UNIT - I

Production Management– Scope and Significance –Production System – Functions and Types – Factors influencing Plant Location – Plant Layout and its kinds.

MEANING OF PRODUCTION MANAGEMENT:

Production Management refers to the application of management principles to the production function in a factory. In other words, production management involves application of planning, organizing, directing and controlling the production process.

Production management also deals with decision-making regarding the quality, quantity, cost, etc., of production. It applies management principles to production.

Production management is a part of business management. It is also called "**Production Function**." Production management is slowly being replaced by operations management.

DEFINITION OF PRODUCTION MANAGEMENT:

It is observed that one cannot demarcate the beginning and end points of Production Management in an establishment. The reason is that it is interrelated with many other functional areas of business, viz., marketing, finance, industrial relation policies etc.

Alternately, Production Management is not independent of marketing, financial and personnel management due to which it is very difficult to formulate some single appropriate definition of Production Management.

"Production Management is the process of effective planning and regulating the operations of that section of an enterprise which is responsible for the actual transformation of materials into finished products."

This definition limits the scope of production management to those activities of an enterprise which is associated with the transformation process of inputs into outputs. & the definition does not include the human factors involved in a production process. It lays stress on materialistic features only.

Production Management deals with decision-making related to production process. So that the resulting goods and services are produced in accordance with the quantitative specifications and demand schedule with minimum cost.

FUNCTIONS OF PRODUCTION MANAGEMENT:

The definitions discussed above clearly shows that the concept of production management is related mainly to the organizations engaged in production of goods and services. Earlier these organizations were mostly in the form of one man shops having insignificant problems of managing the productions.

But with development and expansion of production organizations in the shape of factories more complicated problems like location and lay out, inventory control, quality control, routing and scheduling of the production process etc. came into existence which required more detailed analysis and study of the whole phenomenon.

This resulted in the development of production management in the area of factory management. In the beginning the main function of production management was to control labour costs which at that time constituted the major proportion of costs associated with production.

But with development of factory system towards mechanization and automation the indirect labour costs increased tremendously in comparison to direct labour costs, e.g., designing and packing of the products, production and inventory control, plant layout and location,

transportation of raw materials and finished products etc. The planning and control of all these activities required more expertise and special techniques.

IMPORTANCE OF PRODUCTION MANAGEMENT

(i) Design and development of production process.
(ii) Production planning and control.
(iii) Implementation of the plan and related activities to produce the desired output.
(iv) Administration and co-ordination of the activities of various components and departments responsible for producing the necessary goods and services.
However, the responsibility of determining the output characteristics and the distribution strategy followed by an organization including pricing and selling policies are normally outside the scope of Production Management.

OBJECTIVE OF PRODUCTION MANAGEMENT

The main **objective** of production management is to produce goods and services of the right quality, right quantity, at the right time and at minimum cost. It also tries to improve the efficiency. An efficient organisation can face competition effectively. Production management ensures full or optimum utilisation of available production capacity.

SCOPE OF PRODUCTION MANAGEMENT

Production concern with the conversion of inputs into outputs, using physical resources, so as to provide the desired utilities to the customer while meeting the other organizational objectives of effectiveness, efficiency and adoptability. It distinguishes itself from other functions such as personnel, marketing, finance, etc., by its primary concern for 'conversion by using physical resources.' Following are the activities which are listed under production and operations management functions:

1. Location of facilities
2. Plant layouts and material handling
3. Product design
4. Process design
5. Production and planning control
6. Quality control
7. Materials management
8. Maintenance management.

Location of facilities:

Location of facilities for operations is a long-term capacity decision which involves a long term commitment about the geographically static factors that affect a business organization. It is an important strategic level decision-making for an organization. It deals with the questions such as 'where our main operations should be based?' The selection of location is a key-decision as large investment is made in building plant and machinery. An improper location of plant may lead to waste of all the investments made in plant and machinery equipments. Hence, location of plant should be based on the company's expansion plan and policy, diversification plan for the products, changing sources of raw materials and many other factors. The purpose of the location study is to find the optimal location that will results in the greatest advantage to the organization.

Plant layout and material handling:

Plant layout refers to the physical arrangement of facilities. It is the configuration of departments, work centers and equipment in the conversion process. The overall objective of the plant layout is to design a physical arrangement that meets the required output quality and quantity most economically.

According to **James Moore,** "Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipments and all other supporting services along with the design of best structure to contain all these facilities".'Material Handling' refers to the 'moving of materials from the store room to the machine and from one machine to the next during the process of manufacture'. It is also defined as the 'art and science of moving, packing and storing of products in any form'. It is a specialized activity for a modern manufacturing concern, with 50 to 75% of the cost of production. This cost can be reduced by proper section, operation and maintenance of material handling devices. Material handling devices increases the output, improves quality, speeds up the deliveries and decreases the cost of production. Hence, material handling is a prime consideration in the designing new plant and several existing plants.

Product design:

Product design deals with conversion of ideas into reality. Every business organization has to design, develop and introduce new products as a survival and growth strategy. Developing the new products and launching them in the market is the biggest challenge faced by the organizations.

The entire process of need identification to physical manufactures of product involves three functions: marketing, product development, and manufacturing. Product development translates the needs of customers given by marketing into technical specifications and designing the various features into the product to these specifications. Manufacturing has the responsibility of selecting the processes by which the product can be manufactured. Product design and development provides link between marketing, customer needs and expectations and the activities required to manufacture the product.

Process design:

Process design is a macroscopic decision-making of an overall process route for converting the raw material into finished goods. These decisions encompass the selection of a process, choice of technology, process flow analysis and layout of the facilities. Hence, the important decisions in process design are to analyze the workflow for converting raw material into finished product and to select the workstation for each included in the workflow.

IMPORTANCE OF PRODUCTION MANAGEMENT

1. **Accomplishment of firm's objectives** : Production management helps the business firm to achieve all its objectives. It produces products, which satisfy the customers' needs and wants. So, the firm will increase its sales. This will help it to achieve its objectives.
2. **Reputation, Goodwill and Image**: Production management helps the firm to satisfy its customers. This increases the firm's reputation, goodwill and image. A good image helps the firm to expand and grow.
3. **Helps to introduce new products**: Production management helps to introduce new products in the market. It conducts Research and development (R&D). This helps the firm to develop newer and better quality products. These products are successful in the market because they give full satisfaction to the customers.

4. **Supports other functional areas**: Production management supports other functional areas in an organisation, such as marketing, finance, and personnel. The marketing department will find it easier to sell good-quality products, and the finance department will get more funds due to increase in sales. It will also get more loans and share capital for expansion and modernisation. The personnel department will be able to manage the human resources effectively due to the better performance of the production department.
5. **Helps to face competition**: Production management helps the firm to face competition in the market. This is because production management produces products of right quantity, right quality, and right price and at the right time. These products are delivered to the customers as per their requirements.
6. **Optimum utilisation of resources**: Production management facilitates optimum utilisation of resources such as manpower, machines, etc. So, the firm can meet its capacity utilisation objective. This will bring higher returns to the organisation.
7. **Minimises cost of production**: Production management helps to minimise the cost of production. It tries to maximise the output and minimise the inputs. This helps the firm to achieve its cost reduction and efficiency objective.
8. **Expansion of the firm** : The Production management helps the firm to expand and grow. This is because it tries to improve quality and reduce costs. This helps the firm to earn higher profits. These profits help the firm to expand and grow.

Production System in Production and Operation Management

The production system of an organization is that part, which produces products of an organization. It is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with the policies communicated by management. A simplified production system is shown above.The production system has the following characteristics:

1. Production is an organized activity, so every production system has an objective.
2. The system transforms the various inputs to useful outputs.
3. It does not operate in isolation from the other organization system.
4. There exists a feedback about the activities, which is essential to control and improve system performance.

PRODUCTION SYSTEM

INTRODUCTION OF PRODUCTION SYSTEM

The production system of an organization is that part, which produces products of an organization. It is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with the policies communicated by management. A simplified production system is shown above.The production system has the following characteristics:

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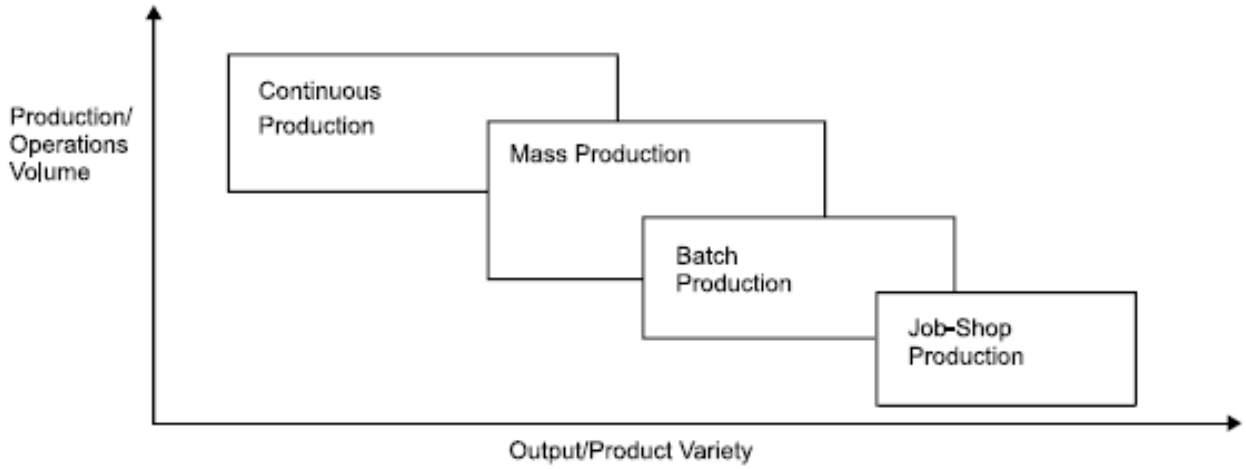
CLASSIFICATION OF PRODUCTION SYSTEM

Production systems can be classified as Job Shop, Batch, Mass and Continuous Production systems.

Classification of production systems



Job shop production:

Job shop production are characterized by manufacturing of one or few quantity of products designed and produced as per the specification of customers within prefixed time and cost. The distinguishing feature of this is low volume and high variety of products.

A job shop comprises of general purpose machines arranged into different departments. Each job demands unique technological requirements, demands processing on machines in a certain sequence.

Characteristics

The Job-shop production system is followed when there is:

1. High variety of products and low volume.
2. Use of general purpose machines and facilities.
3. Highly skilled operators who can take up each job as a challenge because of uniqueness.
4. Large inventory of materials, tools, parts.
5. Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

Advantages

Following are the advantages of job shop production:

1. Because of general purpose machines and facilities variety of products can be produced.
2. Operators will become more skilled and competent, as each job gives them learning opportunities.
3. Full potential of operators can be utilized.
4. Opportunity exists for creative methods and innovative ideas.

Limitations

Following are the limitations of job shop production:

1. Higher cost due to frequent set up changes.
2. Higher level of inventory at all levels and hence higher inventory cost.
3. Production planning is complicated.

4. Larger space requirements.

Batch production:

Batch production is defined by American Production and Inventory Control Society (APICS) "as a form of manufacturing in which the job passes through the functional departments in lots or batches and each lot may have a different routing."It is characterized by the manufacture of limited number of products produced at regular intervals and stocked awaiting sales.

Characteristics

Batch production system is used under the following circumstances:

1. When there is shorter production runs.
2. When plant and machinery are flexible.
3. When plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.
4. When manufacturing lead time and cost are lower as compared to job order production.

Advantages

Following are the advantages of batch production:

1. Better utilization of plant and machinery.
2. Promotes functional specialization.
3. Cost per unit is lower as compared to job order production.
4. Lower investment in plant and machinery.
5. Flexibility to accommodate and process number of products.
6. Job satisfaction exists for operators.

Limitations

Following are the limitations of batch production:

1. Material handling is complex because of irregular and longer flows.
2. Production planning and control is complex.
3. Work in process inventory is higher compared to continuous production.
4. Higher set up costs due to frequent changes in set up.

Mass production:

Manufacture of discrete parts or assemblies using a continuous process are called mass production. This production system is justified by very large volume of production. The machines are arranged in a line or product layout. Product and process standardization exists and all outputs follow the same path.

Characteristics

Mass production is used under the following circumstances:

1. Standardization of product and process sequence.
2. Dedicated special purpose machines having higher production capacities and output rates.
3. Large volume of products.
4. Shorter cycle time of production.
5. Lower in process inventory.
6. Perfectly balanced production lines.
7. Flow of materials, components and parts is continuous and without any back tracking.
8. Production planning and control is easy.
9. Material handling can be completely automatic.

Advantage

Following are the advantages of mass production:

1. Higher rate of production with reduced cycle time.

2. Higher capacity utilization due to line balancing.
3. Less skilled operators are required.
4. Low process inventory.
5. Manufacturing cost per unit is low.

Limitations

Following are the limitations of mass production:

1. Breakdown of one machine will stop an entire production line.
2. Line layout needs major change with the changes in the product design.
3. High investment in production facilities.
4. The cycle time is determined by the slowest operation.

Continuous production:

Production facilities are arranged as per the sequence of production operations from the first operations to the finished product. The items are made to flow through the sequence of operations through material handling devices such as conveyors, transfer devices, etc.

Characteristics

Continuous production is used under the following circumstances:

1. Dedicated plant and equipment with zero flexibility.
2. Material handling is fully automated.
3. Process follows a predetermined sequence of operations.
4. Component materials cannot be readily identified with final product.
5. Planning and scheduling is a routine action.

Advantages

Following are the advantages of continuous production:

1. Standardization of product and process sequence.
2. Higher rate of production with reduced cycle time.
3. Higher capacity utilization due to line balancing.
4. Manpower is not required for material handling as it is completely automatic.
5. Person with limited skills can be used on the production line.
6. Unit cost is lower due to high volume of production.

Limitations

Following are the limitations of continuous production:

1. Flexibility to accommodate and process number of products does not exist.
2. Very high investment for setting flow lines.
3. Product differentiation is limited.

PLANT LOCATION AND LAYOUT

INTRODUCTION

Plant location or the facilities location problem is an important strategic level decision making for an organization. One of the key features of a conversion process (manufacturing system) is the efficiency with which the products (services) are transferred to the customers. This fact will include the determination of where to place the plant or facility.

The selection of location is a key-decision as large investment is made in building plant and machinery. It is not advisable or not possible to change the location very often. So an

improper location of plant may lead to waste of all the investments made in building and machinery, equipment.

Before a location for a plant is selected, long range forecasts should be made anticipating future needs of the company. The plant location should be based on the company's expansion plan and policy, diversification plan for the products, changing market conditions, the changing sources of raw materials and many other factors that influence the choice of the location decision. The purpose of the location study is to find an optimum location one that will result in the greatest advantage to the organization.

NEED FOR SELECTING A SUITABLE LOCATION

The need for selecting a suitable location arises because of three situations.

I. When starting a new organization, i.e., location choice for the first time.
II. In case of existing organization.
III. In case of Global Location.

I. **In Case of Location Choice for the First Time or New Organizations**

Cost economies are always important while selecting a location for the first time, but should keep in mind the cost of long-term business/ organizational objectives. The following are the factors to be considered while selecting the location for the new organizations:

1. **Identification of region:**
   The organizational objectives along with the various long-term considerations about marketing, technology, internal organizational strengths and weaknesses, region-specific resources and business environment, legal-governmental environment, social environment and geographical environment suggest a suitable region for locating the operations facility.
2. **Choice of a site within a region:**
   Once the suitable region is identified, the next step is choosing the best site from an available set. Choice of a site is less dependent on the organization's long-term strategies. Evaluation of alternative sites for their tangible and intangible costs will resolve facilities-location problem. The problem of location of a site within the region can be approached with the following cost-oriented non-interactive model, i.e., dimensional analysis.
3. **Dimensional analysis:**
   If all the costs were tangible and quantifiable, the comparison and selection of a site is easy. The location with the least cost is selected. In most of the cases intangible costs which are expressed in relative terms than in absolute terms. Their relative merits and demerits of sites can also be compared easily. Since both tangible and intangible costs need to be considered for a selection of a site, dimensional analysis is used.

Need for Plant Location

The plant Location of warehouses and other facilities are also having direct bearing on the operational performance of organizations.

The existing firms will seek new locations in order to expand the capacity or to place the existing facilities. When the demand for product increases, it will give rise to following decisions:

- Whether to expand the existing capacity and facilities.
- Whether to look for new locations for additional facilities.
- Whether to close down existing facilities to take advantage of some new locations.

II. **In Case of Location Choice for Existing Organization**

In this case a manufacturing plant has to fit into a multi-plant operations strategy. That is, additional plant location in the same premises and elsewhere under following circumstances:

1. Plant manufacturing distinct products.
2. Manufacturing plant supplying to specific market area.
3. Plant divided on the basis of the process or stages in manufacturing.
4. Plants emphasizing flexibility.

The different operations strategies under the above circumstances could be:

1. **Plants manufacturing distinct products:**

Each plant services the entire market area for the organization. This strategy is necessary where the needs of technological and resource inputs are specialized or distinctively different for the different product-lines. For example, a high quality precision product-line should not be located along with other product-line requiring little emphasis on precision. It may not be proper to have too many contradictions such as sophisticated and old equipment, highly skilled and semi-skilled personnel, delicates processes and those that could permit rough handlings, all under one roof and one set of managers. Such a setting leads to much confusion regarding the required emphasis and the management policies.

Product specialization may be necessary in a highly competitive market. It may be necessary to exploit the special resources of a particular geographical area. The more decentralized these pairs are in terms of the management and in terms of their physical location, the better would be the planning and control and the utilization of the resources.

2. **Manufacturing plants supplying to a specific market area:**

Here, each plant manufactures almost all of the company's products. This type of strategy is useful where market proximity consideration dominates the resources and technology considerations. This strategy requires great deal of coordination from the corporate office. An extreme example of this strategy is that of soft drinks bottling plants.

3. **Plants divided on the basis of the process or stages in manufacturing:**

Each production process or stage of manufacturing may require distinctively different equipment capabilities, labor skills, technologies, and managerial policies and emphasis. Since the products of one plant feed into the other plant, this strategy requires much centralized coordination of the manufacturing activities from the corporate office that are expected to understand the various technological aspects of all the plants.

4. **Plants emphasizing flexibility:**

This requires much coordination between plants to meet the changing needs and at the same time ensure efficient use of the facilities and resources. Frequent changes in the long-term strategy in order to improve be efficiently temporarily, are not healthy for the organization. In any facility location problem the central question is: 'Is this a location at which the company can remain competitive for a long time?'

For an established organization in order to add on to the capacity, following are the ways:

- Expansion of the facilities at the existing site: This is acceptable when it does not violate the basic business and managerial outlines, i.e ., philosophies, purposes, strategies and capabilities. For example, expansion should not compromise quality, delivery, or customer service.
- Relocation of the facilities (closing down the existing ones): This is a drastic step which can be called as 'Uprooting and Transplanting'. Unless there are very compelling reasons,

relocation is not done. The reasons will be either bringing radical changes in technology, resource availability or other destabilization.

All these factors are applicable to service organizations, whose objectives, priorities and strategies may differ from those of hardcore manufacturing organizations.

III. **In Case of Global Location**:

Because of globalization, multinational corporations are setting up their organizations in India and Indian companies are extending their operations in other countries. In case of global locations there is scope for virtual proximity and virtual factory.

VIRTUAL PROXIMITY: With the advance in telecommunications technology, a firm can be in virtual proximity to its customers. For a software services firm much of its logistics is through the information/ communication pathway. Many firms use the communications highway for conducting a large portion of their business transactions. Logistics is certainly an important factor in deciding on a location whether in the home country or abroad. Markets have to be reached. Customers have to be contacted. Hence, a market presence in the country of the customers is quite necessary.

VIRTUAL FACTORY: Many firms based in USA and UK in the service sector and in the manufacturing sector often out sources part of their business processes to foreign locations such as India. Thus, instead of one's own operations, a firm could use its business associates' operations facilities. The Indian BPO firm is a foreign-based company's 'virtual service factory'. So a location could be one's own or one's business associates. The location decision need not always necessarily pertain to own operations.

REASONS FOR GALOBAL/FOREIGN LOCATION

A. **Tangible Reasons**:

The tangible reasons for setting up an operations facility abroad could be as follows:

Reaching the customer: One obvious reason for locating a facility abroad is that of capturing a share of the market expanding worldwide. The phenomenal growth of the GDP of India is a big reason for the multinationals to have their operations facilities in our country. An important reason is that of providing service to the customer promptly and economically which is logistics-dependent. Therefore, cost and case of logistics is a reason for setting up manufacturing facilities abroad. By logistics set of activities closes the gap between productions of goods/services and reaching of these intended goods/services to the customer to his satisfaction. Reaching the customer is thus the main objective. The tangible and intangible gains and costs depend upon the company defining for itself as to what that 'reaching' means. The tangible costs could be the logistics related costs; the intangible costs may be the risk of operating is a foreign country. The tangible gains are the immediate gains; the intangible gains are an outcome of what the company defines the concepts of reaching and customer for itself.

The other tangible reasons could be as follows:

a. The host country may offer substantial tax advantages compared to the home country.
b. The costs of manufacturing and running operations may be substantially less in that foreign country. This may be due to lower labor costs, lower raw material cost, better availability of the inputs like materials, energy, water, ores, metals, key personnel etc.

c. The company may overcome the tariff barriers by setting up a manufacturing plant in a foreign country rather than exporting the items to that country.

B. **Intangible Reasons**:

The intangible reasons for considering setting up an operations facility abroad could be as follows:

1. **Customer-related Reasons**:
   a. With an operations facility in the foreign country, the firm's customers may feel secure that the firm is more accessible. Accessibility is an important 'service quality' determinant.
   b. The firm may be able to give a personal tough.
   c. The firm may interact more intimately with its customers and may thus understand their requirements better.
   d. It may also discover other potential customers in the foreign location.
2. **Organizational Learning-related Reasons**:
   a. The firm can learn advanced technology. For example, it is possible that cutting-edge technologies can be learnt by having operations in a technologically more advanced country. The firm can learn from advanced research laboratories/universities in that country. Such learning may help the entire product-line of the company.
   b. The firm can learn from its customers abroad. A physical location there may be essential towards this goal.
   c. It can also learn from its competitors operating in that country. For this reason, it may have to be physically present where the action is.
   d. The firm may also learn from its suppliers abroad. If the firm has a manufacturing plant there, it will have intensive interaction with the suppliers in that country from whom there may be much to learn in terms of modern and appropriate technology, modern management methods, and new trends in business worldwide.
3. **Other Strategic Reasons**:
   a. The firm by being physically present in the host country may gain some 'local boy' kind of psychological advantage. The firm is no more a 'foreign' company just sending its products across international borders. This may help the firm in lobbying with the government of that country and with the business associations in that country.
   b. The firm may avoid 'political risk' by having operations in multiple countries.
   c. By being in the foreign country, the firm can build alternative sources of supply. The firm could, thus, reduce its supply risks.
   d. The firm could hunt for human capital in different countries by having operations in those countries. Thus, the firm can gather the best of people from across the globe.
   e. Foreign locations in addition to the domestic locations would lower the market risks for the firm. If one market goes slow the other may be doing well, thus lowering the overall risk.

FACTORS AFFECTING IN FACILITY LOCATION:

Facility location is the process of determining a geographic site for a firm's operations. Managers of both service and manufacturing organizations must weigh many factors when assessing the desirability of a particular site, including proximity to customers and suppliers, labor costs, and transportation costs.

Location conditions are complex and each comprises a different Characteristic of a tangible (i.e. Freight rates, production costs) and non-tangible (i.e. reliability, frequency security, quality) nature.

Location conditions are hard to measure. Tangible cost based factors such as wages and products costs can be quantified precisely into what makes locations better to compare. On the other hand non-tangible features, which refer to such characteristics as reliability, availability and security, can only be measured along an ordinal or even nominal scale. Other non-tangible features like the percentage of employees that are unionized can be measured as well. To sum this up non-tangible features are very important for business location decisions.

It is appropriate to divide the factors, which influence the plant location or facility location on the basis of the nature of the organization as

1. **General location factors**, which include controllable and uncontrollable factors for all type of organizations.
2. **Specific location factors** specifically required for manufacturing and service organizations.

Location factors can be further divided into two categories: Dominant factors are those derived from competitive priorities (cost, quality, time, and flexibility) and have a particularly strong impact on sales or costs. Secondary factors also are important, but management may downplay or even ignore some of them if other factors are more important.

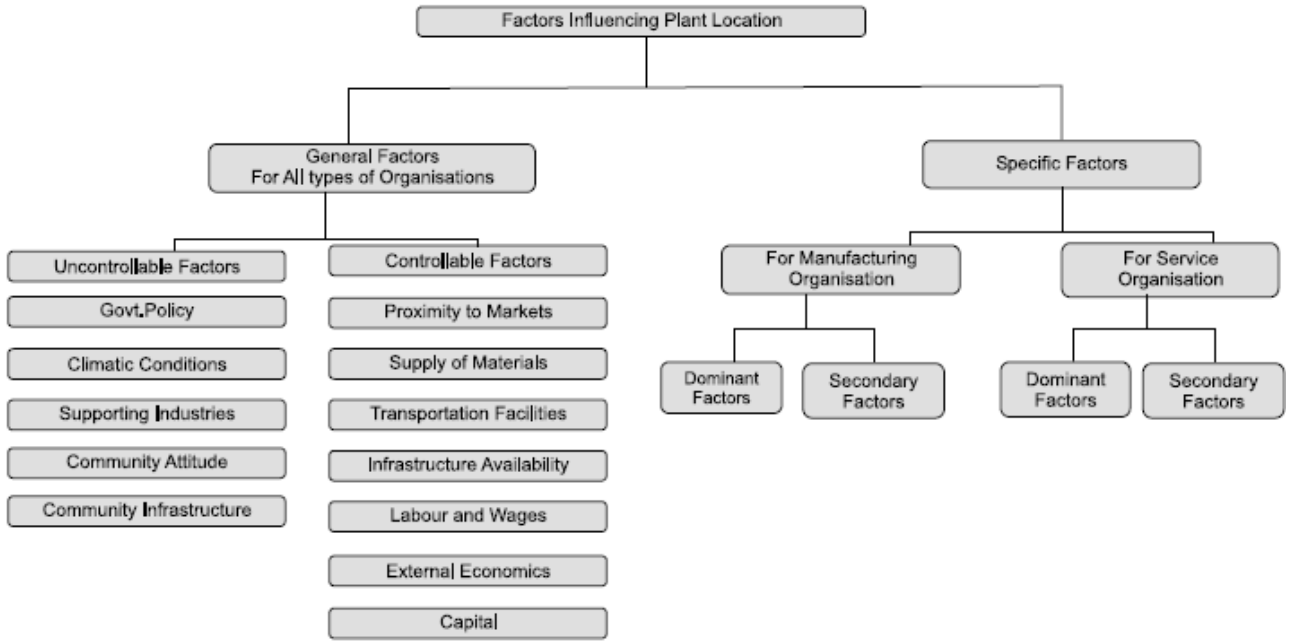
General Location Factors:

Following are the general factors required for location of plant in case of all types of organisations.

CONTROLLABLE FACTORS

1. Proximity to markets.
2. Supply of materials
3. Transportation facilities
4. Infrastructure availability
5. Labour and wages

FACTORS INFLUENCING PLANT LOCATION



6. External economies
7. Capital

UNCONTROLLABLE FACTORS

8. Government policy
9. Climate conditions
10. Supporting industries and services
11. Community and labor attitudes
12. Community Infrastructure

CONTROLLABLE FACTORS

1. **Proximity to markets:**

Every company is expected to serve its customers by providing goods and services at the time needed and at reasonable price organizations may choose to locate facilities close to the market or away from the market depending upon the product. When the buyers for the product are concentrated, it is advisable to locate the facilities close to the market. Locating nearer to the market is preferred if,

- The products are delicate and susceptible to spoilage.
- After sales services are promptly required very often.
- Transportation cost is high and increase the cost significantly.
- Shelf life of the product is low.

Nearness to the market ensures a consistent supply of goods to customers and reduces the cost of transportation.

2. **Supply of raw material:**

It is essential for the organization to get raw material in right qualities and time in order to have an uninterrupted production. This factor becomes very important if the materials are perishable and cost of transportation is very high. General guidelines suggested by Yaseen regarding effects of raw materials on plant location are:

- When a single raw material is used without loss of weight, locate the plant at the raw material source, at the market or at any point in between.

- When weight loosing raw material is demanded, locate the plant at the raw material source.
- When raw material is universally available, locate close to the market area.
- If the raw materials are processed from variety of locations, the plant may be situated so as to minimize total transportation costs.

Nearness to raw material is important in case of industries such as sugar, cement, jute and cotton textiles.

3. **Transportation facilities:**

Speedy transport facilities ensure timely supply of raw materials to the company and finished goods to the customers. The transport facility is a prerequisite for the location of the plant. There are five basic modes of physical transportation, air, road, rail, water and pipeline. Goods that are mainly intended for exports demand a location near to the port or large airport. The choice of transport method and hence the location will depend on relative costs, convenience, and suitability. Thus transportation cost to value added is one of the criteria for plant location.

4. **Infrastructure availability:**

The basic infrastructure facilities like power, water and waste disposal, etc., become the prominent factors in deciding the location. Certain types of industries are power hungry e.g., aluminum and steel and they should be located close to the power station or location where uninterrupted power supply is assured throughout the year. The non-availability of power may become a survival problem for such industries. Process industries like paper, chemical, cement, etc., require continuous. Supply of water in large amount and good quality, and mineral content of water becomes an important factor. A waste disposal facility for process industries is an important factor, which influences the plant location.

5. **Labor and wages:**

The problem of securing adequate number of labor and with skills specific is a factor to be considered both at territorial as well as at community level during plant location. Importing labor is usually costly and involve administrative problem. The history of labor relations in a prospective community is to be studied. Prospective community is to be studied. Productivity of labor is also an important factor to be considered. Prevailing wage pattern, cost of living and industrial relation and bargaining power of the unions' forms in important considerations.

6. **External economies of scale:**

External economies of scale can be described as urbanization and locational economies of scale. It refers to advantages of a company by setting up operations in a large city while the second one refers to the "settling down" among other companies of related Industries. In the case of urbanization economies, firms derive from locating in larger cities rather than in smaller ones in a search of having access to a large pool of labor, transport facilities, and as well to increase their markets for selling their products and have access to a much wider range of business services.

Location economies of scale in the manufacturing sector have evolved over time and have mainly increased competition due to production facilities and lower production costs as a result of lower transportation and logistical costs. This led to manufacturing districts where many companies of related industries are located more or less in the same area. As large corporations have realized that inventories and warehouses have become a major cost factor, they have tried reducing inventory costs by launching "Just in Time" production system (the so called Kanban System). This high efficient production system was one main factor in the Japanese car industry for being so successful. Just in time ensures to get spare parts from suppliers within just a few hours after ordering. To fulfill these criteria corporations have to be located in the same area increasing their market and service for large corporations.

7. **Capital:**

By looking at capital as a location condition, it is important to distinguish the physiology of fixed capital in buildings and equipment from financial capital. Fixed capital costs as building and construction costs vary from region to region. But on the other hand buildings can also be rented and existing plants can be expanded. Financial capital is highly mobile and does not very much influence decisions. For example, large Multinational Corporations such as Coca- Cola operate in many different countries and can raise capital where interest rates are lowest and conditions are most suitable.Capital becomes a main factor when it comes to venture capital. In that case young, fast growing (or not) high tech firms are concerned which usually have not many fixed assets. These firms particularly need access to financial capital and also skilled educated employees.

UNCONTROLLABLE FACTORS

8. **Government policy:**

The policies of the state governments and local bodies concerning labor laws, building codes, safety, etc., are the factors that demand attention. In order to have a balanced regional growth of industries, both central and state governments in our country offer the package of incentives to entrepreneurs in particular locations. The incentive package may be in the form of exemption from a safes tax and excise duties for a specific period, soft loan from financial institutions, subsidy in electricity charges and investment subsidy. Some of these incentives may tempt to locate the plant to avail these facilities offered.

9. **Climatic conditions:**

The geology of the area needs to be considered together with climatic conditions (humidity, temperature). Climates greatly influence human efficiency and behavior. Some industries require specific climatic conditions e.g., textile mill will require humidity.

10. **Supporting industries and services:**

Now a day the manufacturing organization will not make all the components and parts by itself and it subcontracts the work to vendors. So, the source of supply of component parts will be the one of the factors that influences the location.The various services like communications, banking services professional consultancy services and other civil amenities services will play a vital role in selection of a location.

11. **community and labor attitudes:**

Community attitude towards their work and towards the prospective industries can make or mar the industry. Community attitudes towards supporting trade union activities are important criteria. Facility location in specific location is not desirable even though all factors are favoring because of labor attitude towards management, which brings very often the strikes and lockouts.

12. **Community infrastructure and amenity:**

All manufacturing activities require access to a community infrastructure, most notably economic overhead capital, such as roads, railways, port facilities, power lines and service facilities and social overhead capital like schools, universities and hospitals.

These factors are also needed to be considered by location decisions as infrastructure is enormously expensive to build and for most manufacturing activities the existing stock of infrastructure provides physical restrictions on location possibilities.

SPECIFIC LOCATION FACTORS FOR MANUFACTURING ORGANIZATION

DOMINANT FACTORS

Factors dominating location decisions for new manufacturing plants can be broadly classified in six groups. They are listed in the order of their importance as follows.

1. Favorable labor climate
2. Proximity to markets
3. Quality of life
4. Proximity to suppliers and resources
5. Utilities, taxes, and real estate costs

1. **Favorable labor climate:**

A favorable labor climate may be the most important factor in location decisions for labour-intensive firms in industries such as textiles, furniture, and consumer electronics. Labor climate includes wage rates, training requirements, attitudes toward work, worker productivity, and union strength. Many executives consider weak unions or al low probability of union organizing efforts as a distinct advantage.

2. **Proximity to markets:**

After determining where the demand for goods and services is greatest, management must select a location for the facility that will supply that demand. Locating near markets is particularly important when the final goods are bulky or heavy and outbound transportation rates are high. For example, manufacturers of products such as plastic pipe and heavy metals all emphasize proximity to their markets.

3. **Quality of life:**

Good schools, recreational facilities, cultural events, and an attractive lifestyle contribute to quality of life. This factor is relatively unimportant on its own, but it can make the difference in location decisions.

4. **Proximity to suppliers and resources:**

In many companies, plants supply parts to other facilities or rely on other facilities for management and staff support. These require frequent coordination and communication, which can become more difficult as distance increases?

5. **Utilities, taxes, and real estate costs:**

Other important factors that may emerge include utility costs (telephone, energy, and water), local and state taxes, financing incentives offered by local or state governments, relocation costs, and land costs.

SECONDARY FACTORS:

There are some other factors needed to be considered, including room for expansion, construction costs, accessibility to multiple modes of transportation, the cost of shuffling people and materials between plants, competition from other firms for the workforce, community attitudes, and many others. For global operations, firms are emphasizing local employee skills and education and the local infrastructure.

Specific Location Factors for Service Organization

DOMINANT FACTORS:

The factors considered for manufacturers are also applied to service providers, with one important addition the impact of location on sales and customer satisfaction. Customers usually look about how close a service facility is, particularly if the process requires considerable customer contact.

PROXIMITY TO CUSTOMERS:
Location is a key factor in determining how conveniently customers can carry on business with a firm. For example, few people would like to go to remotely located dry cleaner or supermarket if another is more convenient. Thus the influence of location on revenues tends to be the dominant factor.

TRANSPORTATION COSTS AND PROXIMITY TO MARKETS:
For warehousing and distribution operations, transportation costs and proximity to markets are extremely important. With a warehouse nearby, many firms can hold inventory closer to the customer, thus reducing delivery time and promoting sales.

LOCATION OF COMPETITORS:
One complication in estimating the sales potential at different location is the impact of competitors. Management must not only consider the current location of competitors but also try to anticipate their reaction to the firm's new location. Avoiding areas where competitors are already well established often pays. However, in some industries, such as new-car sales showrooms and fast- food chains, locating near competitors is actually advantageous. The strategy is to create a critical mass, whereby several competing firms clustered in one location attract more customers than the total number who would shop at the same stores at scattered locations. Recognizing this effect, some firms use a follow –the leader strategy when selecting new sites.

SECONDARY FACTORS:
Retailers also must consider the level of retail activity, residential density, traffic flow, and site visibility. Retail activity in the area is important, as shoppers often decide on impulse to go shopping or to eat in a restaurant. Traffic flows and visibility are important because businesses' customers arrive in cars. Visibility involves distance from the street and size of nearby buildings and signs. High residential density ensures nighttime and weekend business when the population in the area fits the firm's competitive priorities and target market segment.

Plant Layout in Operation Management

Plant layout refers to the physical arrangement of production facilities. It is the configuration of departments, work centers and equipment in the conversion process. It is a floor plan of the physical facilities, which are used in production.

According to Moore "Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipment and all other supporting services along with the design of best structure to contain all these facilities".

Plant Location and Plant Layout in Production Management

The Plant location and Plant layout in production management are

PLANT LAYOUT

DEFINITION OF PLANT LAYOUT

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OBJECTIVES OF PLANT LAYOUT:

The primary goal of the plant layout is to maximize the profit by arrangement of all the plant facilities to the best advantage of total manufacturing of the product. The objectives of plant layout are:

1. Streamline the flow of materials through the plant.
2. Facilitate the manufacturing process.
3. Maintain high turnover of in-process inventory.
4. Minimize materials handling and cost.
5. Effective utilization of men, equipment and space.
6. Make effective utilization of cubic space.
7. Flexibility of manufacturing operations and arrangements.
8. Provide for employee convenience, safety and comfort.
9. Minimize investment in equipment.
10. Minimize overall production time.
11. Maintain flexibility of arrangement and operation.
12. Facilitate the organizational structure.

PRINCIPLES OF PLANT LAYOUT

1. **Principle of integration:** A good layout is one that integrates men, materials, machines and supporting services and others in order to get the optimum utilization of resources and maximum effectiveness.
2. **Principle of minimum distance:** This principle is concerned with the minimum travel (or movement) of man and materials. The facilities should be arranged such that, the total distance travelled by the men and materials should be minimum and as far as possible straight line movement should be preferred.
3. **Principle of cubic space utilization:** The good layout is one that utilizes both horizontal and vertical space. It is not only enough if only the floor space is utilized optimally but the third dimension, i.e., the height is also to be utilized effectively.
4. **Principle of flow:** A good layout is one that makes the materials to move in forward direction towards the completion stage, i.e., there should not be any backtracking.
5. **Principle of maximum flexibility**: The good layout is one that can be altered without much cost and time, i.e., future requirements should be taken into account while designing the present layout.
6. **Principle of safety, security and satisfaction:** A good layout is one that gives due consideration to workers safety and satisfaction and safeguards the plant and machinery against fire, theft, etc.
7. **Principle of minimum handling:** A good layout is one that reduces the material handling to the minimum

CLASSIFICATION AND ADVANTAGES OF PLANT LAYOUT

Layouts can be classified into the following five categories:

1. Process layout.
2. Product layout
3. Combination layout
4. Fixed position layout
5. Group layout

Process Layout:

Process layout is recommended for batch production. All machines performing similar type of operations are grouped at one location in the process layout e.g., all lathes, milling machines, etc. are grouped in the shop will be clustered in like groups. Thus, in process layout the arrangement of facilities are grouped together according to their functions. A typical process layout is shown in the following figure. The flow paths of material through the facilities from one functional area to another vary from product to product. Usually the paths are long and there will be possibility of backtracking.

Process layout is normally used when the production volume is not sufficient to justify a product layout. Typically, job shops employ process layouts due to the variety of products manufactured and their low production volumes.

Process layout

Advantages

1. In process layout machines are better utilized and fewer machines are required.
2. Flexibility of equipment and personnel is possible in process layout.
3. Lower investment on account of comparatively less number of machines and lower cost of general purpose machines.
4. Higher utilization of production facilities.
5. A high degree of flexibility with regards to work distribution to machineries and workers.
6. The diversity of tasks and variety of job makes the job challenging and interesting.
7. Supervisors will become highly knowledgeable about the functions under their department.

Limitations

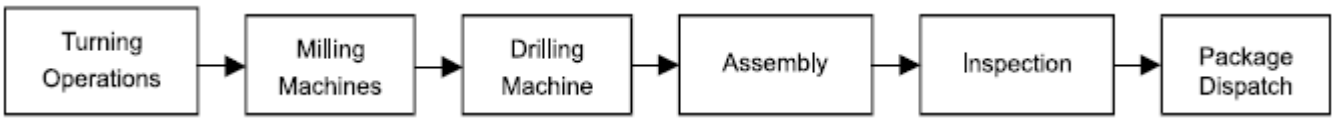
1. Backtracking and long movements may occur in the handling of materials thus, reducing material handling efficiency.
2. Material handling cannot be mechanized which adds to cost.
3. Process time is prolonged which reduce the inventory turnover and increases the in- process inventory.
4. Lowered productivity due to number of set-ups.
5. Throughput (time gap between in and out in the process) time is longer.
6. Space and capital are tied up by work-in-process.

Product Layout:

In this type of layout, machines and auxiliary services are located according to the processing sequence of the product. If the volume of production of one or more products is large, the facilities can be arranged to achieve efficient flow of materials and lower cost per unit. Special purpose machines are used which perform the required function quickly and reliably.

The product layout is selected when the volume of production of a product is high such that a separate production line to manufacture it can be justified. In a strict product layout, machines are not shared by different products. Therefore, the production volume must be sufficient to achieve satisfactory utilization of the equipment. A typical product layout is shown in the following figure.

Product layout



Advantages

1. The flow of product will be smooth and logical in flow lines.
2. In-process inventory is less.
3. Throughput time is less.
4. Minimum material handling cost.
5. Simplified production, planning and control systems are possible.
6. Less space is occupied by work transit and for temporary storage.
7. Reduced material handling cost due to mechanised handling systems and straight flow.
8. Perfect line balancing which eliminates bottlenecks and idle capacity.
9. Manufacturing cycle is short due to uninterrupted flow of materials.
10. Small amount of work-in-process inventory.
11. Unskilled workers can learn and manage the production.

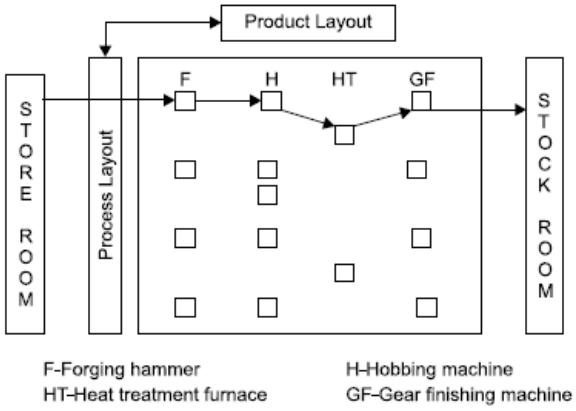
Limitations

1. A breakdown of one machine in a product line may cause stoppages of machines in the downstream of the line.
2. A change in product design may require major alterations in the layout.
3. The line output is decided by the bottleneck machine.
4. Comparatively high investment in equipments is required.
5. Lack of flexibility. A change in product may require the facility modification.

Combination Layout:

A combination of process and product layouts combines the advantages of both types of layouts. A combination layout is possible where an item is being made in different types and sizes. Here machinery is arranged in a process layout but the process grouping is then arranged in a sequence to manufacture various types and sizes of products. It is to be noted that the sequence of operations remains same with the variety of products and sizes. The following figure shows a combination type of layout for manufacturing different sized gears.

Combination layout for making different types and sizes of gears

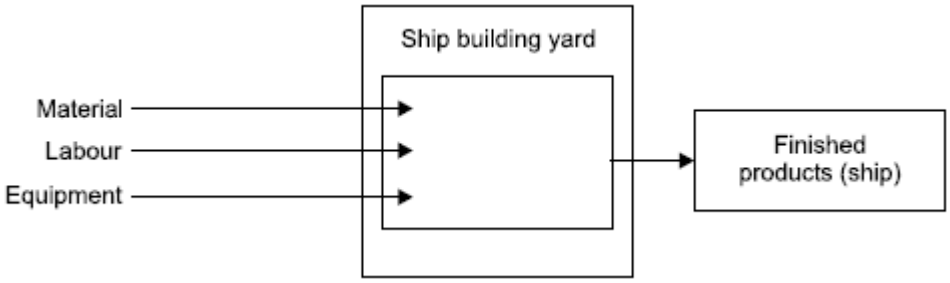


Fixed Position Layout:

This is also called the **project type** of layout. In this type of layout, the material, or major components remain in a fixed location and tools, machinery, men and other materials are brought

to this location. This type of layout is suitable when one or a few pieces of identical heavy products are to be manufactured and when the assembly consists of large number of heavy parts, the cost of transportation of these parts is very high.

Fixed position layout



Advantages

The major advantages of this type of layout are:

1. Helps in job enlargement and upgrades the skills of the operators.
2. The workers identify themselves with a product in which they take interest and pride in doing the job.
3. Greater flexibility with this type of layout.
4. Layout capital investment is lower.

Group Layout (or Cellular Layout):

There is a trend now to bring an element of flexibility into manufacturing system as regards to variation in batch sizes and sequence of operations. A grouping of equipment for performing a sequence of operations on family of similar components or products has become all the important.

Group technology layout in Operation Management

Group technology (GT) is the analysis and comparisons of items to group them into families with similar characteristics. GT can be used to develop a hybrid between pure process layout and pure flow line (product) layout. This technique is very useful for companies that produce variety of parts in small batches to enable them to take advantage and economics of flow line layout.

The application of group technology involves two basic steps; first step is to determine component families or groups. The second step in applying group technology is to arrange the plants equipment used to process a particular family of components. This represents small plants within the plants. The group technology reduces production planning time for jobs. It reduces the set-up time.

Thus **group layout** is a combination of the product layout and process layout. It combines the advantages of both layout systems. If there are m-machines and n-components, in a group layout (Group-Technology Layout), the M -machines and n -components will be divided into number of machine-component cells (group) such that all the components assigned to a cell are almost processed within that cell itself. Here, the objective is to minimize the intercell movements.

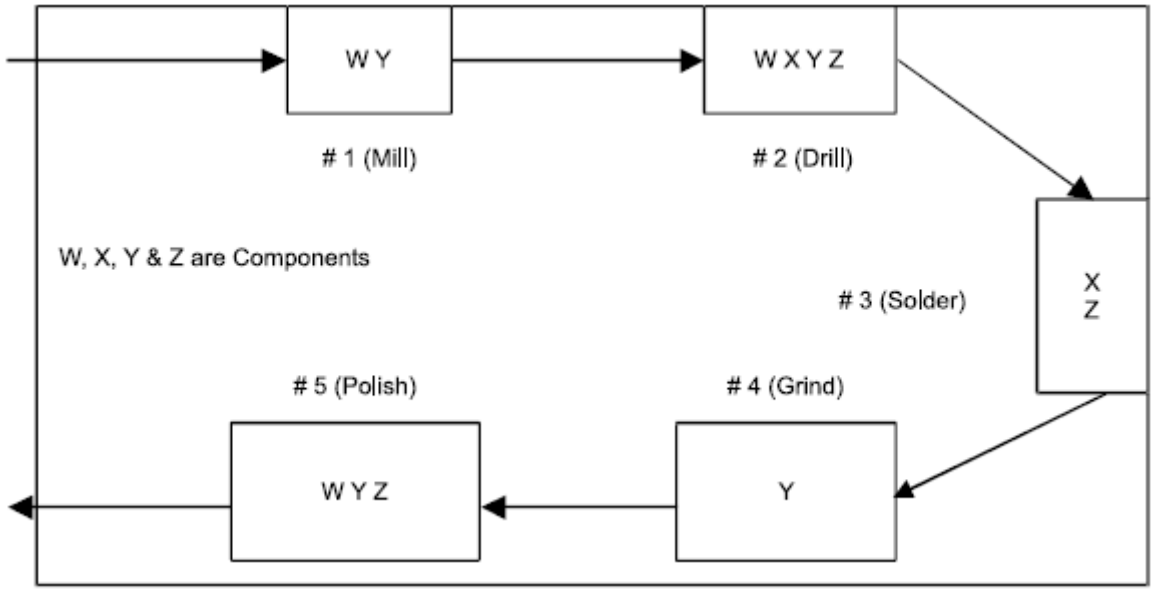
The basic aim of a group technology layout is to identify families of components that require similar of satisfying all the requirements of the machines are grouped into cells. Each cell is capable of satisfying all the requirements of the component family assigned to it.

The layout design process considers mostly a single objective while designing layouts. In process layout, the objective is to minimize the total cost of materials handling. Because of the nature of the layout, the cost of equipments will be the minimum in this type of layout. In product layout,

the cost of materials handling will be at the absolute minimum. But the cost of equipments would not be at the minimum if the equipments are not fully utilized.

In-group technology layout, the objective is to minimize the sum of the cost of transportation and the cost of equipments. So, this is called as multi-objective layout. A typical process layout is shown .

Group layout or Cellular layout



Advantages of Group Technology Layout:

Group Technology layout can increase

1. Component standardization and rationalization.
2. Reliability of estimates.
3. Effective machine operation and productivity.
4. Customer service.

It can decrease the

1. Paper work and overall production time.
2. Work-in-progress and work movement.
3. Overall cost.

Limitations of Group Technology Layout:

This type of layout may not be feasible for all situations. If the product mix is completely dissimilar, then we may not have meaningful cell formation.

UNIT - II

Work Study - Time Study - Motion Study – Work Measurement– Principles and factors - Maintenance of Plant – Types.

WORK STUDY

MEANING OF WORK STUDY:

"Work study is a generic term for those techniques, method study and work measurement which are used in the examination of human work in all its contexts. And which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement."

DEFINITION OF WORKSTUDY

- Work study is defined as that body of knowledge concerned with the analysis of the work methods and the equipment used in performing a job, the design of an optimum work method and the standardisation of proposed work methods.
- Work study has contributed immeasurably to the search for better methods, and the effective utilisation of this management tool has helped in the accomplishment of higher productivity.
- Work study is a management tool to achieve higher productivity in any organisation, whether manufacturing tangible products or offering services to its customers.
- British Standards Institution defines work-study as "a generic term for those techniques particularly method study and work measurement which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvements".
- Work study is also understood as a systematic, objective and critical examination of the factors, affecting productivity for the purpose of improvement. It makes use of techniques of method study and work measurement to ensure the best possible use of human and material resources in carrying out a specific activity.

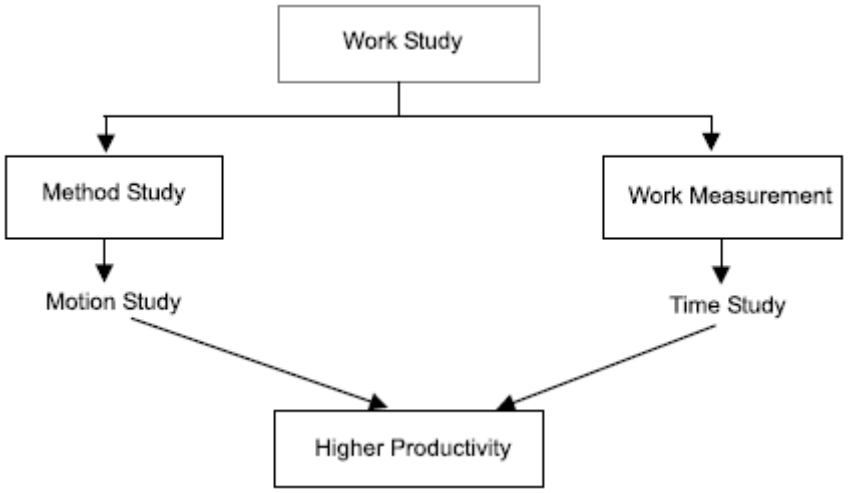
OBJECTIVES OF WORK STUDY

- To recommend and implement the desired improvements in work methods by establishing the most economical way of doing the work
- Investigation and analysis of existing situation
- Examination of weaknesses, if any, in the production process
- Most effective use of the existing or proposed plant
- Efficient use of human efforts
- Ensuring proper performance of those employed in production process.
- Measurement of work values
- Initiating and awarding incentive bonus schemes.
- Setting standards for labour cost and labour cost control documentation
- To standardise the method, material and equipment used in the production process.
- To determine the time required by an ideal (a qualified and properly trained) operator to perform a task at some desired level of performance.

FRAMEWORK OF WORK STUDY OR MAJOR COMPONENTS OF WORK STUDY OR SCOPE OF WORK STUDY

Mainly, it incorporates the following:

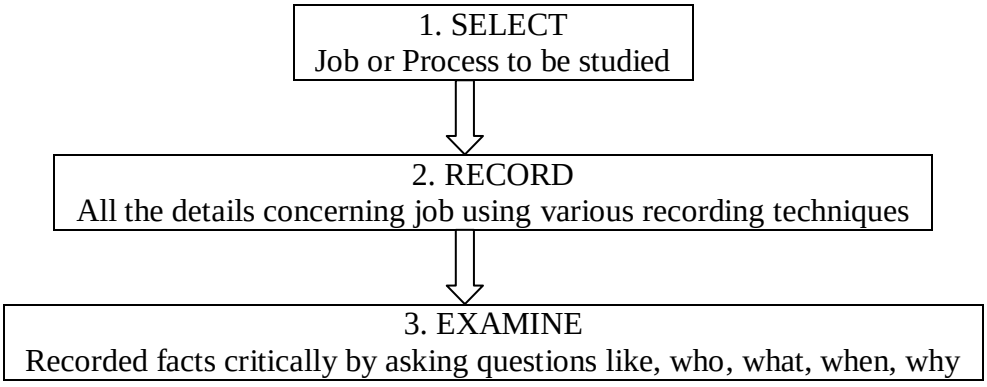
1. Work simplification or method study, widely known as motion study.
2. Work measurement which is popularly known as time study.

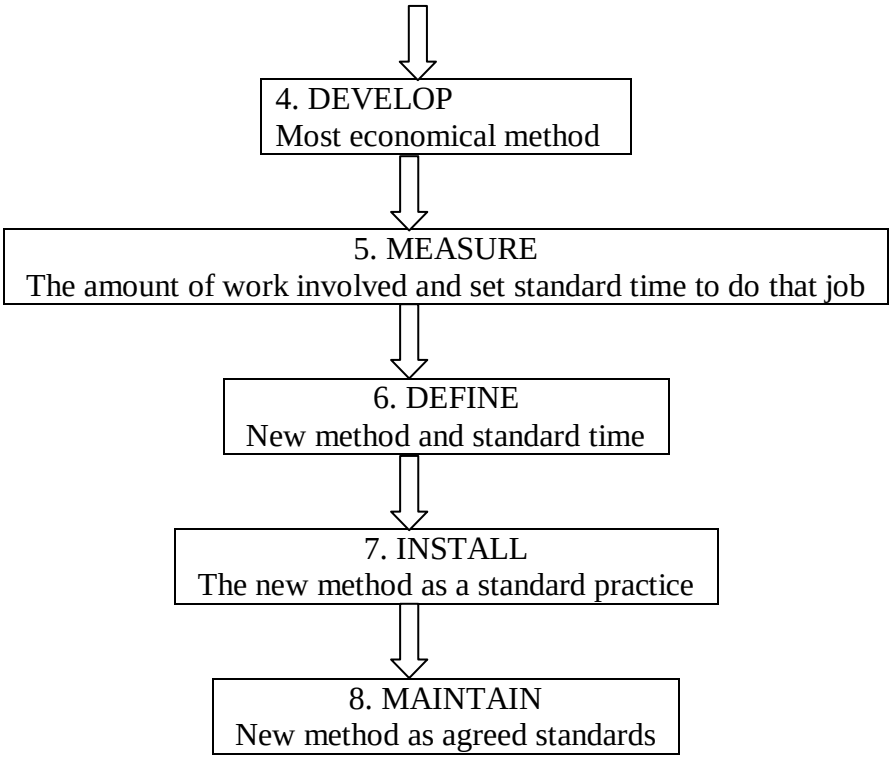


IMPORTANCE / SIGNIFICANCE OF WORK STUDY

- It is a means of raising productivity of a factory by re-organisation of the work involving little or no capital expenditure on plant and equipment.
- It is a systematic study where no factor of productions is overlooked.
- It is a most accurate method of determining the standards of performance on which effective planning and control depend.
- It results in savings and efficient use of resources by increasing output and reducing scrap.
- Results in improved safety.
- Reduction in training time.
- It is a tool which can be applied everywhere.

STEPS INVOLVED IN WORK STUDY





There are eight steps in performing a complete work-study. They are:

- Select the job or process to be studied
- Record from direct observation everything that happens, using the most suitable recording technique so that data will be in the most convenient form for analysis.
- Examine the recorded fact critically and challenge everything that it contains, considering in turn, the purpose of activity, the place where it is performed, the sequence in which it is done, the person who is doing it the means by which it is done.
- Develop the most economical method, taking into account all the factors.
- Measure the quantity of work involved in the method selected and calculate a standard time for performing it
- Define the new method and the related time so that it can always be identified.
- Install the new method as agreed standard practice with the time allowed.
- Maintain the new standard practice by proper control procedures

TIME STUDY:

Time study is also called work measurement. It is essential for both planning and control of operations. According to British Standard Institute time study has been defined as "The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance."

Steps in Making Time Study:

Stop watch time is the basic technique for determining accurate time standards. They are economical for repetitive type of work. Steps in taking the time study are:

1. Select the work to be studied.

2. Obtain and record all the information available about the job, the operator and the working conditions likely to affect the time study work.
3. Breakdown the operation into elements. An element is a instinct part of a specified activity composed of one or more fundamental motions selected for convenience of observation and timing.
4. Measure the time by means of a stop watch taken by the operator to perform each element of the operation. Either continuous method or snap back method of timing could be used.
5. At the same time, assess the operator's effective speed of work relative to the observer's concept of 'normal' speed. This is called performance rating
6. Adjust the observed time by rating factor to obtain normal time for each element
   Normal = Observed time Rating / 100
7. Add the suitable allowances to compensate for fatigue, personal needs, contingencies etc. to give standard time for each element.
8. Compute allowed time for the entire job by adding elemental standard times considering frequency of occurrence of each element.
9. Make a detailed job description describing the method for which the standard time is established.
10. Test and review standards wherever necessary. The basic steps in time study are represented by a block diagram in the figure "Steps in time study"

Computation of Standard Time:

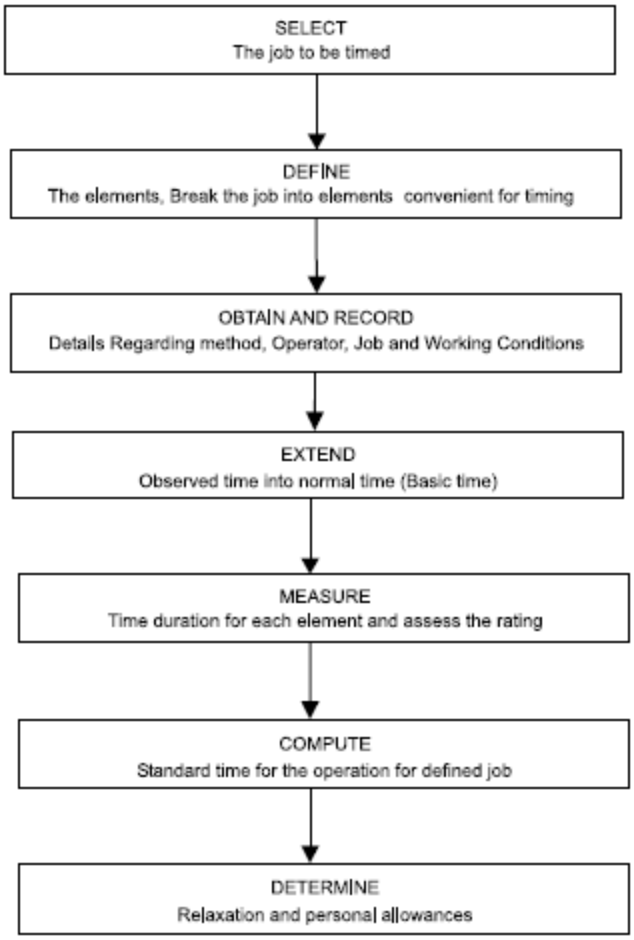
Standard time is the time allowed to an operator to carry out the specified task under specified conditions and defined level of performance. The various allowances are added to the normal time as applicable to get the standard time "Components standard time". Standard time Calculation time study

Standard time may be defined as the, amount of time required to complete a unit of work: (a) under existing working conditions, (b) using the specified method and machinery, (c) by an operator, able to the work in a proper manner, and (d) at a standard pace.

Thus basic constituents of standard time are:

1. Elemental (observed time).
2. Performance rating to compensate for difference in pace of working.
3. Relaxation allowance.
4. Interference and contingency allowance.
5. Policy allowance.

Steps in time study



MOTION STUDY (OR) METHOD STUDY

Definition of Method Study

Method Study is defined as "A procedure for examining the various activities of problem which ensures a systematic, objective and critical evaluation of the existing facts and in addition, an imaginative approach when developing improvements'

Method study is a systematic and scientific evaluation of existing and proposed plans and performance of any work system and the evaluation of improvement, through analytical process of critical examination.

There are three different levels and aspects of the application of method study:

a. Method study proper: Method study proper is the broad investigation and improvement of a total department or section, the layout of machines and equipment, working conditions, etc., the flow of materials, the movement of men. Layout of physical facilities, tools, manufacturing operations, and their sequences, gauges and other instruments.

b. Motion study: Motion study is a more detailed investigation of an Individual operator, the layout of his bench or machines, his tools, jigs and fixtures, the movements of his body as he performs his work. The study of his environment, body posture, the temperature and noise level of his surroundings.

c. Micro motion study: Micro motion study is a much more detailed Investigation of rapid movements of the hands and arms. It requires the use of a camera and the analysis of filmed records of hand movements.

AIMS / OBJECTIVES OF METHOD STUDY (OR) MOTION STUDY

i Better design of plant equipment and buildings
ii. Improved layout of factory and offices
iii. Better working conditions and environment
iv. High standards of safety and health
V. Improved flow of work
vi. Better quality
vii. Greater job satisfaction
viii. High earnings
ix. Improved utilisation of resources
X. Effective material handling
xi. Efficient processes and procedures
xii. Optimum inventory
xiii. Optimum output
xiv. Improved administration
XV. Waste reduction
xvi. Standardisation and rationalization

ANALYTICAL APPROACH OF METHOD STUDY

The following are the steps involved in method study.
Select - Analysis of the job
Record - Record by means of charts and diagrams all relevant facts about the present method
Examine - Critical examination of all facts
Develop - Develop an efficient and economical method
Define - The new method to be introduced
Install - Installation of the new method as a standard practice
Maintain - Maintaining the standard practice

SELECT			
See Selecting and Surveying Jobs for Study			
RECORD			
Process Charting	Path of movements	Therbligs and Film Analysis	Other Techniques
Outline Process Charting	Therbligs	Therbligs	Activity Sampling
Flow Process Charting	String Diagrams	Micro motion	Matrix
Two-Handed Process	Cycle graph	Simo charting	Relationship Chart

Charting	Chrono Cycle graph	Memo motion	Gnatt Charts
	Wire Diagrams	Multiple Activity	Network Technique
	'3D' Models Charting		
Critical Examination			
Develop			
Define			
Install			
Maintain			

1. Selection:

(a) Diagnostic Approach: In major assignments of larger magnitude and wider scope, diagnostic approach is useful in selection of specific areas investigation. The steps involved in diagnostic approach are as follows:

i. Breakdown in the capital structure.
ii. Arrange in terms of succession of cost.
iii. Make spot checks.
iv. Rearrange in succession in order of feasibility of cost reduction and value added.
V. Draw action programme.

(b) Consideration in Selection: While selecting the subject for study, the following considerations should be borne in mind:

i. Economic considerations
ii. Technical considerations
iii. Human considerations
iv. Economic considerations

2. Recording Techniques

According to the nature of the job being studied and the purpose for which the record is required, the techniques fall into following categories:

A. Charts
B. Diagrams
C. Templates and models

A. Chart:

1 Operation Process Chart or (outline process chart)
2 Flow Process Chart

- Man type
- Material type
- Equipment type

3. Two-handed Process Chart
4. Multiple Activity Chan
5. Travel Chart
6. SIMO Chat (simultaneous motion cycle chart)

B. Diagram

7. Flow and String Diagrams
8. Models and Materials
9. Cycle graph and chronocycle graph

3. Critical Examination

- Purpose
- Place
- Sequence
- Person
- Means

4. Developing a New Method

- Elimination
- Combination
- Rearrangement
- Simplicity

5. Installation of a New Method

6. Maintain the New Method

WORK MEASUREMENT

Meaning of Work Measurement

Work measurement is also called by the name 'time study'. Work measurement is absolutely essential for both the planning and control of operations. Without measurement data, we cannot determine the capacity of facilities or it is not possible to quote delivery dates or costs. We are not in a position to determine the rate of production and also labor utilization and efficiency. It may not be possible to introduce incentive schemes and standard costs for budget control.

Objectives of Work Measurement:

The use of work measurement as a basis for incentives is only a small part of its total application. The objectives of work measurement are to provide a sound basis for:

- Comparing alternative methods
- Assessing the correct initial manning (manpower requirement planning).
- Planning and control.
- Realistic costing
- Financial incentive schemes
- Delivery date of goods
- Cost reduction and cost control.
- Identifying substandard workers
- Training new employees

Purpose of Work Measurement

Work Measurement is a technique for establishing a Standard Time, which is the required time to perform a given task, based on time measurements of the work content of the prescribed method, with due consideration for fatigue and for personal and unavoidable delays. Method study is the principal technique for reducing the work involved, primarily by eliminating unnecessary movement on the part of material or operatives and by substituting good methods for poor ones.

Work measurement is concerned with investigating, reducing and subsequently eliminating ineffective time, that is time during which no effective work is being performed, whatever the cause. Work measurement, as the name suggests, provides management with a means of measuring the time taken in the performance of an operation or series of operations in such a way that ineffective time is shown up and can be separated from effective time. In this way its existence, nature and extent become known where previously they were concealed within the total. To see how much work has been done by the worker and how many salaries is given to him

Factors or Techniques of Work measurement in Production Management

For the purpose of work measurement, work can be regarded as:

1. ***Repetitive work*:** The type of work in which the main operation or group of operations repeat continuously during the time spent at the job. These apply to work cycles of extremely short duration.
2. ***Non-repetitive work:*** It includes some type of maintenance and construction work, where the work cycle itself is hardly ever repeated identically.

Various techniques of work measurement are:

1. Time study (stop watch technique),
2. Synthesis,
3. Work sampling,
4. Predetermined motion and time study,
5. Analytical estimating.

Time study and work sampling involve direct observation and the remaining are data based and analytical in nature.

1. ***Time study*:**
   A work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analyzing the data so as to determine the time necessary for carrying out the job at the defined level of performance. In other words measuring the time through stop watch is called time study.
2. ***Synthetic data:***
   A work measurement technique for building up the time for a job or pans of the job at a defined level of performance by totaling element times obtained previously from time studies on other jobs containing the elements concerned or from synthetic data.
3. ***Work sampling:***
   A technique in which a large number of observations are made over a period of time of one or group of machines, processes or workers. Each observation records what is happening at that instant and the percentage of observations recorded for a particular activity, or delay, is a measure of the percentage of time during which that activities delay occurs.
4. ***Predetermined motion time study (PMTS):***
   A work measurement technique whereby times established for basic human motions (classified according to the nature of the motion and conditions under which it is made) are used to build up the time for a job at the defined level of performance. The most commonly used PMTS is known as Methods Time Measurement (MTM).
5. ***Analytical estimating:***
   A work measurement technique, being a development of estimating, whereby the time required to carry out elements of a job at a defined level of performance is estimated partly from knowledge and practical experience of the elements concerned and partly from synthetic

data. The work measurement techniques and their applications are shown in the following table.

PLANT MAINTENANCE

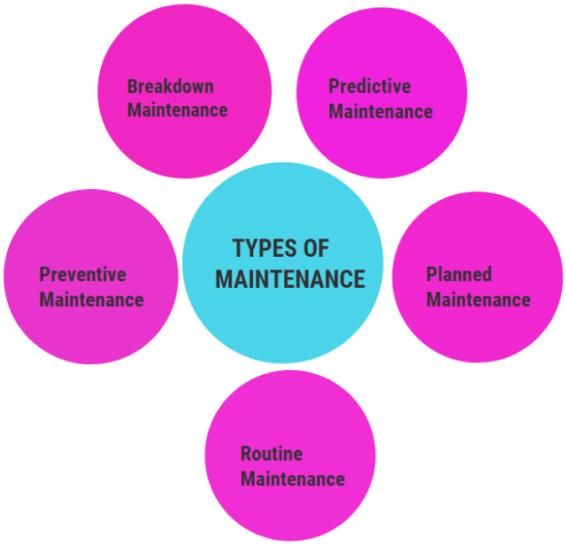
Definition of Plant Maintenance

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

Objectives of maintenance management

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

The following are different types of maintenance.



1. Breakdown Maintenance

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

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

2. Preventive Maintenance

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

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

3. Predictive Maintenance

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

4. Routine Maintenance

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

i) Running maintenance

In this, the maintenance work is carried out while the equipment is in the operating conditions.

ii) Shutdown maintenance

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

5. Planned Maintenance

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

UNIT - III

Production Planning and Control – Definition – Objectives and Importance – Elements of Production Planning – Routing and Scheduling.

Introduction of Production planning and control:

Production planning and control is a tool available to the management to achieve the stated objectives. Thus, a production system is encompassed by the four factors. *i.e*., quantity, quality, cost and time.

Production planning starts with the analysis of the given data, *i.e*., demand for products, delivery schedule etc., and on the basis of the information available, a scheme of utilization of firms resources like machines, materials and men are worked out to obtain the target in the most economical way.

Once the plan is prepared, then execution of plan is performed in line with the details given in the plan. Production control comes into action if there is any deviation between the actual and planned. The corrective action is taken so as to achieve the targets set as per plan by using control techniques.

Definition of Production Planning & Control (PPC)

Thus production planning and control can be defined as the "*direction and coordination of firms' resources towards attaining the prefixed goals*." Production planning and control helps to achieve uninterrupted flow of materials through production line by making available the materials at right time and required quantity.

What is Production Planning & Control (PPC)?

Production planning and control is a predetermined process which includes the use of human resource, raw materials, machines etc. PPC is the technique to plan each and every step in a long series of separate operation. It helps to take the right decision at the right time and at the right place to achieve maximum efficiency.

NEED FOR PRODUCTION PLANNING AND CONTROL

The present techno-economic scenario of India emphasize on competitiveness in manufacturing. Indian industries have to streamline the production activities and attain the maximum utilization of firms' resources to enhance the productivity. Production planning and control serves as a useful tool to coordinate the activities of the production system by proper planning and control system. Production system can be compared to the nervous system with PPC as a brain.

Production planning and control is needed to achieve:

1. Effective utilization of firms' resources.
2. To achieve the production objectives with respect to quality, quantity, cost and timeliness of delivery.
3. To obtain the uninterrupted production flow in order to meet customers varied demand with respect to quality and committed delivery schedule.
4. To help the company to supply good quality products to the customer on the continuous basis at competitive rates.

Need of Production Planning and Control

Production planning is a pre-production activity. It is the pre-determination of manufacturing requirements such as manpower, materials, machines and manufacturing process. Ray wild defines "*Production planning is the determination, acquisition and arrangement of all facilities necessary for future production of products."*

It represents the design of production system. Apart from planning the resources, it is going to organize the production. Based on the estimated demand for company's products, it is going to establish the production programme to meet the targets set using the various resources.

Production Control:

Inspite of planning to the minute details, most of the time it is not possible to achieve production 100 per cent as per the plan. There may be innumerable factors which affect the production system and because of which there is a deviation from the actual plan. Some of the factors that affect are:

1. Non-availability of materials (due to shortage, etc.);
2. Plant, equipment and machine breakdown;
3. Changes in demand and rush orders;
4. Absenteeism of workers; and
5. Lack of coordination and communication between various functional areas of business.

Thus, if there is a deviation between actual production and planned production, the control function comes into action. Production control through control mechanism tries to take corrective action to match the planned and actual production. Thus, production control reviews the progress of the work, and takes corrective steps in order to ensure that programmed production takes place. The essential steps in control activity are:

1. Initiating the production,
2. Progressing, and
3. Corrective action based upon the feedback and reporting back to the production planning.

OBJECTIVES OF PRODUCTION PLANNING AND CONTROL

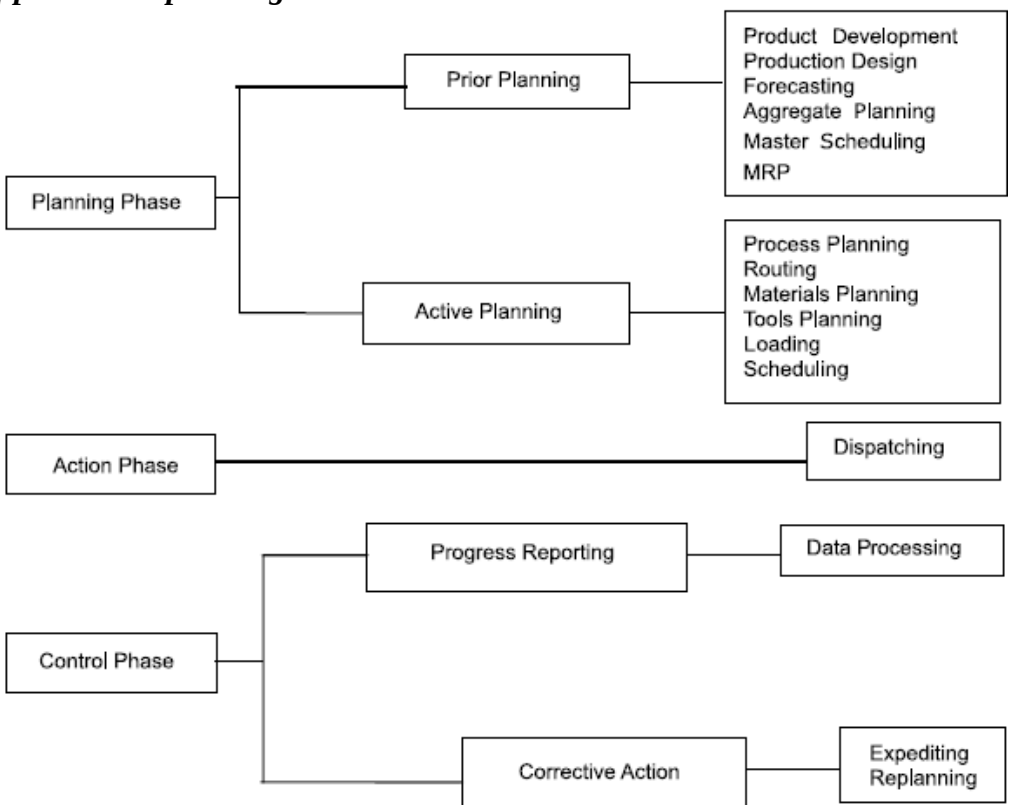
1. Systematic planning of production activities to achieve the highest efficiency in production of goods/services.
2. To organize the production facilities like machines, men, etc., to achieve stated production objectives with respect to quantity and quality time and cost.
3. Optimum scheduling of resources.
4. Coordinate with other departments relating to production to achieve regular balanced and uninterrupted production flow.
5. To conform to delivery commitments.
6. Materials planning and control.
7. To be able to make adjustments due to changes in demand and rush orders.

ELEMENTS OR STAGES OF PRODUCTION PLANNING AND CONTROL

The stages of Production planning and control has three phases namely:

A. Planning Phase
B. Action Phase
C. Control Phase

Phases of production planning and control



I. PLANNING PHASE:

Planning is an exercise of intelligent anticipation in order to establish how an objective can be achieved or a need fulfilled in circumstances, which are invariably restrictive. Production planning determines the optimal schedule and sequence of operations economic batch quantity, machine assignment and dispatching priorities for sequencing. It has two categories of planning namely

1. Prior planning
2. Active planning.

PRIOR PLANNING:

Prior planning means pre-production planning. This includes all the planning efforts, which are taking place prior to the active planning.

Modules of pre-planning:

The modules of prior planning are as follows:

1. ***Product development and design*** is the process of developing a new product with all the features, which are essential for effective use in the field, and designing it accordingly. At the

design stage, one has to take several aspects of design like, design for selling, design for manufacturing and design for usage.

2. ***Forecasting*** is an estimate of demand, which will happen in future. Since, it is only an estimate based on the past demand, proper care must be taken while estimating it. Given the sales forecast, the factory capacity, the aggregate inventory levels and size of the work force, the manager must decide at what rate of production to operate the plant over an intermediate planning horizon.
3. ***Aggregate planning*** aims to find out a product wise planning over the intermediate planning horizon.
4. ***Material requirement planning*** is a technique for determining the quantity and timing for the acquisition of dependent items needed to satisfy the master production schedule.

ACTIVE PLANNING:

The modules of active planning are: Process planning and routing, Materials planning. Tools planning, Loading, Scheduling etc.

1. ***Process planning and routing*** is a complete determination of the specific technological process steps and their sequence to produce products at the desired quality, quantity and cost. It determines the method of manufacturing a product selects the tools and equipments, analyses how the manufacturing of the product will fit into the facilities. Routing in particular prescribes the flow of work in the plant and it is related to the considerations of layout, temporary locations for raw materials and components and materials handling systems.
2. A ***material planning*** is a process which determines the requirements of various raw materials/subassemblies by considering the trade-off between various cost components like, carrying cost, ordering cost, shortage cost, and so forth.
3. ***Tools' planning*** determines the requirements of various tools by taking process specification (surface finish, length of the job, overall depth of cut etc.), material specifications (type of material used, hardness of the material, shape and size of the material etc.) and equipment specifications (speed range, feed range, depth of cut range etc.).
4. ***Loading*** is the process of assigning jobs to several machines such that there is a load balance among the machines. This is relatively a complex task, which can be managed with the help of efficient heuristic procedures.
5. ***Scheduling*** is the time phase of loading and determines when and in what sequence the work will be carried out. This fixes the starting as well as the finishing time for each job.

II. ACTION PHASE:

Action phase has the major step of **dispatching.** Dispatching is the transition from planning phase to action phase. In this phase, the worker is ordered to start manufacturing the product. The tasks which are included in dispatching are job order, store issue order, tool order, time ticket, inspection order, move order etc.

The **job order** number is the key item which is to be mentioned in all other reports/orders.

Stores issue order gives instruction to stores to issue materials for manufacturing the product as per product specifications. As per tooling requirements for manufacturing the product, the **tool Order** instruct the tool room to issue necessary tools.

Time ticket is nothing but a card which is designed to note down the actual time taken at various processes. This information is used for deciding the costs for future jobs of similar nature and also for performing variance analysis, which helps to exercise control.

Job order is the official authorization to the shop floor to start manufacturing the product. Generally, the process sequence will contain some testing and inspection. So, these are to be instructed to inspection wing in the form of inspection order for timely testing and inspection so that the amount of rework is minimized. The manufacture of product involves moving raw materials/subassemblies to the main line. This is done by a well-designed materials handling system. So, proper instruction is given to the materials handling facilities for major movements of materials/subassemblies in the form of a move order. Movements which involve less distance and fewer loads are managed at the shop floor level based on requests from operators.

III. CONTROL PHASE:

The control phase has the following two major modules:

1. Progress reporting, and
2. Corrective action.

1. ***PROGRESS REPORTING***:

   In progress reporting, the data regarding what is happening with the job is collected. Also, it helps to make comparison with the present level of performance. The various data pertaining to materials rejection, process variations, equipment failures, operator efficiency, operator absenteeism, tool life, etc., are collected and analyzed for the purpose of progress reporting. These data are used for performing variance analysis, which would help us to identify critical areas that deserve immediate attention for corrective actions.

2. ***CORRECTIVE ACTION***:

   The tasks under corrective action primarily make provisions for an unexpected event. Some examples of corrective actions are creating schedule flexibility, schedule modifications, capacity modifications, make or buy decisions, expediting the work, pre-planning, and so on. Due to unforeseen reasons such as, machine breakdown, labor absenteeism, too much rejection due to poor material quality etc., it may not be possible to realize the schedule as per the plan. Under such condition, it is better to reschedule the whole product mix so that we get a clear picture of the situation to progress further. Under such situation, it is to be re-examined for selecting appropriate course of action. Expediting means taking action if the progress reporting indicates deviations from the originally set targets. Pre-planning of the whole affair becomes essential in case the expediting fails to bring the deviated plan to its right path.

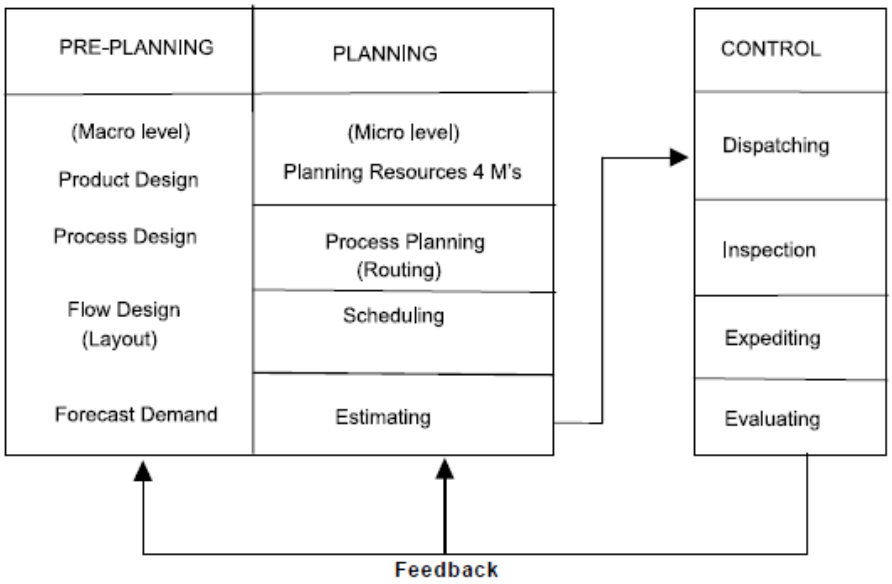
PRODUCTION PLANNING AND CONTROL FUNCTIONS

Functions of production planning and controlling is classified into:

1. Pre-planning function
2. Planning function
3. Control function

1. ***PRE-PLANNING FUNCTION***:

   Pre-planning is a macro level planning and deals with analysis of data and is an outline of the planning policy based upon the forecasted demand, market analysis and product design and development. This stage is concerned with process design (new processes and developments, equipment policy and replacement and work flow (Plant layout). The pre-planning function of PPC is concerned with decision-making with respect to methods, machines and work flow with respect to availability, scope and capacity.



2. ***PLANNING FUNCTION:***
   The planning function starts once the task to be accomplished is specified, with the analysis of **four M's**, *i.e*., Machines, Methods, Materials and Manpower. This is followed by process planning (routing). Both short-term (near future) and long-term planning are considered. Standardization, simplification of products and processes are given due consideration.
3. **CONTROL FUNCTION**:
   Control phase is effected by dispatching, inspection and expediting materials control, analysis of work-in-process. Finally, evaluation makes the PPC cycle complete and corrective actions are taken through a feedback from analysis. A good communication, and feedback system is essential to enhance and ensure effectiveness of PPC.

PARAMETERS FOR PPC:

The functions of PPC can be explained with the following parameters:

1. ***Materials*:** Raw materials, finished parts and bought out components should be made available in required quantities and at required time to ensure the correct start and end for each operation resulting in uninterrupted production. The function includes the specification of materials (quality and quantity) delivery dates, variety reduction (standardization) procurement and make or buy decisions.
2. ***Machines and equipment:*** This function is related with the detailed analysis of available production facilities, equipment down time, maintenance policy procedure and schedules. Concerned with economy of jigs and fixtures, equipment availability. Thus, the duties include the analysis of facilities and making their availability with minimum down time because of breakdowns.
3. ***Methods*:**
   This function is concerned with the analysis of alternatives and selection of the best method with due consideration to constraints imposed. Developing specifications for processes is an important aspect of PPC and determination of sequence of operations.
4. ***Process planning (Routing):***
   It is concerned with selection of path or route which the raw material should follow to get transformed into finished product. The duties include:

a. Fixation of path of travel giving due consideration to layout.
b. Breaking down of operations to define each operation in detail.
c. Deciding the set up time and process time for each operation.

5. ***Estimating:***
   Once the overall method and sequence of operations is fixed and process sheet for each operation is available, then the operations times are estimated. This function is carried out using extensive analysis of operations along with methods and routing and a standard time for operation are established using work measurement techniques.
6. ***Loading and scheduling:***
   Scheduling is concerned with preparation of machine loads and fixation of starting and completion dates for each of the operations. Machines have to be loaded according to their capability of performing the given task and according to their capacity. Thus the duties include:
   a. Loading, the machines as per their capability and capacity.
   b. Determining the start and completion times for each operation.
   c. To coordinate with sales department regarding delivery schedules.
7. ***Dispatching:***
   This is the execution phase of planning. It is the process of setting production activities in motion through release of orders and instructions. It authorizes the start of production activities by releasing materials, components, tools, fixtures and instruction sheets to the operator. The activities involved are:
   a. To assign definite work to definite machines, work centers and men.
   b. To issue required materials from stores.
   c. To issue jigs, fixtures and make them available at correct point of use.
   d. Release necessary work orders, time tickets, etc., to authorize timely start of operations.
   e. To record start and finish time of each job on each machine or by each man.
8. ***Expediting****:*
   This is the control tool that keeps a close observation on the progress of the work. It is logical step after dispatching which is called 'follow-up'. It coordinates extensively to execute the production plan. Progressing function can be divided into three parts, *i.e.*, follow up of materials, follow up of work-in-process and follow up of assembly. The duties include:
   a. Identification of bottlenecks and delays and interruptions because of which the production schedule may be disrupted.
   b. To devise action plans (remedies) for correcting the errors.
   c. To see that production rate is in line with schedule.
9. ***Inspection:***
   It is a major control tool. Though the aspects of quality control are the separate function, this is of very much important to PPC both for the execution of the current plans and its scope for future planning. This forms the basis for knowing the limitations with respects to methods, processes, etc., which is very much useful for evaluation phase.
10. ***Evaluation:***
    This stage though neglected is a crucial to the improvement of productive efficiency. A thorough analysis of all the factors influencing the production planning and control helps to identify the weak spots and the corrective action with respect to pre-planning and planning will be effected by a feedback. The success of this step depends on the communication, data and information gathering and analysis.

ROUTING:

Production routing is a process concerned with determining exact route or path; a product has to follow right from raw material till its transformation into finished product. A few definitions of routing can be cited here:

According to Kimball and Kimball Jr, "Routing may be defined as the selection of paths or routes over which each piece is to travel in being transformed from raw material into finished product".

According to James C. Lundy, "Production routing involves the planning of the exact sequence of work stations to be used in processing a part of product. Once a layout has been established the routing of an item is the determination of the path that item should follow as it is manufactured".

According to Alford and Beatty, "Routing is the specification of the flow or sequence of operations and processes to be followed in producing a particular manufacturing lot".

According to Spriegel and Lansburgh, "Routing includes the planning of where and by whom work shall be done, the determination of the path that work shall follow and the necessary sequence of operations; it forms a groundwork for most of the scheduling and dispatching functions of planning department."

The above mentioned definitions clearly lay down that routing is concerned with the selection of the most economical and appropriate path for the product in the process of final completion from raw material to finished product.

OBJECTS OF ROUTING:

The main objective of routing is to lay down the best and the most economical sequence of operations to be undertaken in the process of production. Another objective of routing is to determine proper tools and equipments and the required number of workers required for doing or carrying total production processes in an organisation.

Routing becomes automatic and continuous in case of continuous manufacturing units where standardized products are produced by undertaking standardized production operations.

On the other hand, in case of job order units or intermittent- process industries such as ship building, every product requires different designs and varying sequences of operations.

PROCEDURE FOLLOWED IN ROUTING:

In case where a new product is going to be produced, different steps are involved in a total routing procedure. These steps are:

(a) Complete analysis or study of the product as to decide what parts of the product are to be manufactured and what may be purchased from the market.

(b) Analysis of the article so as to know what sorts of materials are needed for producing the article or product. This includes the complete study with regard to quality, quantity, kind and grade of materials required.

(c) To determine different manufacturing operations and their sequence. This can be worked out by knowing accurately about the machines and their layout. This also necessitates the knowledge of allied equipment, jigs, tools and implements needed for efficient production.
(d) Determining lot to proper size in relation to order placed by the customers.
(e) Possibility of scrap in manufacturing a product must be properly determined. Anticipated scrap should be compared with actual scrap. Steps should be undertaken to control excess scrap.
(f) Determination of the cost of the article or the product produced must be properly worked out. Calculation of total cost and per unit cost production is primarily the job of costing department, but still cost estimates pertaining to direct material, direct labour, direct expenses and indirect expenses and overheads must be prepared by the production department. These estimates will be greatly helpful for the costing department.
(g) Complete information pertaining to different types of production control forms viz., time and job cards, inspection cards and tool tickets, etc. must be kept by the works manager. This will be very helpful in carrying planned and systematic production.
(h) Preparation of route sheets is another important step in routing procedure. Route sheets relate to specific production orders. One sheet is prepared for each part or component of the product. Route sheets also indicate the sequence of operations to be undertaken and also contain various requirements of production viz., men, materials and machinery etc. Route sheets also indicate total number of pieces to be produced and number of pieces to be included in each lot where production is carried in lots.

It must be remembered that routing is a complex and tedious process as such it should be entrusted to an expert who knows all the intricacies and complexities of production operations. A number of factors viz. human considerations, plant layout, type of production undertaken and processes employed and type of equipment being undertaken must be kept in mind before selecting a proper route for production.

SCHEDULING:

Scheduling in simple words means fixation of time and date when each operation is to be commenced and completed. It is an important part of production control as all future process of production is based on it. Scheduling lays down ground work for all subsequent steps in production process.

A FEW DEFINITIONS OF SCHEDULING ARE GIVEN AS UNDER:

According to Kimball and Kimball Jr, "The determination of the time that should be required to perform each operation and also the time necessary to perform the entire series as routed, making allowance for all factors concerned."

According to Spriegel and Lansburgh, "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 work. This includes allocating the quality and rate of output of the plant or department and also the date or order of starting each unit of work at each station along the route prescribed."

According to James C. Lundy, "Work Scheduling consists of the assignment of starting and completion times for the various operations to be performed."

According to John D. Mclellan, "The detailed planning of material, labour and machine time, so that materials and parts will be at the right place and at the right time so that a job can be completed within the time planned and in accordance with the requirements."

From the above mentioned definitions, it is clear that scheduling is concerned with allocating time for each operation of production and finally total time in the completion of production.

TYPES OF SCHEDULING:

Scheduling is of three types viz:

(a) Master scheduling;
(.b) Manufacturing or operation scheduling;
(c) Retail operation scheduling.

(a) Master scheduling:

It relates to a specified period; say a month, a week or a fortnight. It contains production requirements of a single product or different products during the specified period of time. It is easier to prepare master schedule for a single product, but difficulty arises where the number of products are more. It is also known as over-all schedule.

The preparation of master schedule varies from industry to industry according to type of production undertaken by them. Master schedule usually contains information pertaining to direct material requirements, estimated requirements in man-hours per product at various work centres and estimated overhead expenses etc.

(b) Manufacturing or operation scheduling:

Manufacturing schedules are prepared in case of process or continuous type of industries. In case of mass production industries, where uniform products of same size, colour and design etc., are produced, manufacturing schedules can be easily prepared.

But in case where a product is produced in different sizes, quantity, colour and design, it is bit difficult to prepare manufacturing schedule. The important information contained in this schedule relates to name, number of the product, quantity to be produced each day, week or any other stipulated time.

(c) Detail operation scheduling:

This type of schedule relates to allocation of time for each production operation within each machine and manufacturing process in the organisation.

Both routing and scheduling are important elements in the process of product control. They are interdependent on each other. Proper route cannot be assigned to a product without proper schedule, at the same time schedules cannot be prepared properly without the knowledge of exact route of production.

UNIT - IV

Quality Control and Inspection – Objectives and Significance – SQC – AGMARK, ISI and ISO – Certification Marks.

DEFINITION OF QUALITY

- **According to Juran** defined as "Quality is fitness for use".
- "The Quality of a product or service is the fitness of that product or service for meeting or exceeding its intended use as required by the customer."

DEFINITION OF CONTROL

- The process through which the standards are established and met with standards is called control.

DEFINITION OF QUALITY CONTROL

- **According to Alford and Beatty,** "Quality control means the recognition and removal of identifiable causes and defects, and variables from the set standards".
- **According to J.A. Shubin,** "Quality control is used to connote all those activities which are directed for defining, controlling and maintaining quality".
- **According to K.G. Lockyer,** "Quality control is systematic control by management of the variables in the manufacturing process that affect goodness of the end-product."

OBJECTIVES OF QUALITY CONTROL:

1. To establish the desired quality standards which are acceptable to the customers?
2. To discover flaws or variations in the raw materials and the manufacturing processes in order to ensure smooth and uninterrupted production.
3. To evaluate the methods and processes of production and suggest further improvements in their functioning.
4. To study and determine the extent of quality deviation in a product during the manufacturing process.
5. To analyse in detail the causes responsible for such deviation.
6. To undertake such steps which are helpful in achieving the desired quality of the product

IMPORTANCE OR BENEFITS OF QUALITY CONTROL

1. Encourages quality consciousness:

The most important advantage derived by introducing quality control is that it develops and encourages quality consciousness among the workers in the factory which is greatly helpful in achieving desired level of quality in the product.

2. Satisfaction of consumers:

Consumers are greatly benefited as they get better quality products on account of quality control. It gives them satisfaction.

3. Reduction in production cost:

By undertaking effective inspection and control over production processes and operations, production costs are considerably reduced. Quality control further checks the production of inferior products and wastages thereby bringing down the cost of production considerably.

4. Most effective utilisation of resources:

Quality control ensures maximum utilisation of available resources thereby minimising wastage and inefficiency of every kind.

5. Reduction in inspection costs:

Quality control brings about economies in inspection and considerably reduces cost of inspection.

6. Increased goodwill:

By producing better quality products and satisfying customer's needs, quality control raises the goodwill of the concern in the minds of people. A reputed concern can easily raise finances from the market.

7. Higher morale of employees:

An effective system of quality control is greatly helpful in increasing the morale of employees, and they feel that they are working in the concern producing better and higher quality products.

8. Improved employer-employee relations:

Quality control develops to better industrial atmosphere by increasing morale of employees which ensures cordial employer-employee relations leading to better understanding and closeness between them.

9. Improved techniques and methods of production:

By supplying technical and engineering data for the product and manufacturing processes, improved methods and designs of production are ensured by quality control.

10. Effective advertisement:

Organisations producing quality products have effective advertisement. They win the public confidence by supplying those better quality products.

11. Facilitates price fixation:

By introducing quality control measures, uniform products of same quality are produced. This greatly facilitates the problem of price fixation. One price of standard products becomes prevalent in the market.

12. Increased sales:

Quality control ensures production of quality products which is immensely helpful in attracting more customers for the product thereby increasing sales. It is greatly helpful in maintaining existing demand and creating new demand for the product. It has been rightly pointed out that quality control is a powerful instrument with the help of which markets both at home and abroad can be expanded.

INSPECTION

MEANING OF INSPECTION

"A visit to a factory or other building to check that everything is satisfactory and all rules are being obeyed. An official check done on something to see that it is of the right standard or quality, or whether it is safe to use."

OBJECTIVES OF INSPECTION

1. To detect and remove the faulty raw materials before it undergoes production.
2. To detect the faulty products in production whenever it is detected.
3. To bring facts to the notice of managers before they become serous to enable them discover weaknesses and over the problem.
4. To prevent the substandard reaching the customer and reducing complaints.
5. To promote reputation for quality and reliability of product.

IMPORTANCE OR PURPOSE OF INSPECTION

1. To distinguish good lots from bad lots.

2. To distinguish good pieces from bad pieces.
3. To determine if the process is changing.
4. To determine if the process is approaching the specification limits.
5. To rate quality of product.
6. To rate accuracy of inspectors.
7. To measure the precision of the measuring instrument.
8. To secure products-design information.
9. To measure process capability.

STATISTICAL QUALITY CONTROL (SQC):

MEANING OF SQC

Statistics:

Statistics means the good amount of data to obtain reliable results. The Science of statistics handles this data in order to draw certain conclusions. Its techniques find extensive applications in quality control, production planning and control, business charts, linear programming etc.

Quality:

Quality is a relative term and is generally explained with reference to the end use of the product. Quality is defined as fitness for purpose.

Control:

Control is a system for measuring and checking or inspecting a phenomenon. It suggests when to inspect, how often to inspect and how much to inspect, how often to inspect. Control ascertains quality characteristics of an item, compares the same with prescribed quality standards and separates defective item from non-defective ones.

Statistical Quality Control (SQC):

- **SQC** is the term used to describe the set of statistical tools used by quality professionals.
- SQC is used to analyze the quality problems and solve them. Statistical quality control refers to the use of statistical methods in the monitoring and maintaining of the quality of products and services

BENEFITS OF STATISTICAL QUALITY CONTROL

- It provides a means of detecting error at inspection.
- It leads to more uniform quality of production.
- It improves the relationship with the customer.
- It reduces inspection costs.
- It reduces the number of rejects and saves the cost of material.
- It provides a basis for attainable specifications.
- It points out the bottlenecks and trouble spots.
- It provides a means of determining the capability of the manufacturing process.
- It promotes the understanding and appreciation of quality control.

TOOLS OF STATISTICAL QUALITY CONTROL

Statistical Quality Control (SQC) is the term used to describe the set of statistical tools used by quality professionals. SQC is used to analyze the quality problems and solve them. Statistical quality control refers to the use of statistical methods in the monitoring and maintaining of the quality of products and services.

All the tools of SQC are helpful in evaluating the quality of services. SQC uses different tools to analyze quality problem.

1) Descriptive Statistics
2) Statistical Process Control (SPC)
3) Acceptance Sampling

Descriptive Statistics involves describing quality characteristics and relationships. SPC involves inspect random sample of output from process for characteristic. Acceptance Sampling involves batch sampling by inspection.

The seven major tools used for Statistical Process Control are,

- Histogram
- Pareto Chart
- Cause and Effect Diagram
- Defect Concentration Diagram
- Control Chart
- Scatter Diagram
- Check Sheet

AGMARK

What is AGMARK?

AGMARK is a certification mark employed on agricultural products in India, assuring that they conform to a set of standards approved by the *Directorate of Marketing and Inspection* an attached Office of the Department of Agriculture, Cooperation and Farmers Welfare under Ministry of Agriculture & Farmers Welfare an agency of the Government of India.

MEANING OF AGMARK

AGMARK is a certification mark that is used to show that – it is a quality agriculture product of India. The term AGMARK was made by joining the words: "Ag" means- Agriculture and "mark means – **Certification Mark.**

This MARK is only used in India country. So in a simple world, it is clear that AG-MARK means, the mark which is used to show that it is a quality agriculture product of India

The full form of AGMARK = Agricultural Mark

AGMARK is created by Archibald MacDonald Livingstone, Agricultural and Marketing Advisory to the Government of India from 1934 to 1941.

AG-MARK plays a very important role because it assures that, the product containing the Ag-mark is good in terms of quality and produced in hygienic conditions or it is fit for human consumption. It is useful, both for consumers and producers, marketers and traders.

COMMODITIES AND TESTS OF AGMARK:
The testing done across these laboratories include chemical analysis, microbiological analysis, pesticide residue, and aflatoxin analysis on whole spices, ground spices, ghee, butter, vegetable oils, mustard oil, honey, food grains (wheat), wheat products (atta, suji, and maida), gram flour, soybean seed, bengal gram, ginger, oil cake, NON edible oil, oils and fats, animal casings, meat and other food products

ISI
ISI stands for Indian Standards Institute**.**

MEANING OF ISI
The ISI mark is a standards-compliance mark for industrial products in India since 1955. The mark certifies that a product conforms to an Indian standard (IS) developed by the Bureau of Indian Standards (BIS), the national standards body of India.

WHAT IS ISI MARK REGISTRATION?
ISI mark registration is mandatory for all the certifying products sold in India. The mark is meant for better quality and safety of the products. The Products having ISI indicate that products are in compliance with the Indian standard quality. Through getting ISI certification on your products, you are eligible to expand your business. If products sold in India don't have ISI, then those products cannot be sold within the territory of India.

PURPOSE OF ISI REGISTRATION
The purpose of ISI registration is to

- Provide quality assurance of any product or good;
- Increase the confidence of the customer while buying the good;
- Provide a safeguard to the health of the customer.

IS IT MANDATORY TO OBTAIN ISI MARK?
The government of India, as well as Bureau of Indian Standard, makes it mandatory to obtain ISI on certain products sold in India. Those products include electrical appliances as well as industrial items. However, from September 2012 ISI is compulsory for certified steel products and steel items.

WHO IS AUTHORIZED TO ISSUE ISI MARK?
ISI certifies that a product is made as per the Indian Standard. Bureau of Indian Standards (BIS) is an authorized body for the issuance of the mark.

LIST OF THE PRODUCTS THAT REQUIRE ISI REGISTRATION
For the following products, ISI registration is mandatory:

- Cement
- Steel products
- Electrical Transformers
- Food Products
- Cylinders, valves, and regulators
- Batteries
- Capacitors
- Electrical motors
- Stainless Steel plate
- Clinical thermometer
- Packaged Drinking water
- Stoves
- Steel wire and steel sheets
- Kitchen Appliances

BENEFITS OF ISI MARK

There are numerous benefits of ISI mark. The list of the benefits of ISI is described below:

- It helps to increase the satisfaction of the customer.
- Where the customer is unsatisfied with the product's quality, then the company selling the product will exchange the product with a new one.
- For every customer, the mark makes it possible to get the best quality of the product.
- If any customer finds that the product having ISI is of bad quality, then the customer can take action against the manufacturer of the product.
- It helps the manufacturers and owners of the product to increase their business.

ISI REGISTRATION PROCESS

As we discussed above, ISI registration is compulsory. If you are thinking to obtain ISI registration, then you have to follow the below steps:

1. Choose the product code

- Firstly, you are required to select the product quality as prescribed in the Indian Standard Institute.
- Identify an ISI standard code for your product

2. Filing of Application Form

1. After choosing the product code, in the next step, you have to file the file the registration application form. (Form-V)
2. Affix all the necessary documents along with the application form.
3. In this step, you need to pay fees as required for the certification and inspection of your factory premise.

3. Inspection of the Factory premise

- Upon successful submission of the application, Inspection team and the persons authorized by the Government will visit the factory premise.
- The inspection team and authorized person will inspect the factory premise and quality control process.
- The inspection team will take some samples of your product and good for testing in BIS approved lab.

4. Collect the Test report

- Get lab test report of the sample done by the inspection
- Submit the lap report to BIS.

5. Issuance of ISI registration certificate

BIS, after proper verification of the testing report and application form, will issue a registration certificate.

HOW MUCH TIME IS REQUIRED TO GET ISI REGISTRATION CERTIFICATE?

Generally, it takes 30 days from the date of submission of an application to get ISI registration certificate.

DOCUMENTS REQUIRED FOR ISI REGISTRATION

If you are willing to take ISI registration, then you have to submit certain documents as described below:

- Registration certificate of the company
- Receipt of Property tax
- Insurance policy
- If the property is rented, then submit the rent agreement
- Telephone bill
- Electricity bill
- Bank statement
- Aadhar card of the directors of the company
- Voter ID card
- Driving License
- Copy of test reports
- List of Manufacturing machinery
- Copies of calibration certificates of testing equipment

ISO STANDS FOR INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

MEANING OF ISO

ISO stands for International Organization for Standardization. It is an international body, which consists of representatives from more than 90 countries. The national standard bodies of these countries are the members of this organization. Bureau of Indian Standards (BIS) are the Indian representative to ISO, ISO and International Electro Technical Commission (IEC)) operate jointly as a single system. These are non-governmental organizations, which exist to provide common standards on international trade of goods and services.

ISO 9000 SERIES

ISO 9000 standards expect firms to have a quality manual that meets ISO guidelines, documents, quality procedures and job instructions, and verification of compliance by third-party auditors. ISO 9000 series has five international standards on quality managements. They are:

1. ISO 9000 — Quality management and Quality assurance standards
2. ISO 9001 — Quality systems: Quality in design
3. ISO 9002 — Quality systems: Production and Installation
4. ISO 9003 — Quality systems: Final inspection and test
5. ISO 9004 — Quality management and systems

OBJECTIVES OF ISO 9000 SERIES:

The objectives of ISO 9000 series are listed in the following table.

ISO 9000 SERIES

Standard	*Objectives/Tasks*
ISO 9000	This provides guidelines on selection and use of quality management and quality assurance standards.
ISO 9001	It has 20 elements covering design, development, production, installation and servicing.
ISO 9002	It has 18 elements covering production and installation. It is same as ISO 9001 without the first two tasks, *viz*., design and development. This is applicable for the units excluding R & D functions.
ISO 9003	It has 12 elements covering final inspection and testing for laboratories and warehouses etc.
ISO 9004	This provides guidelines to interpret the quality management and quality assurance. This also has suggestions which are not mandatory.

BENEFITS OF ISO 9000 SERIES:-

ISO 9000 series provides several tangible and intangible benefits which are listed below:

1. This gives competitive advantage in the global market.
2. Consistency in quality, since ISO helps in detecting non-conformity early which makes it possible to take corrective action.
3. Documentation of quality procedures adds clarity to quality system.
4. ISO 9000 ensures adequate and regular quality training for all members of the organization.
5. ISO helps the customers to have cost effective purchase procedure.
6. The customers while making purchases from companies with ISO certificate need not spend much on inspection and testing. This will reduce the quality cost and lead-time.
7. This will help in increasing productivity.
8. This will aid to improved morale and involvement of workers.
9. The level of job satisfaction would be more.

STEPS IN ISO 9000 REGISTRATION

1. Selection of appropriate standard from ISO 9001, ISO 9002 and ISO 9003 using the guidelines given in ISO 9000.
2. Preparation of quality manual to cover all the elements in the selected model.

3. Preparation of procedures and shop floor instructions which are used at the time of implementing the system. Also document these items.
4. Self-auditing to check compliance of the selected model.
5. Selection of a registrar and making application to obtain certificate for the selected model.

A registrar is an independent body with knowledge and experience to evaluate any one of the three models of the company's quality system (ISO 9002). Registrars are approved and certified by acridities.

The registrar, on successful verification and assessment will register the company. Before selecting a registrar, one should know the following:

1. Accreditors of the registrar.
2. Background and credibility of the registrar.
3. Cost of registration through the proposed registrar.
4. Expected harmony between the company and the potential registrar while working towards implementing ISO model in the company.

CERTIFICATION MARKS

Indian Product Certification marks, Non-statutory mark, Recycling symbols and Other marks. 1. ISI 2. Agmark 3. Bis Hallmark 4. FPO Mark 5. Eco mark 6. Veg & Non veg. Mark 7. Toxicity mark 8. FSSAI 9. Recycle mark symbol 10. Silk mark and Other mark

MEANING OF CERTIFICATION MARKS

India has a comprehensive system of product certifications governed by laws made by the Parliament of India at various times. These certifications are managed by various agencies, and hold various statuses before the law. Some of these marks are mandatory for such products to be manufactured or to be placed in the Indian market while some of the marks hold only an advisory status. All the industrial standardisation and industrial product certifications are governed by the Bureau of Indian Standards, the national standards organisation of India, while standards for other areas (like agricultural products) are developed and managed by other governmental agencies.

TYPES OF CERTIFICATION MARKS

- **Agmark** for all agricultural products.
- **BIS hallmark** (**BIS hallmark**) certifies the purity of gold jewellery.
- **Ecomark** is an ecolabel for various products issued by the Bureau of Indian Standards. Voluntary and promotional.
- **FPO mark**. A mandatory mark for all processed fruit products in India. Certifies that the product was manufactured in a hygienic 'food-safe' environment.
- **Geographical Indications marks**, defined under the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), have been in force since 2003. Examples include the **Darjeeling tea** and **Basmati mark**.
- **India Organic** certification mark for organically farmed food products. Certifies that the product conforms to the specifications of *National Standards for Organic Products, 2000* and any eventual amendments. The certification is issued by testing centre's accredited by the Agricultural and Processed Food Products Export Development Authority (APEDA) under the National Program for Organic Production of the Government of India.
- **ISI mark**. For industrial product. Certifies that a product conforms to a set of standards laid by the Bureau of Indian Standards.
- **Non Polluting Vehicle mark** on motor vehicles certifying conformity to the **Bharat Stage emission standards**.
- **FSSAI** for all food products.

OTHER MARKS:

These are mandatory marks or labels required by the law in India, but are not exactly certifications marks (alphabetical list).

- **Toxicity label** is mandatory on the containers of pesticides sold in India. Identifies the level of toxicity of the pesticide in four levels
- **Vegetarian mark** (green dot symbol) and the Non-vegetarian mark (brown dot symbol), either of this is mandatory for packaged food products. To distinguish between vegetarian and non-vegetarian food.

NON-STATUTORY MARKS:

There are other non-statutory certification marks or schemes in India which are promoted by the Government of India, by policy, or through governmental or semi-governmental agencies. But these certifications bear no legal status in the nation and are purely promotional in nature.

Examples of such certifications are:

- Silk Mark. Certifies that a piece of textile is pure silk. Managed by the 'Silk Mark Organisation of India'.
- The *Ayush Mark* or the *Ayush Product Certification Scheme* for herbal products by the *Department of Ayush*.
- The Darjeeling tea certification mark, a geographical indication mark for tea produced in Darjeeling.

UNIT - V

Material Management – Objectives and importance – Purchasing – Procedure – Store Keeping – Objectives – Functions - JIT

MATERIAL MANAGEMENT

MEANING OF MATERIAL MANAGEMENT:

Materials management is just managing all types of materials in an organization. It can be broken down into three areas: acquisition, quality control, and standards.

"Material management is the planning, directing, controlling and co-ordination of all those activities concerned with material and inventory requirements, from the point of their inception to their introduction into manufacturing process."

DEFINITION OF MATERIALS MANAGEMENT

Materials Management thus can be defined as that function of business that is responsible for the Coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide service to the customer, at a pre-decided level at a minimum cost.

According to N.K. Nair, "Material management is the integrated functioning of the various sections of an organization dealing with the supply of materials and allied activities in order to achieve maximum co-ordination."

OBJECTIVES OF MATERIALS MANAGEMENT

The primary objectives of Materials Management department are:

- Low Procurement price
- High inventory turnover
- Low cost of acquisition and possession
- Continuity of supply
- Consistent quality
- Low payroll costs
- Favorable supplier relations
- Maintenance of good records

The secondary objectives of Materials Management are:

- New materials, processes and products
- Economic make or buy decisions
- Standardization
- Product improvement

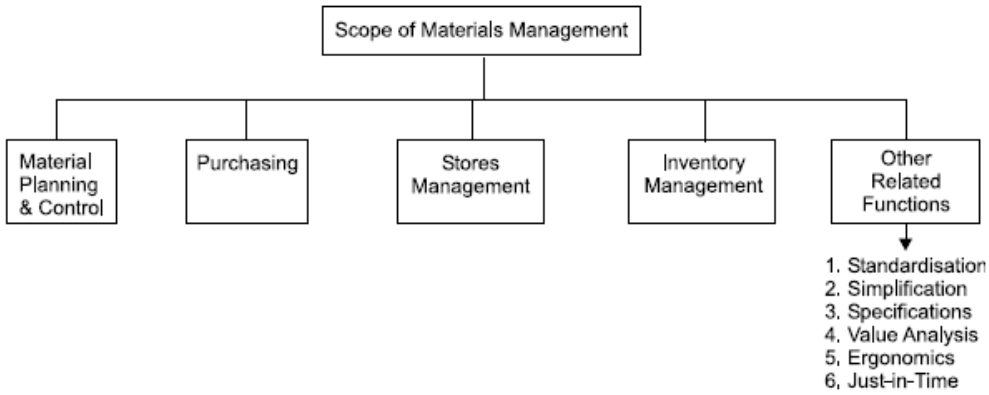
THE IMPORTANCE OF MATERIAL MANAGEMENT

- The material cost content of total cost is kept at a reasonable level. Scientific purchasing helps in acquiring materials at reasonable prices. Proper storing of materials also helps in reducing their wastages. These factors help in controlling cost content of products.
- The cost of indirect materials is kept under check. Sometimes cost of indirect materials also increases total cost of production because there is no proper control over such materials.

- The equipment is properly utilized because there are no break downs due to late supply of materials.
- The loss of direct labour is avoided.
- The wastages of materials at the stage of storage as well as their movement is kept under control.
- The supply of materials is prompt and late delivery instances are only few.
- The investments on materials are kept under control as under and over stocking are avoided.
- Congestion in the stores and at different stages of manufacturing is avoided.

FUNCTIONS OR NATURE AND SCOPE OF MATERIAL MANAGEMENT

1. Material Planning and Control
2. Purchasing
3. Stores Management
4. Inventory Control or Management
5. Standardization
6. Simplification
7. Value Analysis
8. Ergonomics
9. Just-in-Time (JIT)



Material Planning and Control

Based on the sales forecast and production plans, the materials planning and control is done. This involves estimating the individual requirements of parts, preparing materials budget, forecasting the levels of inventories, scheduling the orders and monitoring the performance in relation to production and sales.

Purchasing

This includes selection of sources of supply finalization in terms of purchase, placement of purchase orders, follow-up, maintenance of smooth relations with suppliers, approval of payments to suppliers, evaluating and rating suppliers.

Stores Management

This involves physical control of materials, preservation of stores, minimization of obsolescence and damage through timely disposal and efficient handling, maintenance of stores records, proper

location and stocking. A store is also responsible for the physical verification of stocks and reconciling them with book figures. A store plays a vital role in the operations of a company.

Inventory Control or Management

Inventory generally refers to the materials in stock. It is also called the idle resource of an enterprise. Inventories represent those items, which are either stocked for sale or they are in the process of manufacturing or they are in the form of materials, which are yet to be utilized. The interval between receiving the purchased parts and transforming them into final products varies from industries to industries depending upon the cycle time of manufacture. It is, therefore, necessary to hold inventories of various kinds to act as a buffer between supply and demand for efficient operation of the system. Thus, an effective control on inventory is a must for smooth and efficient running of the production cycle with least interruptions.

A. Other related activities

3S

i. ***Standardization:*** Standardization means producing maximum variety of products from the minimum variety of materials, parts, tools and processes. It is the process of establishing standards or units of measure by which extent, quality, quantity, value; performance etc. may be compared and measured.

ii. ***Simplification:*** The concept of simplification is closely related to standardization. Simplification is the process of reducing the variety of products manufactured. Simplification is concerned with the reduction of product range, assemblies, parts, materials and design.

iii. ***Specifications:*** It refers to a precise statement that formulizes the requirements of the customer. It may relate to a product, process or a service.

B. ***Value analysis****:* Value analysis is concerned with the costs added due to inefficient or unnecessary specifications and features. It makes its contribution in the last stage of product cycle, namely, the maturity stage. At this stage research and development no longer make positive contributions in terms of improving the efficiency of the functions of the product or adding new functions to it.

C. ***Ergonomics (or) Human Engineering****:* The human factors or human engineering is concerned with man-machine system. Ergonomics is "the design of human tasks, man-machine system, and effective accomplishment of the job, including displays for presenting information to human sensors, controls for human operations and complex man-machine systems." Each of the above functions is dealt in detail.

PURCHASING

MEANING OF PURCHASING

1. Purchasing describes the process of buying. It covers the knowledge of the requirements, identifying and selecting a supplier and negotiating price.
2. Purchasing is the first phase of Materials Management. Purchasing means procurement of goods and services from some external agencies. The object of purchase department is to arrange the supply of materials, spare parts and services or semi-finished goods, required by the organisation to produce the desired product, from some agency or source outside the organisation.

DEFINITION OF PURCHASING

1. **According to Alford and Beatty**, "Purchasing is the procuring of materials, supplies, machines, tools and services required for equipment, maintenance, and operation of a manufacturing plant".
2. **According to Walters,** "purchasing function means 'the procurement by purchase of the proper materials, machinery, equipment and supplies for stores used in the manufacture of a product adopted to marketing in the proper quality and quantity at the proper time and at the lowest price, consistent with quality desired."

OBJECTIVES OF PURCHASING

The basic objective of the purchasing function is to ensure continuity of supply of raw materials, sub-contracted items and spare parts and to reduce the ultimate cost of the finished goods. In other words, the objective is not only to procure the raw materials at the lowest price but to reduce the cost of the final product. The objectives of the purchasing department can be outlined as under:

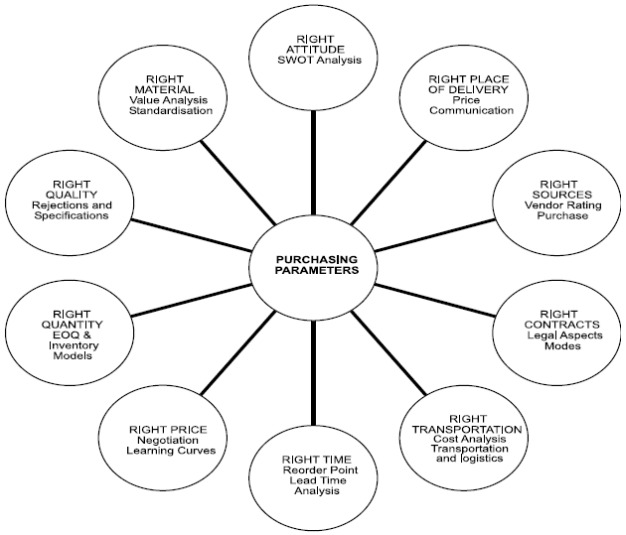
- ***To avail the materials, suppliers and equipments at the minimum possible costs:*** These are the inputs in the manufacturing operations. The minimization of the input cost increases the productivity and resultantly the profitability of the operations.
- ***To ensure the continuous flow of production:*** through continuous supply of raw materials, components, tools etc. with repair and maintenance service.
- ***To increase the asset turnover:*** The investment in the inventories should be kept minimum in relation to the volume of sales. This will increase the turnover of the assets and thus the profitability of the company.
- ***To develop an alternative source of supply:*** Exploration of alternative sources of supply of materials increases the bargaining ability of the buyer, minimization of cost of materials and increases the ability to meet the emergencies.
- ***To establish and maintain the good relations with the suppliers:*** Maintenance of good relations with the supplier helps in evolving a favorable image in the business circles. Such relations are beneficial to the buyer in terms of changing the reasonable price, preferential allocation of material in case of material shortages, etc.
- ***To achieve maximum integration with other department of the company:*** The purchase function is related with **production department** for specifications and flow of material, **engineering department** for the purchase of tools, equipments and machines, **marketing department** for the forecasts of sales and its impact on procurement of materials, **financial department** for the purpose of maintaining levels of materials and estimating the working capital required, **personnel department** for the purpose of manning and developing the personnel of purchase department and maintaining good vendor relationship.
- ***To train and develop the personnel:*** Purchasing department is manned with varied types of personnel. The company should try to build the imaginative employee force through training and development.
- ***Efficient record keeping and management reporting:*** Paper processing is inherent in the purchase function. Such paper processing should be standardized so that record keeping can be facilitated. Periodic reporting to the management about the purchase activities justifies the independent existence of the department.

PARAMETERS OF PURCHASING:

The success of any manufacturing activity is largely dependent on the procurement of raw materials of right quality, in the right quantities, from right source, at the right time and at right price popularly known as **ten 'R's'** of the art of efficient purchasing. They are described as the basic principles of purchasing. There are other well known parameters such as right contractual terms, right material, right place, right mode of transportation and right attitude are also considered for purchasing

1. **Right price:**

It is the primary concern of any manufacturing organization to get an item at the right price. But right price need not be the lowest price. It is very difficult to determine the right price; general guidance can be had from the cost structure of the product. The 'tender system' of buying is normally used in public sector organizations but the objective should be to identify the lowest 'responsible' bidder and not the lowest bidder. The technique of 'learning curve' also helps the purchase agent to determine the price of items with high labor content. The price can be kept low by proper planning and not by rush buying. Price negotiation also helps to determine the right prices.



2. **Right quality:**

Right quality implies that quality should be available, measurable and understandable as far as practicable. In order to determine the quality of a product sampling schemes will be useful. The right quality is determined by the cost of materials and the technical characteristics as suited to the specific requirements. The quality particulars are normally obtained from the indents. Since the objective of purchasing is to ensure continuity of supply to the user departments, the time at which the material is provided to the user department assumes great importance.

3. **Right time:**

Right time for determining the right time, the purchase manager should have lead time information for all products and analyze its components for reducing the same. Lead time is the total time elapsed between the recognition of the need of an item till the item arrives and is provided for use. This covers the entire duration of the materials cycle and consists of pre-contractual administrative lead time, manufacturing and transporting lead time and inspection

lead time. Since the inventory increases with higher lead time, it is desirable to analyze each component of the lead time so as to reduce the first and third components which are controllable. While determining the purchases, the buyer has to consider emergency situations like floods, strikes, etc. He should have 'contingency plans' when force major clauses become operative, for instance, the material is not available due to strike, lock-out, floods, and earthquakes.

4. **Right Source:**

The source from which the material is procured should be dependable and capable of supplying items of uniform quality. The buyer has to decide which item should be directly obtained from the manufacturer. Source selection, source development and vendor rating play an important role in buyer-seller relationships. In emergencies, open market purchases and bazaar purchases are restored to.

5. **Right quantity**

The right quantity is the most important parameter in buying. Concepts, such as, economic order quantity, economic purchase quantity, fixed period and fixed quantity systems, will serve as broad guidelines. But the buyer has to use his knowledge, experience and common sense to determine the quantity after considering factors such as price structure, discounts, availability of the item, favorable reciprocal relations, and make or buy consideration.

6. **Right attitude**

Developing the right attitude, too, is necessary as one often comes across such statement: 'Purchasing knows the price of everything and value of nothing'; 'We buy price and not cost'; 'When will our order placers become purchase managers?'; 'Purchasing acts like a post box'. Therefore, purchasing should keep 'progress' as its key activity and should be future-oriented. The purchase manager should be innovative and his long-term objective should be to minimize the cost of the ultimate product. He will be able to achieve this if he aims himself with techniques, such as, value analysis, materials intelligence, purchases research, SWOT analysis, purchase budget lead time analysis, etc.

7. **Right contracts:**

The buyer has to adopt separate policies and procedures for capital and consumer items. He should be able to distinguish between indigenous and international purchasing procedures. He should be aware of the legal and contractual aspects in international practices.

8. **Right Material:**

Right type of material required for the production is an important parameter in purchasing. Techniques, such as, value analysis will enable the buyer to locate the right material.

9. **Right transportation:**

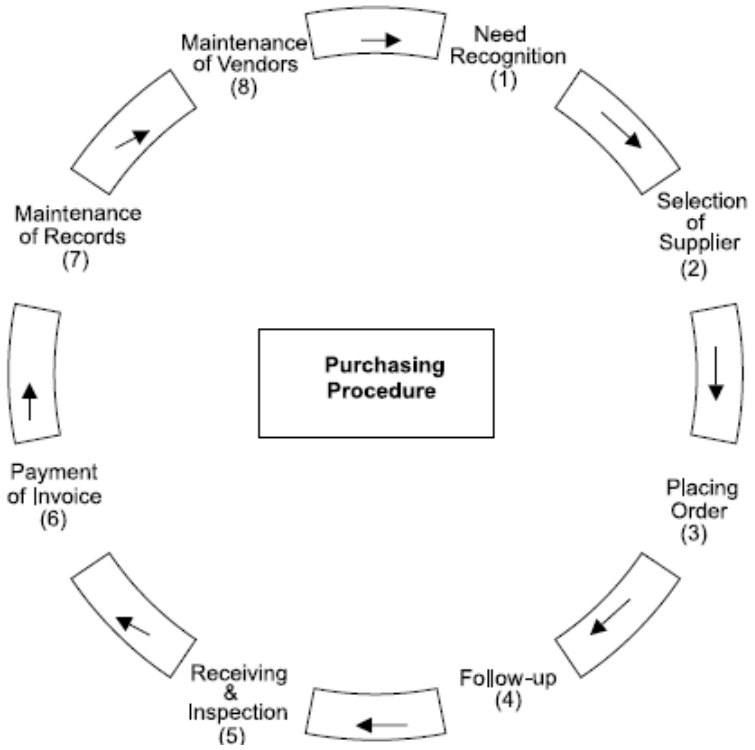
Right mode of transportation has to be identified as this forms a critical segment in the cost profile of an item. It is an established fact that the cost of the shipping of ore, gravel, sand, etc., is normally more than the cost of the item itself.

10. **Right place of delivery:**

Specifying the right place of delivery, like head office or works, would often minimize the handling and transportation cost.

PURCHASING PROCEDURE

The procedure describes the sequence of steps leading to the completion of an identified specific task. The purchasing procedure comprises the following steps.



i. ***Recognition of the need***:

The initiation of procedure starts with the recognition of the need by the needy section. The demand is lodged with the purchase department in the prescribed Purchase Requisition Form forwarded by the authorized person either directly or through the Stores Department. The purchase requisition clearly specifies the details, such as, specification of materials, quality and quantity, suggested supplier, etc. Generally, the low value sundries and items of common use are purchased for stock while costlier and special items are purchased according the production programmes. Generally, the corporate level executives are authorized signatories to such demands. Such purchases are approved by the Board of Directors. The reference of the approval is made on requisition and a copy of the requisition is sent to the secretary for the purpose of overall planning and budgeting.

ii. ***The selection of the supplier:***

The process of selection of supplier involves two basic aspects: searching for all possible sources and short listing out of the identified sources. The complete information about the supplier is available from various sources, such as, trade directories, advertisement in trade journals, direct mailing by the suppliers, interview with suppliers, salesmen, suggestions from business associates, visit to trade fair, participation in industries convention, etc. Identification of more and more sources helps in selecting better and economical supplier. It should be noted that the low bidder is not always the best bidder. When everything except price is equal, the low bidder will be selected. The important considerations in the selection are the price, ability to supply the required quantity, maintenance of quality standards, financial standing etc. It should be noted that it is not necessary to go for this process for all types of purchases. For the repetitive orders and for the purchases of low-value, small lot items, generally the previous suppliers with good records are preferred.

iii. Placing the order:

Once the supplier is selected the next step is to place the purchase order. Purchase order is a letter sent to the supplier asking to supply the said material. At least six copies of purchase order are prepared by the purchase section and each copy is separately signed by the purchase officer. Out these copies, one copy each is sent to store-keeper, supplier, accounts section, inspection department and to the department placing the requisition and one copy is retained by the purchase department for record.

iv. ***Follow up of the order:***

Follow-up procedure should be employed wherever the costs and risks resulting from the delayed deliveries of materials are greater than the cost of follow-up procedure, the follow-up procedure tries to see that the purchase order is confirmed by the supplier and the delivery is promised. It is also necessary to review the outstanding orders at regular intervals and to communicate with the supplier in case of need. Generally, a routine urge is made to the supplier by sending a printed post card or a circular letter asking him to confirm that the delivery is on the way or will be made as per agreement. In absence of any reply or unsatisfactory reply, the supplier may be contact through personal letter, phone, telegram and/or even personal visit.

v. ***Receiving and inspection of the materials***:

The receiving department receives the materials supplied by the vendor. The quantity are verified and tallied with the purchase order. The receipt of the materials is recorded on the specially designed receiving slips or forms which also specify the name of the vendor and the purchase order number. It also records any discrepancy, damaged condition of the consignment or inferiority of the materials. The purchase department is informed immediately about the receipt of the materials. Usually a copy of the receiving slip is sent to the purchase department.

vi. ***Payment of the invoice***:

When the goods are received in satisfactory condition, the invoice is checked before it is approved for the payment. The invoice is checked to see that the goods were duly authorized to purchase, they were properly ordered, they are priced as per the agreed terms, the quantity and quality confirm to the order, the calculations are arithmetically correct etc

vii. ***Maintenance of the records***:

Maintenance of the records is an important part and parcel of the efficient purchase function. In the industrial firms, most of the purchases are repeat orders and hence the past records serve as a good guide for the future action. They are very useful for deciding the timings of the purchases and in selecting the best source of the supply.

viii. ***Maintenance of vendo relations***:

The quantum and frequency of the transactions with the same key suppliers provide a platform for the purchase department to establish and maintain good relations with them. Good relations develop mutual trust and confidence in the course of the time which is beneficial to both the parties. The efficiency of the purchase department can be measured by the amount of the goodwill it has with its suppliers.

STORE KEEPING

MEANING:

- After the completion of purchase procedure, the next important aspect of materials management is storekeeping.
- A storehouse is a building provided for preserving materials, stores and finished goods. The in-charge of store is called storekeeper or stores manager. The organisation of the

stores department depends upon the size and layout of the factory, nature of the materials stored and frequency of purchases and issue of materials.

DEFINITION OF STORE KEEPING:-

- According to Alford and Beatty "storekeeping is that aspect of material control concerned with the physical storage of goods." In other words, storekeeping relates to art of preserving raw materials, work-in-progress and finished goods in the stores.

TYPES:

Its classified in TWO types 1. Centralised 2. Decentralised

CENTRALIZED	DECENTRALISED
Centralised storage means a single store for the whole organisation,	Decentralised storage means independent small stores attached to various departments.
Centralised storekeeping ensures better layout and control of stores, economical use of storage space, lesser staff, saving in storage costs and appointment of experts for handling storage problems. It further ensures continuous stock checking. It suffers from certain drawbacks also. It leads to higher cost of materials handling, delay in issue of materials to respective departments, exposure of materials to risks of fire and accident losses are practical difficulties in managing big stores.	decentralised stores involve lesser costs and time in moving bulky materials to distant departments and are helpful in avoiding overcrowding in central store. However, it too suffers from certain drawbacks viz., uniformity in storage policy of goods cannot be achieved under decentralised storekeeping, more staff is needed and experts may not be appointed.

OBJECTIVES OF STOREKEEPING:

1. To ensure uninterrupted supply of materials and stores without delay to various production and service departments of the organisation.
2. To prevent overstocking and understocking of materials,
3. To protect materials from pilferage, theft fire and other risks.
4. To minimise the storage costs.
5. To ensure proper and continuous control over materials.
6. To ensure most effective utilisation of available storage space and workers engaged in the process of storekeeping.

FUNCTIONS OF STOREKEEPING:

1. Issuing purchase requisitions to Purchase Department as and when necessity for materials in stores arises.
2. Receiving purchased materials from the purchase department and to confirm their quality and quantity with the purchase order.
3. Storing and preserving materials at proper and convenient places so that items could be easily located.
4. Storing the materials in such a manner so as to minimise the occurrence of risks and to prevent losses due to defective storage handling.
5. Issuing materials to various departments against material requisition slips duly authorized by the respective departmental heads.

6. Undertaking a proper system of inventory control, taking up physical inventory of all stores at periodical intervals and also to maintain proper records of inventory.
7. Providing full information about the availability of materials and goods etc., whenever so necessary by maintaining proper stores records with the help of bin cards and stores ledger etc.

JUST-IN-TIME (JIT)

INTRODUCTION

Just-In-Time (JIT) Manufacturing is a philosophy rather than a technique. By eliminating all waste and seeking continuous improvement, it aims at creating manufacturing system that is response to the market needs.

The phase just in time is used to because this system operates with low WIP (Work-In-Process) inventory and often with very low finished goods inventory. Products are assembled just before they are sold, subassemblies are made just before they are assembled and components are made and fabricated just before subassemblies are made. This leads to lower WIP and reduced lead times. To achieve this organizations have to be excellent in other areas *e.g*. quality.

DEFINITION OF JIT:

- Just-in-time is defined as the production of the minimum number of units in the smallest possible quantities at the latest possible time, which eliminates the need for inventory. It does not mean to produce on time but to produce "just in time".
- JIT is defined as an approach for providing smoother production flows and making continual improvements in processes and products. (Svensson, 2001)
- According to Voss, JIT is viewed as a "*Production methodology which aims to improve overall productivity through elimination of waste and which leads to improved quality*".

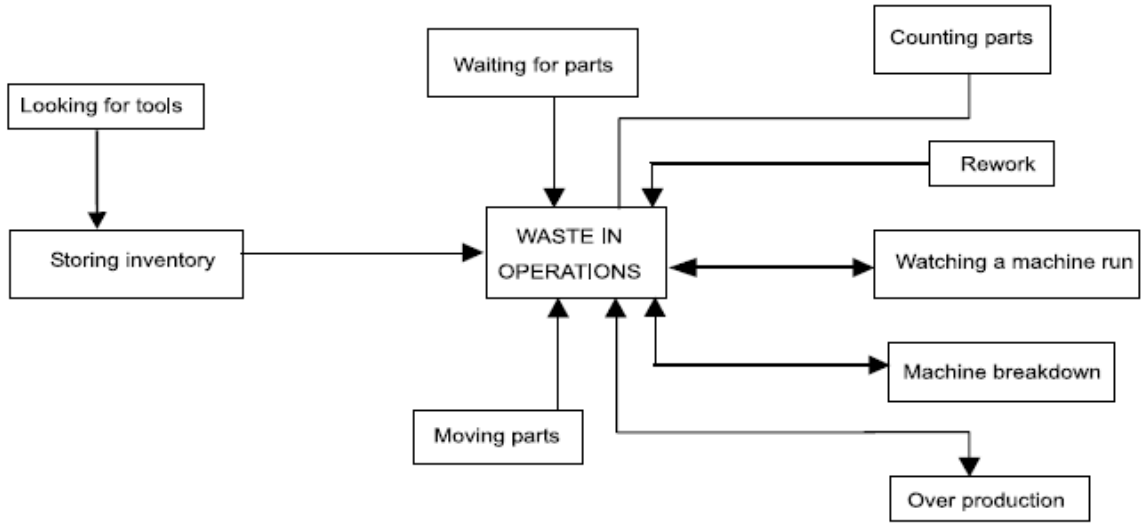
JIT IN PRODUCTION MANAGEMENT

JIT provides an efficient production in an organization and delivery of only the necessary parts in the right quantity, at the right time and place while using the minimum facilities".

SEVEN WASTES:

Shiego Shingo, a Japanese JIT authority and engineer at the Toyota Motor Company identifies seven wastes as being the targets of continuous improvement in production process. By attending to these wastes, the improvement is achieved.

1. Waste of over production eliminate by reducing set-up times, synchronizing quantities and timing between processes, layout problems. Make only what is needed now.
2. Waste of waiting eliminate bottlenecks and balance uneven loads by flexible work force and equipment.
3. Waste of transportation establishes layouts and locations to make handling and transport unnecessary if possible. Minimize transportation and handling if not possible to eliminate.
4. Waste of processing itself question regarding the reasons for existence of the product and then why each process is necessary.
5. Waste of stocks reducing all other wastes reduces stocks.



6. Waste of motion study for economy and consistency. Economy improves productivity and consistency improves quality. First improve the motions, then mechanize or automate otherwise. There is danger of automating the waste.
7. Waste of making defective products develop the production process to prevent defects from being produced, so as to eliminate inspection. At each process, do not accept defects and makes no defects. Make the process fail-safe. A quantify process always yield quality product.

BENEFITS OF JIT

The most significant benefit is to improve the responsiveness of the firm to the changes in the market place thus providing an advantage in competition. Following are the benefits of JIT:

1. ***Product cost***—is greatly reduced due to reduction of manufacturing cycle time, reduction of waste and inventories and elimination of non-value added operation.
2. ***Quality*** —is improved because of continuous quality improvement programs.
3. ***Design***—Due to fast response to engineering change, alternative designs can be quickly brought on the shop floor.
4. Productivity improvement.
5. Higher production system flexibility.
6. Administrative and ease and simplicity.