sales promotion performs an immediate task of increasing current sales.
- While advertising helps sales by adding some durable and longterm value to the product, sales promotion aids selling by temporarily changing the existing price-value relationship of the product.

Objectives of sales promotion. Marketers use by sales promotion to meet several marketing needs, such as:

- For introducing new products.

- For unloading accumulated inventory.
- For overcoming a unique competitive situation.
- For overcoming seasonal slumps/decline.
- As a support and supplement to the advertising effort.
- As a support and supplement to the salesmen's effort.
- For persuading salesmen to sell the full line of products.
- For persuading dealers to buy more/ increase the size of orders.



Tools or devices of sales promotion. The tools or devices used for sales promotion depend upon the target group, nature of the product and innovative talents of the marketers. The promotion tools are broadly classified of efforts such as in home or business promotion and in store promotion tools. The common sales promotion devices are shown in the given above chart.

ADVERTISING

Advertising and promotion are integral parts of the marketing effort. Advertising is the art of disseminating marketing information through various media of communication (such as newspapers, magazines, radio and T.V.) at the expense of the company for the purpose of increasing or maintaining) effective demand and facilitating the sale of specific goods and services. It informs the customers about the products and the place where they can get it. Advertising promotes trade and creates demand and hence it is the pivot of modern trade, commerce and business.

The word “advertising” has been derived from Latin term “adverto”. ‘ad’ means towards and ‘verto’ meaning to turn. To turn the attention of the people towards the product. American Marketing Association defines advertising as “any paid form of non-personal and promotion of goods and services or ideas by an identifies”.

“Advertising is any form of paid non-personal presentation of ideas, goods or services for the purpose of inducing people to buy” – Weeler.

According to Mason and Rath “advertising is salesmanship without a personal salesman”.

Stanton says that advertising consists of all activities involved in presenting to a group a non-personal, oral or visual, openly sponsored message regarding a product, service or idea.

From the above definitions it could be said briefly that advertising is:

- i) paid from of communication,
- ii) having an indentified sponsor.
- iii) A presentation about the product or service or idea,
- iv) Done through divers media, and
- v) Meant to improve/ create the sales of goods and services.

It should be noted that advertisement is the message itself. Advertising is a process- it is a programme or a series of activities necessary to prepare the message and get it to the intended markets.

Functions and Objectives of Advertising

The purpose of advertising is to sell something- a product, a service, or an idea. Stated another way the real goal of advertising is effective communication. That is, the ultimate effect to advertising should be to modify the attitudes and /or behavior of the receiver of the message.

Depending on its marketing objectives one or more of the following may be the objectives of the advertising:

- i) To introduce a new product, model, or service to the market.
- ii) To facilitate or increase the sale of present products by constantly keeping the commodity before the market, thereby maintaining consumer awareness, offsetting the advertisements of competing firms and reducing the amount of personal sales effort required to secure an order.
- iii) To enlighten the public as to the features and uses of the products and overcome tradition or prejudices that may retard consumption.
- iv) To create or enhance company goodwill and thereby maintain or increase demand for the product.
- v) To create confidence in the minds of buyers regarding quality of the goods or products of the company.
- vi) Make the product stand against its competitor’s products.
- vii) To improve dealer relations.
- viii) Reach people inaccessible to the sales force.
- ix) Enter a new geographic market or attract new group of customers.
- x) Advertising campaign may also be designed to lengthen the season for product (as has been done in case of soft drinks).
- xi) To disseminate information about the changes that have come in the form, content, colour, brand etc., of production.

Planning an Advertising Campaign. Proper of advertisement campaign is necessary for optimum utilization of money spent on advertising. It involves the following steps:

- i) Locating the potential demand and the class of buyers to which advertisements are to be directed.

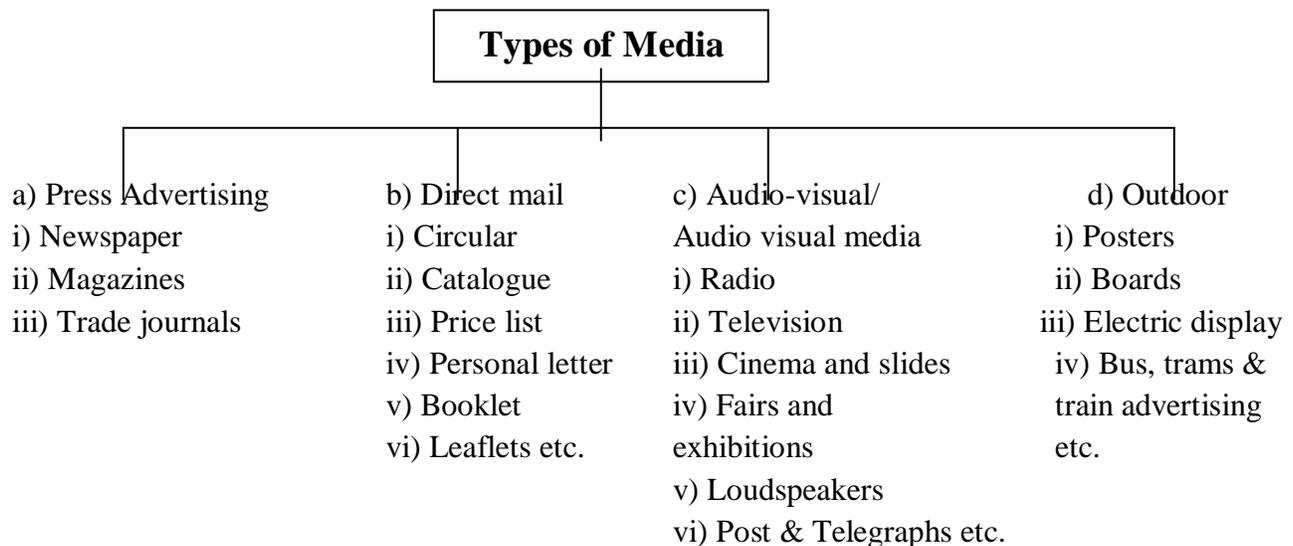
- ii) Ascertain the advertisement theme and illustration to suit the customer's needs. (Determining motivating data).
- iii) Selection of most effective and economical media.
- iv) Preparing advertisement.
- v) Estimate the advertisement budget.
- vi) Schedule the campaign
- vii) Appraising the marketing effectiveness of advertising.

Advertising media and media selection

Advertising message may be conveyed by many methods. A firm may deliver its message through an advertising medium, a single source or media more than one source. An advertising medium is any object or device that carries the advertising to a selected audience. In general, an advertising medium should be capable of accomplishing the following objectives:

- a) It must reach the largest number of people possible.
- b) It must gain their attention.
- c) It must be less expensive.

Selecting the appropriate media and arriving at a sound, sound media mix is a very crucial function of advertising.



Consideration in media planning/ media selection

Media has a vital role to play in the process of advertising communication. Effective advertising is possible only if suitable media is selected/available.

The task of media planning and selection consists of identifying media and the factors governing the media selection, laying down the criteria for selection and evaluating each media against them, developing the media-mix and resource allocation.

Media selection is the problem of finding the most cost effective media to deliver the desired number of message to target customers. The factors governing the media selection are:

I. Purpose of advertisement (communication objectives). The objectives of a specific as well as the total advertising programme influence the choice of media. In planning the

advertising strategy of the concern, marketing Manager set goals for the concern's advertising campaign, which are:

1. One primary goal is to inform potential customers about product or service. Without knowledge of a product, people may not buy it.

2. Advertising also tries to inform people about the superiority of one company's products or services over competitors.

3. Another goal of advertising is to make a 'brand name' so familiar that it becomes a household word. This widespread familiarity of product name helps the mass distribution and selling of product.

4. To emphasize the merits of established product or introduce a product.

II. Coverage. The selection of media also depends upon the firm's existing image in the market, characteristics of major customer segments, their buying habits, their life styles, their reading habits, the age, income, occupation, education, religion, social class etc.

III. Exposures required. A prospective buyer should go through certain stage for final purchase action to take place. These stages are Awareness, Interest, Desire and Action. It is thus necessary to ascertain the number of exposures of a message required to take a typical number of target group through all the stages of the purchase process. An initial exposure may create a curiosity. The next exposure may perhaps create some interest. Some more exposures at well planned intervals may in a desire to buy.

For new products several exposures may be required. For established products, an exposure at the appropriate time may serve as a reminder to stick to the brand.

IV. Reach and frequency. So, the main consideration in selecting the media is : How many exposures can be planned for an already decided budget? Which media/ media vehicle offers the best buy?

The cost of exposure in different media and different vehicles in the same media, also vary. Reach denotes the total number of persons exposed to the given media vehicles at least once during the period under reference. Frequency denotes the number of times the audience is exposed to the media vehicle.

The cost of advertising media/media vehicle and number of exposures required forms a basic for selection.

V. Impact of the Media. Exposures in different media have varying impact on the audience. The same message seen in newspaper and T.V. by the same audience member will have different impact on him.

VI. Cost of Advertising Media. Those charged with the responsibility for the advertising programme of a firm should compare the advertisement costs for the various media to the size of the audience reached.

One method of estimating cost is based on how much it costs to reach each reader or viewer. This is calculated by the cost of advertisement divided by the size of audience. For T.V. or Radio this cost is based on the cost per thousand, with a commercial of a certain length say 10 sec, 30sec, 40sec and 60second spot. Rates may vary according to time of day or night the advertisement is broadcast.

Magazine rates are also measured in cost per thousand, the cost for a single page advertisement for each thousand circulation. Each publisher has a rate card showing the cost for advertising space in the magazine.

In the same way newspapers rates vary for each paper. They charge according to the size of the space occupied by the advertisement and place of advertisement in the newspaper.

Marketing manager should estimate costs and the size of the audiences and determine the relative effectiveness of the media for the company's advertising programme.

PRICING

Pricing is one of the most important decision areas of marketing. Pricing decisions interconnect the marketing actions affected by pricing decisions:

- | | |
|-------------------------------------|-------------------|
| (1) Sales volume | (2) Profit margin |
| (3) Rate of return on investment | (4) Trade margins |
| (5) Advertising and sales promotion | |
| (6) Product image | |
| (7) New product development | |

The selling price plays a unique role in business because the price level:

- (i) Controls the sales volume and the firm's market share.
- (ii) Determines the total sales revenue (sales revenue= sales volume X unit price).
- (iii) Regulates the rate of return on investment (R.O.I.) and through R.O.I. price influences sales profitability.
- (iv) Creates an impact in unit cost in mass production.

Low price increases total sales turnover and ultimately mass production through economies of scale leads to the lower unit cost of production. Low price induces also efficiency in production and marketing.

Pricing thus plays a very important role in the design of marketing mix. Pricing strategy determines the firm's position in the market.

Price. Price denotes the value of a product or service expressed in money. Only when a buyer and seller agree on price, we can have exchange of goods and services leading to transfer of ownership.

Price must be equal to the amount of benefits (physical, economic, social and psychological benefits).

Pricing Object

The various objectives of pricing are as given below:

- Profit maximization in the short term.
- Profit optimization in the long term.
- Target sales volume.
- Target market share.
- Deeper penetration of the market.
- Entering new market.
- Target profit on the entire product line irrespective of profit level in individual products.
- Keeping competition under check.
- Fast turn around and early cash recovery.
- Stabilizing prices and margins in the market.
- Providing commodities at prices affordable weaker setting.
- Providing commodities/ services at prices that will stimulate economic development.

Pricing procedure. The steps involved in pricing procedure will vary depending on the pricing objectives and the pricing methods selected by the firm. The following are some of the steps generally used for pricing by most of the firms:

- Identify the target customer groups and their profile.
- Decide the desired market position and price image for the brand.
- Determine the extent of price elasticity of demand of the product, and the extent of price sensitivity of target customer groups.
- Estimate the various costs.
- Take into account the life cycle stage of the product.
- Analyse competitors' prices.
- Choose the pricing methods to be adopted after taking all taking all the above factors into account.
- Review periodically the pricing policy as well as the pricing. To achieve this goal, prices will be set where the quantity of a product demanded at a certain price is equal to the quantity that suppliers are willing to supply at that price. This demand-supply relationship is shown by demand and supply curves. The "Demand Curve" shows the amount of product demanded.

Fig. Supply and demand are in equilibrium at point.

The "Supply Curve" shows the quantity of goods offered for various prices. The point at which the quantity demanded to the quantity supplied is equilibrium is called "Equilibrium Price". Point "P" in Fig. denotes the equilibrium point.

DEFINITIONS OF MARKETING RESEARCH

"Marketing research may be defined as the application of scientific method to the solution of marketing problem".

"Marketing research is the systematic, objective and exhaustive search for and study of the facts relating to any problem in the field of marketing"
-Richard Crisp

"Marketing research is the systematic problem analysis, model building and fact finding for the purpose of important decisions making and control in the marketing of goods and services" -Phillip Kotler

"Marketing research is the systematic gathering, recording and analyzing of data about problems relating to the marketing of goods and services"
-American Marketing Association

'Marketing research is defined as the systematic study and evaluation of all factors bearing on any business operation which involves the transfer of goods from a producer to a consumer' - A.G.R.Delens

It is essential to clarify the relationship and the difference between marketing research and Marketing Information Systems (MIS). Whereas the job of MIS is to supply marketing information, problem analysis is the job of marketing research. Marketing research too generates and utilizes marketing information but its purpose is problem solving.

Job Analysis, Job Evaluation and Merit Rating

INTRODUCTION

One of the objectives of a sound wage administration system is to eliminate inequalities in the salaries of the persons working on the same job (comparable jobs) in the same or different organisations. Employees too desire that jobs which are similar in duties and are at the same level of difficulty are paid approximately the same wages while those of greater are paid higher wages. Differences in pay for similar jobs may lead to dis-satisfaction which in turn leads to labour turnover. Therefore a planned comparison of jobs is necessary to restrict the occurrence of such situation. This is possible only if wage structure bases its classification of jobs in terms of their worth or difficulties. Though it is obviously impossible to measure the relative value of company jobs with exact precision, it is possible to rate jobs, in light of its worth.

DEFINITIONS AND CONCEPT

Job evaluation is the technique used to correct inequalities in wages and install a systematic method of pricing of jobs. It is a systematic process of evaluating different jobs of an organisation.

Job evaluation can be defined as the process to determine, in a systematic and analytical manner, the relative worth of each job in the organisation based on a set of carefully selected factors such as skill needed, responsibilities involved, efforts required and job conditions etc. for the purpose of determining wage differentials.

Jobs are studied or evaluated and numerical value or an approximate classification is assigned to each job. On the basis of the analysis of the job, we can have job description and specification. The relative job values are thus converted into definite wage rates by assigning the money rate of pay to each job according to a definite system or scale.

Job evaluation deals with the job only and not with the individuals who perform these jobs. For evaluating the individuals another method known as merit rating is used.

Job. A job may be defined as a regular assignment to individual employee involving a set of duties, responsibilities and conditions entirely different from those of other assignments.

Job analysis. Job analysis is a detailed and systematic study of job to determine the tasks, skills, knowledge, abilities and responsibilities required for their successful performance.

Thus, it is the procedure to discover the facts about each job requirement and personal qualities required for satisfactory performance, in such a manner as to distinguish it from all others.

In this procedure the job analyst (or a supervisor properly trained in the technique) :

- (1) collects information,
- (2) prepares job description,
- (3) works up job specifications.

The analyst obtains the relevant information about the jobs in a company by (i) observing the performance of jobs (ii) by interview of personnel who can provide reliable information (iii) by circulating questionnaires and then investigating to check the accuracy of the collected data.

The data is usually recorded on pre-printed forms which are tailored made to suit the requirements of a particular company.

The data may be classified as:

1. Job identification.

2. Nature of the job:
 - (i) Major duties
 - (ii) Other duties.
3. Operations to be performed.
4. Materials and equipments to be used for performing the job.
5. Skill involved to determine degree of difficulty:
 - (i) Education
 - (ii) Training
 - (iii) Responsibility
 - (iv) Job knowledge
 - (v) Mental capabilities
 - (vi) Desired accuracy.
6. Physical demands to determine physical effort required:
 - (i) physical activities
 - (ii) Surroundings (working conditions)
 - (iii) Hazards.
7. Relations with other jobs.

Some of the above data relate to the job, and the others to the individuals performing the job. On the basis of these, the job analysis can be divided into two main groups namely:

1. Job description
2. Job specification.

Job description. Job description is an abstractor information received from the job analysis report. It is an organised statement of the duties, responsibilities, working conditions, and other essential facts about a job.

Job description comprises of three parts: Job identification, job summary and work performed. Job identification contains the job title, department, section, the date on which data is collected, job code number, name of the supervisor and similar other details which help identifying the job.

Job summary gives a brief information about the duties performed and how the job differs from other jobs. Job summary is usually helpful in defining the job for quick reference.

Work performed gives the details of the tasks performed (regular as well as occasional tasks), equipment and machines used, working conditions and hazards involved in the job.

Job specification. Job specification is an outcome of job analysis and description. The job specification is a statement of qualities or abilities that an employee must possess to perform the job in a satisfactory manner.

Therefore, job specification can be defined as “the statement which specifies the type of employees required. It helps in the selection of employees.

Job specification can be compared with the specification of material. As the material specification helps in purchasing and procurement of right type of material similarly, job specification helps in the selection of employees.

Job specification and job description are the end products of the job analysis and they serve the basis for the job evaluation,

OBJECTIVES OF JOB EVALUATION

- (i) Its main objective is to formulate an appropriate and uniform wage structure.
- (ii) Eliminates wage inequalities (reduce wage imbalance).
- (iii) Determines relative value of different jobs in an organisation and thereby establishes wage differentials between them.
- (iv) Clarifies the responsibility and authority associated with the jobs.
- (v) Provides a basis for recruitment, selection, promotion and transfer of employees.
- (vi) Identify need for training of the employees so as to prepare them for future jobs.
- (vii) Eliminates cause of employees' dissatisfaction and reduces conflicts in industrial relations (i.e. improve employer-employee relations).

War Man Power Commission, USA, published a "Guide for Analysing jobs." It proposes a four point job analysis formula to be used in making an accurate and useful job study.

These four points use:

1. What does the workers do?
2. How does he do it?
3. Why does he do it?
4. The skill involved in doing it

It points out that the analyst must establish all the complete scope of the job and consider all the physical and mental activities involve in determining what worker does.

To analyse how the worker does it, the anslyst must study the physical methods used by the worker, use of machinery, tools, his movements and the necessary know-how or mental operations.

The 'why' for the job is the overall purpose for which the job is done.

The skill factor is necessary to discriminate between jobs and establish the degree of difficulty of any job these factors include the experience and training by which the skill is involved and the working conditions and hazards associated with the jobs.

Fig 21.1 shows the components of job evaluation:

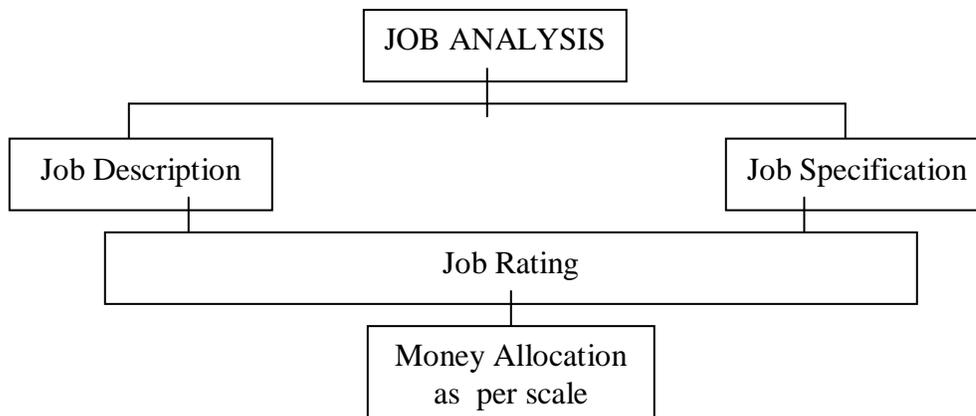


Fig. 21.1. The components of job evaluation.

PRINCIPLES OF JOB EVALUATION

Mr. A.L. Kress suggested the following eight principles of job evaluation:

1. **Rate the job and not the man:** Job requirements are definite and fixed. The man Selected for training may have plus or minus points as regards the job, thus the Payments should be made accordingly.

1. **Explainable elements.** The elements selected should be as few as possible but should cover the necessary requirements for every job.
2. **Uniformity of understanding.** The success of the job is totally dependent upon the uniformity of understanding. All the elements should be well-defined.
3. **The job rating plan must be easily understandable.** So that the plan can be easily understood by workers or supervisors.
4. **Co-operation from employees.** Foremen, supervisors and even workers should be asked to participate in the rating plan.
5. **Discussion of money values.** Discussion on money values should be avoided as it may lead to fighting and quarrels.
6. **Discussion on the job rating plan.** Employees must be allowed to discuss job rating plan.
7. **Establishment of wages.** Too many occupational wage structures should not be established.

PROCEDURE FOR INSTALLING JOB EVALUATION (STEPS IN JOB EVALUATION PROCEDURE)

The basic steps in conducting a job evaluation programme are :

1. Determine the facts about jobs (job analysis).
2. Describe the requirements of the jobs (job description).
3. Specify the attributes that an employee must possess to perform the job in a satisfactory manner (job specification).
4. Determine the relative value or worth of the jobs (job classification).
5. Compare the job with pre-determined key jobs and arrive at a suitable wage structure (wage determination).

The various steps suggested by Lytle for job evaluation are :

1. Most suitable method or technique must be selected.
2. First select the major job characteristics, then minor ones.
3. Give proper information to all concerned i.e. workers, foremen etc.
4. Build definitions and their measuring scale, for comparison purposes.
5. Design job rating forms and questionnaires and collect initial description.
6. Sort out initial descriptions and establish grade or classes.
7. Identify and evaluate the key jobs on the basis of their characteristics.
8. Evaluate the remaining jobs and fix job titles to them.
9. While job rating, ensure that the representation of the workers' union has been considered.
10. Make inter-company survey for key jobs but try to find at least one per class.
11. Transfer the rating values in money values temporarily.
12. Plot the scatter diagram for end jobs and most sure key jobs.
13. Bargain on wage structure.
14. Decide the range limits and the line of reference.
15. Re-adjust all the rates relative to the line of reference, put them into working forms and finally fix all operating procedures.

METHODS OF JOB EVALUATION

The various commonly used methods of job evaluation are :

- (a) Non-quantitative methods
 - (1) Ranking method (grading method)

- (2) Classification method
- (b) Quantitative methods
- (1) Factor comparison method
- (2) The point rating method.

1. Ranking method. This is the easiest and simplest method of job evaluation. In this method the jobs are ranked from the most important one to the least important. Each departmental head arranges the jobs in their department in the order of importance. The individual departments pass on their ranking to a central committee who groups the jobs into grades/classes.

While ranking, following points are considered:

- (i) Amount of work involved.
- (ii) Supervision needed.
- (iii) Extent of responsibility required.
- (iv) Difficulties involved in the work.
- (v) Monotony of work.
- (vi) Working conditions required.
- (vii) Knowledge and experience needed.

Advantages:

- (i) This method is simple, consumes less time and requires fewer forms.
- (ii) It can be easily mastered and administrated.
- (m) It is suitable for small organisations involving lesser number of jobs to be evaluated.
- (iv) It is economical.

Disadvantages:

(i) it is less accurate than other methods, because of judgement factors and also all jobs do not Possess the same factors.

(Job A may be more important than job B with respect to certain factors while, job B may be more important than job A with respect to some other factors).

(ii) it lacks in actual information. It only shows higher or lower values but does not show how much one job differs from others.

(iii) It is not suitable for large organisations.

2. Classification method. In this method, jobs are classified or graded in groups or level of equal skill, responsibility, importance and other requirements. It may be production job, a sales job or an office job, each job family can be broken into a number of grades. For example, production jobs may be classified into five grades, namely grade 1 to grade 5. Grade 1 involves simple tasks requiring less skill, precision and accuracy while grade 5 involves skilled, precise and highly accurate work.

The job evaluation by job classification involves following major steps:

- (i) Deciding the number of grades (five, six etc.).
- (ii) Writing grade level descriptions.
- (iii) Identifying/listing of the jobs to be evaluated.
- (iv) Preparing job descriptions.
- (v) Comparing job descriptions with grade level descriptions and assigning jobs to grades.

Since most of workmen usually have the mental picture of the ranks into which company's different jobs fall, this makes the method easy to use.

3. Factor comparison method. In this method detailed analysis of the jobs is carried out by employing following five main factors :

- (i) Skill (ii) Mental effort
- (iii) Physical effort (iv) Responsibilities (v) Working conditions.

The various steps involved in the factor comparison method are :

- (i) Identify a few key jobs in the organisation which can be described accurately and assumed to be correctly paid.
- (ii) Analyse the key jobs for each of the five factors mentioned above.
- (iii) The salary paid for each key job is allocated amongst the factors in proportion to their importance in the job, (refer Table 21.1).
- (iv) This provides a money rating scale for each of the factors.
- (v) Each of the remaining jobs is evaluated for each of the factors on its money rating scale of the key jobs. The monetary value of the job is obtained by adding up the individual money values assigned to the job for each of the factors depending upon their importance in the job.

Table 21.1. A sample of analysing key jobs for their factors

Key job	Salary (Rs)	Factors				
		Skill	Mental effort	Physical effort	Responsibility	Working conditions
J1	1300	240	100	200	600	160
J2	1640	500	100	600	200	240
J3	2160	400	750	140	800	120
J4	2500	540	380	900	320	360
J5	3200	800	400	200	1100	700 Rs.
X	Job to be evaluated	200	160	240	500	300 1400

Table 21.1 shows that key job 3 requires more mental effort on the part of the worker as compared to key job 2, whereas key job 2 requires more skill as compared to key job 3.

The job X to be evaluated is analysed into these five factors. As per the job requirements determine the importance of each factor in the job, fit the same in the job comparison scale and total the monetary values attached to each. This value for job to be evaluated X comes out to be $200 + 160 + 240 + 500 + 300 = \text{Rs. } 1400$.

Advantages:

- (i) This method is systematic as it takes into account the basic factors that are present in all types of jobs.
- (ii) Wages can be obtained by direct comparison.
- (iii) It can be used for evaluation of unlike jobs.
- (iv) The method can be employed even by a large organisation.

Disadvantages :

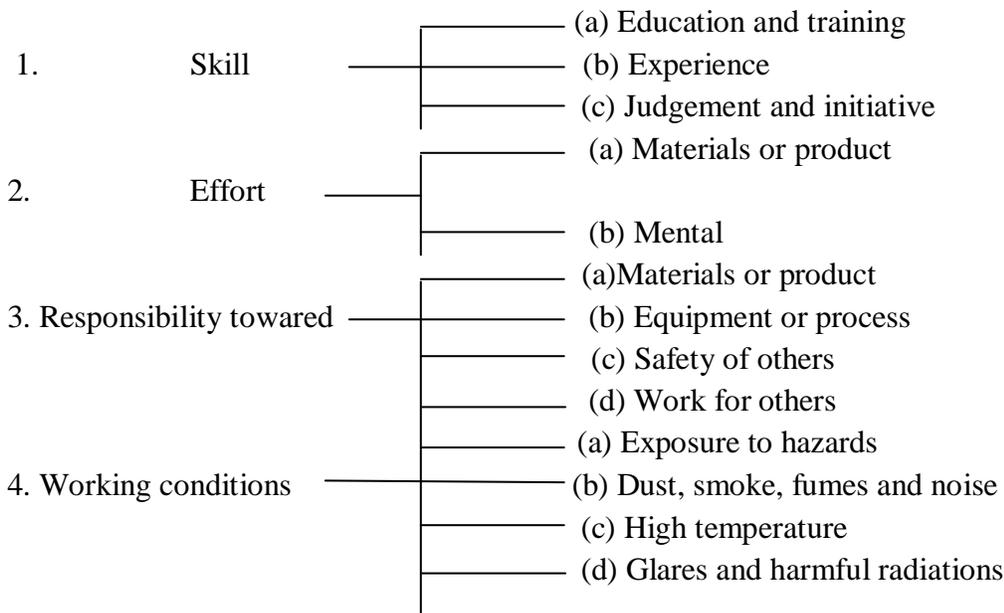
- i) The selection of wrong or unfairly paid jobs as key jobs can result in considerable error.

- ii) It is a complicated method, it is not easily understood and hence less popular as compared point method.
- iii) The method depends upon subjective judgement, different persons may attach different monetary values with each factor for the same importance.
- iv) It is costly to introduce.

4. Point method. The point system a widely used method is based on dividing the jobs into a number of factors which in turn are further subdivided into grades or degrees. Certain points (weightage) is assigned to each grade. (For example, effort is one of the factors which may be subdivided in two grades—physical and mental) when such points for all the factors are added they indicate the importance of the job in the organisation. The points or weightage assigned to each factor will vary from industry to industry. Point method involves the following major steps:

- (a) Decide the type of jobs to be evaluated.
- (b) Select and define job factors which may vary from five to ten.

A few job factors commonly selected are as given below:



While selecting the factors it should be noted that:

- (1) The factors selected must be rateable. For example, education is a rateable factor as it can be specified in varying degrees such as middle school, high school, trade certificate, graduation, postgraduation etc.
- (2) The number of factors should be as few as possible.
- (3) Only important factors should be selected factors which are present to the same degree in all jobs should not be selected.
- (4) Each factor should measure only one aspect of the job.

Select and define grades or degrees to each factor- For example, education and training may have the following factors :

- (i) Diploma in engineering with no training
- (ii) Diploma in engineering 2 years apprentice training.
- (iii) Diploma in engineering with 2 years training in machine shop and certificate course in computer applications.
- (iv) Diploma in engineering, A.M.I.E. and 2 years experience.

Assigning points to the degrees/grades:

Each grade/degree is allotted certain points. The first and the last grades possess minimum and maximum points respectively.

For example, if the percentage weight of education factor is 15% and the factor is split into 4 degrees as above, then the points for the degrees would be as under:

Degree	Point value for the degree
1 st	15
2nd	30
3rd	45
4 th	60

Table 21.2. Illustrative example of factors, degree and their weightages

Factors	Factor weightage %	Point values for the degrees				
		1	2	3	4	5
1. Skill						
(a) Education	20	20	40	60	80	100
(b) Experience	15	15	30	45	60	90
(c) Judgement and initiative	15	15	30	45	60	90
2. Efforts						
(a) Physical	10	10	20	30	40	50
(b) Mental	5	5	10	15	20	25
3. Responsibility						
(a) Materials	3	3	6	9	12	15
(b) Equipments	5	5	10	15	20	25
(c) Safety of others	2	2	4	6	8	10
(d) Work of others	5	5	10	15	20	25
4. Working conditions						
(a) Exposure to hazards	5	5	10	15	20	25
(b) Dust smoke, fumes noise	5	5	10	15	20	25
(c) High temperature	5	5	10	15	20	25
(d) Glares, radiations	5	5	10	15	20	25
	100%					

Table 21.2 shows the weightage given to each factor and the points allocated to each grade. Five grades have been assumed for each factor and the points allocated to each grade.

Suppose for a particular job, the evaluation is as below:

Factors	Points
Skill	80
Effort	25
Responsibility	20
Working conditions	30

Total	155

If it is assumed that point is equal to Rs. 20 then 155 points are equivalent to Rs. 3 100 in money value. In this manner, the evaluation is done in point system.

Advantages:

1. Point method is more accurate and reliable.
2. It is less subjective than other methods.
3. It is easy to understand and logical to explain.
4. It is most widely used method of job evaluation.

Disadvantages:

1. Analysis of (actors and grades requires large experience and expertise.
- . Points allocated to each factor are based on arbitrary grounds.

MERIT RATING

Employees' merit rating is also known as performance appraisal or performance evaluation. U is the assessment of performance of the worker and his utility to the industry. Whereas job evaluation evaluates the job. Merit rating assesses the merit of the person doing the job. It determines the extent to which an employee meets the job requirements. It is basically a controlling and reviewing function.

As we inspect our equipments and machinery periodically to ensure that they are in order and capable of performing intended function, similarly, employees in the organisation need to be inspected periodically to ensure that they produce the desired results. An effective merit rating, system is essential if the enterprise wants to make best use of its available manpower.

Definition:

Merit rating is a systematic and orderly approach to assess the relative worth of an employee working in an organisation in terms of job performance, integrity, leadership, intelligence, behaviour, aptitude and other qualities which are necessary to carry out his job successfully.

Merit rating can also be defined as "a process and a system for knowing how efficiently and effectively the assigned work is carried out by employees and identifying suitability of employees for other jobs, particularly of higher responsibility in an organisation.

It can also be defined as a systematic evaluation of an employee's performance on the job in terms of the requirements of the job.

Merit rating systematically evaluates the fitness of the employee for a given job in terms of assigned factor. It replaces haphazard, guess work, unmethodical and unrecorded judgement by an unbiased and objective method of assessment, subject to over-riding limitations of human nature.

Different between Job Evaluation and Merit Rating

1. Job evaluation evaluates the job, merit rating evaluates the performance of a person doing the job.
2. Job evaluation determines suitable wage structure for the job while, merit rating decides the reward an employee should get in addition to his wages depending upon his merit.
3. Job evaluation does not recognise individual performance or variation within the job. It merely determines wage and salaries level for jobs. Merit rating on the other band recognizes individual differences or variation within job. No two individuals are alike in all respects and merit rating points out the relative difference in individual performance.

Benefits and Objectives of Merit Rating

1. Merit rating is a good device to increase industrial productivity and to reduce hostility between employers and employees.
2. It provides a sound basis in making decisions for promotion, transfer etc. The rating of employees minimizes the chances of arbitrary promotion based on other strengths and weaknesses.
3. It assists in taking decisions about incentive, increments to be given to the workers.
4. It provides the basis for counseling the individual employees by pointing out their strengths and weakness.
5. It increases consciousness of employees and introduces competitive spirit in them.
6. It enables the management to decide training needs of the organisation which can be abstracted from merit rating of the employee.
7. It checks the effectiveness of recruiting, training and placement of employees and provides a basis for better job reassignment when employees have been improperly placed.
8. It promotes a desire for improvement and heightens morale by knowing that management appraises and rewards individual performance and growth.
9. It guides and aids employees in their self-improvement and makes possible a close follow-up of their progress.
10. It forces the supervisors to know their sub-ordinates more closely since judgement of supervisors are put in writing subject to check at higher level.

SELECTION OF FACTORS IN SETTING UP RATING METHOD

The performance factors for merit rating must be carefully selected, defined, sub-divided into degrees, and weighed, the data must be incorporated into a rating scale (i.e. scoring form), and instructions must be drawn up for its proper use. The performance factors in the rating scale for supervisors will, therefore differ to some extent from those for manual workers or office employees. The frequently used factors or set of characteristics which determine the merit of the person are :

- | | |
|--|----------------------|
| 1. Quality of work | 2. Quantity of work |
| 3. Job knowledge | 4. Dependability and |
| 5. Attitudes as reflected for example, in attendance and safety records and ability to co-operate. | |
| 6. Initiative and judgement | 7. Versatility. |
| 8. Quality of leadership etc. | |

Each factor should be precisely defined to secure a common understanding of qualities and consistent standard of appraisal among raters and from one scoring period to another.

To measure the relative influence of a particular factor upon the employee's performance and worth, each factor should be sub-divided onto appropriate degrees (usually five) and described in carefully stated phrases. The factors should then be weighed according to their relative importance and in terms of the purpose of rating. Because of the need to justify rating to employees the "objective qualities" (e.g. quality and quantity of output) measures are sometimes given more weight than the "subjective qualities". A variety of rating scales are used in industry, a typical format used for employee merit-rating is shown in Fig 21.2.

(3) Man to man comparison. (4) Check list plan.

(5) Scale plan.

1. Ranking Method. Ranking is the oldest, simplest and most conventional method. In this method the workers are arranged in rank from best or most satisfactory to worst or least satisfactory. There another way of ranking by classifying the jobs in a firm in terms of various level of skill or responsibility and rank the workers accordingly. This method however does not indicate points of difference between two or more of them or does not indicate specific strengths and weakness. This method is used in business organisations where there are few employees.

2. Paired Comparison Method. This is a modified ranking method. In this method man is compared with every other man. One at a time. Comparison is done with one trait (i.e. ability to perform the job). For example, A’ performance is compared to that of B’s and made concerning whose performance is better. Then A is compared to C, D and E in order. Next , B must be compared with all others, individually. The same approach is used for other personnel. Each time worker is better than the other one point is assigned to him. Once all possible combinations are considered, points scored by each employee are totaled and he is ranked according to his aggregate score in relation to aggregate score of each other employee. The number of combinations can be worked out with the formula.

$$\text{Number of comparisons} = \frac{N(N-1)}{2}$$

Where N = total number of employee to be evaluated.

This method is not suitable where number of employees is large. This method also dose not indicate specific strengths and weaknesses.

3. Man to Man Comparison Plan. The plan was widely used m U.S.A. m rating military officer, and hence sometimes is also known as Army Rating scale. This is based on five basic characteristics:

- a) Physical qualities.
- b) Personal qualities.
- c) Intelligence
- d) General value of service.
- e) Leadership.

Each of the characteristics was sub-divided into five degrees and values assigned to each degree. Thus a person to person comparison of each person or officer was made and position determined Therefore this is known as Man to Man comparison method.

4. Check List Plan. These are the lists made up of a series of questions or statement which concern the importance of the employees performance on the job.

5. Scale Plan. This is mostly used in industries. There are many variants of scale plans and all consist of a list of attributes or traits, each being accompanied by scale, for rating the

(a) Percentile of Numerical scale. In this scale numbers are used to indicate the degree of trait e.g. Personality

10%	20%	30%	80%	90%	100%
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b) Description Scale. This gives description of the degree of trail e.g. Personality

Poor	Fair	Good	Excellent
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(c) Alphabetical Scale. In this alphabets are used to show the degree of trait.

D	C	B	A
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Many thinkers in discussing the rating method base their approach on the distribution of rating takes the form of well-known normal distribution curve. If there 5 degree used in rating each factor, the % distribution of workers receiving each rating from lowest to highest group may be 4%, 24%, 44%, 24% and 4% respectively.

These different categories are explained below :

- (1) High grade: exceptionally industrious, keen and intelligent workers.
- (2) Low grade: disinterested and lazy workers.
- (3) Average grade: Includes moderately intelligent and hard worker.
- (4) Above average Grades: Good and keen workers better than third grade
- (5) This includes the workers, who are worst than the workers of third grade, i.e. not very interested but do the job.

Management by Objectives (MBO), Management by Exception and MIS

INTRODUCTION

The concept ‘management by objectives’ was introduced by Peter Drucker in the year 1954, for increasing organizational effectiveness. It was later on developed by various writers like John Humble, Dale McConkey, George Ordiorne etc. Peter stated that every manager from the highest to lowest levels in the organisation should have clear objectives to pursue. According to him, such a process would enable each manager to have a clear understanding of what the organisation expects of him, what are his responsibilities and their individual objectives are integrated with the overall organizational objective. In other words, he emphasized that objectives are needed in every area where performance and result directly and vitally affect the survival and prosperity of the business. The performance that is expected of the manager must be derived from the performance goals of the business. His results must be measured by the contribution they make to the success of the enterprise. This in turn requires management by objectives and control by self-control. In the recent years there has been an increasing emphasis on managing by objectives or results for accomplishing the objectives of the enterprise in a better way. Now, it has become a philosophy of managing in many organisations.

10.2. MEANING AND DEFINITION

Many approaches have been utilized to integrate individual and group objectives with overall objectives of the Organisation of an enterprise. According to George S. Ordiorne, Management by objectives is basically, a process, whereby the superior and subordinate managers of an enterprise jointly:

- (i) identify the common goals,
- (ii) (ii) define each individual's major areas of responsibility in terms of results expected of him, and
- (iii) use these measures as guides for operating the unit and assessing the contribution of each of its members.

John Humble has defined, “Management by objectives as a dynamic system which integrates the company's need to achieve its goals for profit and growth with manager's need to contribute and develop himself.”

Further, George Ordiorne has also stressed that, management by objectives is not merely a set of rules, a series of procedures or even a set method of managing, but it is a way of thinking about management.

Dale D McConkey has written management by objectives as management by results and goal setting approach.

The goals are jointly established by the manager and his subordinates and agreed upon in advance. These goals emphasize either output variables or intervening variables, or some combinations of both. MBO is an approach to management planning and evaluation. Specific targets for a year, or some other length of time are established for each manager, on the basis of the results which each must achieve if the overall objectives of the company are to be realised. At the end of the predecided time period, the actual results achieved measured against the original goals i.e. against the expected results which each manager/ subordinate is responsible to achieve.

If after evaluation, it is found that there is some discrepancy between the expected results and the work accomplished, steps are suggested to overcome the problems or to make necessary adjustments in the original plan. This sets the stage for the determination of objectives for the next time period.

OBJECTIVES

Objectives are the end points of management action. They provide meaning to the existence of an organisation. Objectives are the specific targets to be achieved by the enterprise. Therefore, the justification for the existence of an organisation lies in achieving the objectives. They are the end-points towards which all management activities like organising, staffing, directing and controlling are directed. In other words, the manager can determine the kind of organisation, the type of personnel and their skills, the kind of motivation and direction and the nature of control techniques only after defining the basic objectives for which the organisation exists. Objectives may be:

Short-term objectives. Short term objectives are those which are to be achieved by the organisation in the immediate future, e.g. expediting the works lagging behind the schedule.

Long term objectives. Long term objectives are those which are aimed to be achieved over a long period, say five to ten years or even more for example, planning for diversification. However, both short term and long term objectives are inter-related.

Tangible or intangible. Objectives may be tangible or intangible; objectives may also be classified as quantitative and qualitative. Enterprise objectives and departmental objectives—Objectives having wider scope and relevant for the whole organisation are known as enterprise objectives. These objectives are split into unit level or departmental objectives. The objectives at all levels in the organisation are inter-related and form a network.

Conflicting. Sometimes objectives may be in conflict with each other. The goals of the various departments at times may clash, in that, each department considers that its goals are more important. For example, the production goal may be in conflict with the sales goal of offering high quality goods. Such conflicts have to be resolved properly to achieve overall organisational goals.

ESSENTIALS OF EFFECTIVE MANAGEMENT OBJECTIVES

Following are the important essentials of an effective management objectives:

1. Management objectives must be drawn from— "What our business is" ? What it will be and what it should be" '. The objectives should serve as standards against which performance can be measured. It should check the members of the organisation from deviating from the route they have set for themselves.
2. Management objectives must be operational in nature. It must be capable of becoming the basis, as well as the motivation, for work and achievement.
It should be capable of being converted into specific targets and assignments.
3. The objectives must work in the same direction towards achieving company goals.
4. They must be reasonably attained. Objectives must be selective rather than encompass everything. It must make possible concentration of resources and efforts.
5. The objective should be clearly defined and communicated to all. Clear objectives encourage consistency in managerial planning and decision making.

6. Management objectives when it is being considered must have multiple objectives rather than a single objective.
7. Objectives should provide direction not only to managerial activities but also to other business activities. Purchasing, production, designing, marketing and financing are all directed towards the objectives of the enterprise.
8. The management must specify the objectives in all areas on which the survival of the business depends.
9. The management objectives be reviewed after definite time period for adjustment if necessary.

For the determination of the objectives of a concern, large number of complex questions are to be decided. They may be what to produce? How much to produce? Where to produce and where to sell? Other questions may either be related to the internal structure of the concern. Following are some of the factors which must be considered for establishing the company's objectives :

1. Government rules and regulations and other govt. control such as, taxes, restrictions, price control etc.
2. Political atmosphere.
3. Personnel available.
4. Level of productivity.
5. Total expected demand.
6. Market area to be covered etc.

HIEHARCH OF MANAGEMENT OBJECTIVES

As already stated, the enterprise objective have wider scope and are relevant for the whole organisation. The higher level objectives are split into unit level or departmental objectives, which may again be split into sectional objectives. The objectives at all the levels in the organisation are inter-related and form a chain or a network. The objectives of the company are determine by Board of Directors or Managing Director. These are the highest level objectives. The company objectives at the highest level may be to earn maximum profit by manufacturing and marketing automobile vehicles say for example, buses. If we come down to the departmental levels then the major objective focuses on designing and establishing the form of the buses. Further there may be intermediate objectives with manufacturing and assembling the major components and at the lower level the objectives of the individuals consist of performing the detailed work on the subcomponent parts. Fig. 10.1 below shows that the objectives at various levels in a company are integrated and follow a logical sequence. There is the 'end-means' chain in the company. The objectives at the top level provides the basis for setting the objectives at the second level which in turn becomes the basis for objectives at the third level and so on.

PARTIAL FUNCTIONAL ORGANISATION CHART

Organisational Level

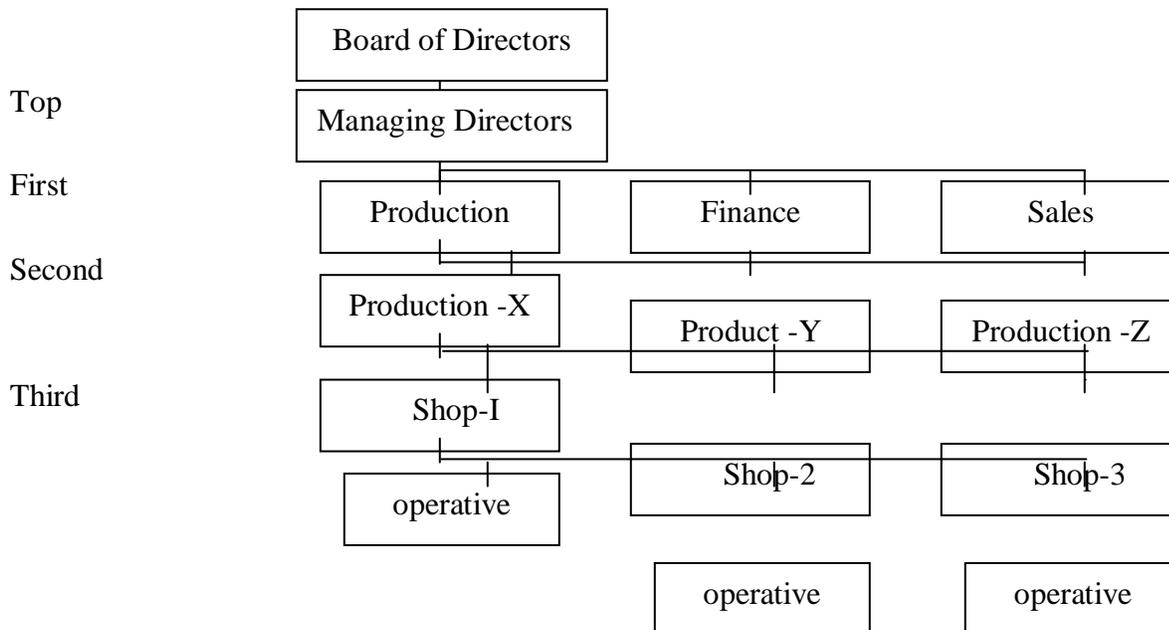


Fig. 10.1. Hierarchy of MBO

PRE-REQUISITES OF MBO

1. MBO is not merely a goal-setting tool. It is Philosophy and has to be understood thoroughly by the managers concerned with achievement of objectives.

2. Top management must be willing to implement the system whole-heartedly. Its support and encouragement are crucial for the success of MBO. The necessary democratic climate has to be created in the organization for setting for setting the goals in a realistic way.

3. Objectives/goals have to be spelt out in specific and clear terms. To the extent possible, they must be made realistic because goals motivate employees towards better performance. The key result areas of the business have to be identified and appropriate objectives have to be specified for these areas. All the important areas of the business must be covered with meaningful objectives.

4. It has to be realised that MBO which involves objective setting is not an end by itself. It is only means to achieve organisational effectiveness. Otherwise, objective setting becomes primary task rather than their achievement.

5. Appropriate organisation structure has to be designed with well understood relationships among people such that every objective/goal becomes some individuals responsibility.

6. Besides clarifying the organisational roles by adopting a suitable organisation structure, attention has to be paid on the resources required by the people to achieve the objectives. Otherwise, objectives by themselves, however effective they are, do not assure performance. Performance depends on the timely availability of resources. Non-availability or inadequate access to the resources frustrates the individuals concerned with the achievement of objectives.

THE PROCESS OF MANAGEMENT BY OBJECTIVES

MBO is a continuous process, it ensures concentration of efforts towards organisation objectives. It also helps in modifying objectives to suit the changed situation. It begins at the top of

the organisation with the establishment of specific organisational objectives. Subsequently, objectives at the various other levels down the hierarchy are decided by mutual discussions and consultations by both superior and subordinates.

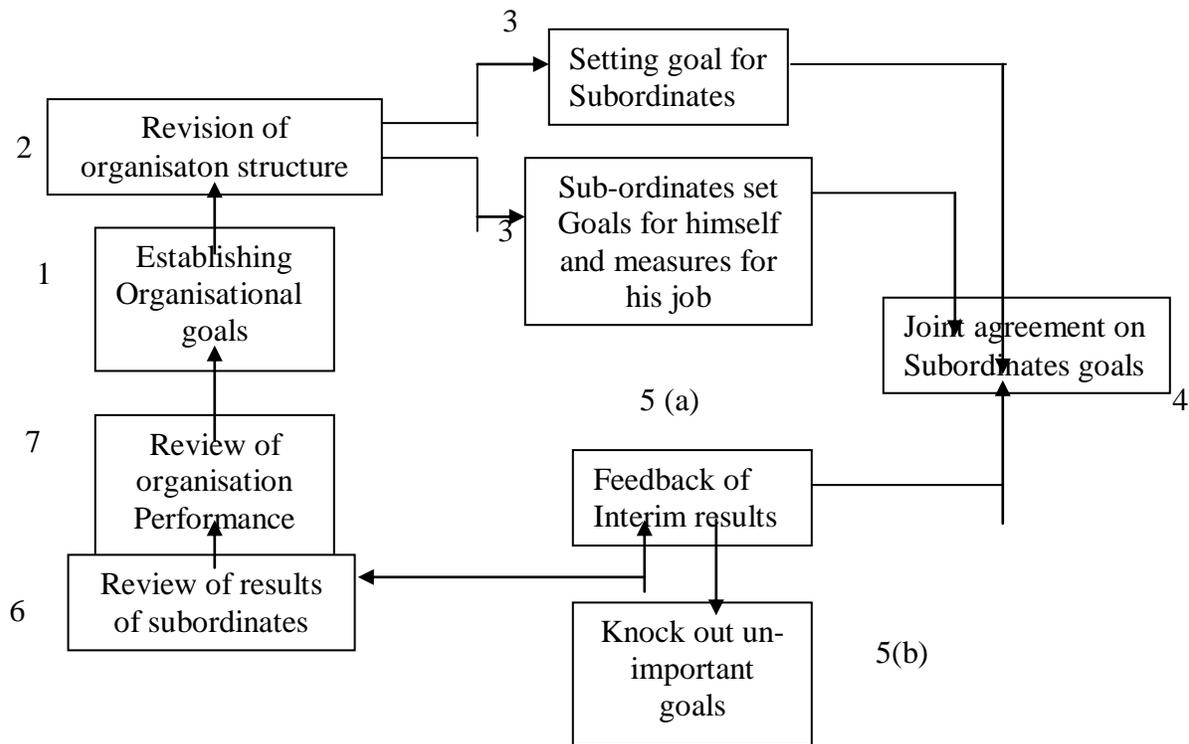


Fig : 10.2. Marketing by objectives.

The process of MBO consists of the following steps:

1. Establishment of objectives for the whole organisation.
2. Revision of organisation structure.
3. Setting goals for the subordinates.
4. Joint agreement upon goals.
5. Establishing check points.
6. Performance appraisal.
7. Corrective measures

1. Establishment of objectives for the whole organisation. The first step is to clarify and establish the common objective for the entire organisation. For setting the objectives the prerequisites are :

- (i) Assessment of various available resources.
- (ii) Study of market and market survey to find out the needs of the customers.
- (iii) Forecast the customers to estimate the demand and business conditions in the country.

This will help in assessing long-term and short-term objectives. Further, an attempt is made to set specific goals on which the survival and growth of the business depends.

2. Revision of organisation structure. When the objectives for each individual are re-organised and re-arranged, there is a considerable change in the job descriptions of various positions. Therefore to achieve these objectives, any appropriate changes in the organisation structure may be made ; Changes in titles, duties, relationships, authority, responsibility, span of

control and so forth. The organisational charts and manuals may be suitably amended to depict the change.

3. Setting goals for the subordinates. After setting the overall objectives of the entire organisation, the top management determines the objectives of every department and their subordinates. The subordinates also propose objectives for their jobs and select the areas in which they must be effective during the period of company plan. Each department has to set its both long term and short term objectives with the approval of top management. Usually, the subordinates must think to obtain desired result in the important areas, such as achievement of greater efficiency, productivity or profitability, reduction of scrap, elimination of bottlenecks etc.

4. Joint agreement/discussion upon goals. Superiors and subordinates sit together, discuss the objectives and reach on joint agreement on subordinate's goals to be achieved during a stated period of time. In other words, the goals are jointly established and agreed upon in advance. Thus the goals are set in a democratic way. Superiors act as facilitators and create a favourable climate where subordinates freely express their opinions, viewpoints and perceptions about what they believe could be achieved.

The process ensures meeting of minds between superiors and sub-ordinates. As a result, there is ample possibility for the subordinates to feel that they are working for their own goals and not for somebody else's. Consequently, they strive to achieve the goals. As they participate in the goal setting exercise actively, they in turn get motivated to achieve them. Thus MBO also serves as a motivational technique.

5. Establishing check points. MBO ensures periodic meeting between the superior and subordinate to review the progress towards the accomplishment of targets of the subordinate. For this, the superior must establish check points or standard of performance for evaluating the progress of the subordinate. The standards should be defined quantitatively as far as possible and the subordinates must understand them fully.

6. Performance Appraisal. Informal performance appraisal of a subordinate is done by his immediate superior almost every day. Usually a major formal review is made annually but it is advisable for quarterly reviews to be undertaken. While carrying out the review, attention is given to the area where progress has been slow or where some unforeseen bottlenecks have occurred.

Corrective measures. Ultimately the performance of the entire organisation should be reviewed with respect to the objectives set. If there is a discrepancy between objectives decided and those achieved, efforts should be initiated to determine the steps to be taken to overcome the problem responsible for discrepancy. This sets the stage for the determination of objectives for the next time period and the entire cycle of MBO is started from the very first step.

ADVANTAGES OF MBO

An organisation can benefit in the following ways by introducing MBO. Following are some of the advantages of MBO:

1. The important benefit of MBO is that it does away with the judgement role of the supervisor. The performance of every individual is evaluated in terms of the standards or end results clearly agreed to, by the superior and the subordinate.

2. MBO leads to greater satisfaction, more agreement, greater comfort, and less tension and hostility between the superiors and subordinates. Under MBO, the superior does not evaluate the

individual concerned but his performance in terms of the standards set in advance. Moreover, the performance review is aimed to assist the subordinate to improve his performance in the future. It also helps in setting goals for the next period.

3. It aims at synchronizing the objectives of the individuals and departments with the objectives of the organisation. This is because the objectives of individuals are consistent with that of the department and the objectives of the department are consistent with the organisational objectives. The possibility for the various departments working at cross purpose is very less.

4. Contributes for effective management by providing lot of clarity in the objectives and the organisation that is necessary to achieve them.

5. It forces the management to plan the activities in a systematic way.

6. Facilitates objective performance appraisal. As the goals themselves become the standards against which the actual performance is measured, MBO system itself acts as an effective performance appraisal tool.

7. It contributes for the installation of a democratic and participative set-up, very essential for the success of an organisation in a complex business environment of today. The interaction that takes place between the subordinates and superiors is a good sign of human resource development in the organisation.

8. Better management and improved communication and organisation structure helps in locating weak and problem areas.

9. It provides a realistic means of analysing training needs and opportunities for growth on the basis of measurement of performance against accepted standards.

10. It helps in stimulating the subordinates' motivation because they work on objectives decided with their consent.

11. MBO keeps company objectives/targets constantly in view and leads to improvement in productivity.

LIMITATIONS OF MBO

1. Inflexibility. Management working by objectives may follow too rigid a pattern in thinking and action. There is always need for flexibility in management thinking due to change in factors external to organisation (for example, market conditions). However, the provisions of written objectives may not allow flexibility in thinking and action.

2. Lack of top management involvement and support. For an MBO programme to succeed, it must have the complete support of top management.

3. Different angle of vision. Each discipline of management (production, finance, marketing, personnel etc.) will view the business in the perspective of its own activities. Hence, functional manager measures his performance by his own professional criteria, instead of measuring his contribution to the enterprise.

4. Difficulty in setting realistic and meaningful objectives. Some jobs and areas of performance cannot be quantified and hence are not amenable for objective evaluation.

5. Lack of relevant skill. Managers may not have the requisite skills for identifying objectives, communication and interpersonal interaction such as counselling and giving as well as receiving feed back.

6. Lack of individual motivation. The rewards and incentives for superior performance have to be specified clearly. If the reward, promotion and such other incentives are not allowed then

with the passage of time consistent good performance cannot be maintained.

7. Poor integration with other system. The objective setting and review phases must be performed in conjunction with other activities such as budgeting, forecasting and the like. Moreover, MBO necessitates decentralisation of decision making powers and delegation of authority so as to fulfil the objectives. Too much decentralisation is also problematic.

8 Lack of understanding of the philosophy behind MBO. MBO programme in some organisations meets the resistance of the employees because it is imposed on them as a 'control device' to curb their freedom.

In spite of various difficulties and shortcomings in management by objectives, it is an efficient way of managing as it emphasizes in practice the setting of objectives as the logic of planning and control. In order to achieve all the merits of managing by objectives, it is essential that it starts at the top of the organisation. Despite a few weaknesses, MBO is still very popular in the industry today. The greatest potential of this technique is that it provides the basis for effective decision making and communication through its emphasis on participative decision making and two-way communication. It aims at integrating the individual goals with the organisational goals. It is used as a technique to set the goals, motivate employees and as a tool to appraise the performance of employees.