

DKR24 - OPERATIONS MANAGEMENT

Unit I : Nature and scope of production and operations management; Function POM, Facility location, Types of Manufacturing systems and layouts - Material Planning, Line balancing, Operations Decisions.

Unit II : Production Planning and control- meaning- functions-Master production Schedule- Material Requirement planning- Capacity requirement planning- Models, Process planning – Maintenance management concepts.

Unit III : Materials management – An Overview of materials planning – materials Planning and inventory Control, types of inventory and inventory control – Inventory control systems- Materials Planning, Budgeting and Materials requirement Planning, Purchase Management- Stores Management.

Unit IV: Quality Control- Purposes, Quality assurance- Acceptance sampling - Statistical Quality Control – Control for variables and attributes- Quality Circles - Total Quality Management -ISO 9000.

Unit V: Economics – Meaning – importance – work study method study. Time and motion study – work measurements work sampling – industrial safety

Unit I : Nature and scope of production and operations management; Function POM, Facility location, Types of Manufacturing systems and layouts - Material Planning, Line balancing, Operations Decisions.

INTRODUCTION TO PRODUCTION & OPERATIONS (IN GENERAL)

Production and Operations Management ("POM") is about the transformation of production and operational inputs into "outputs" that, when distributed it ultimately meet the needs of customers.



The process in the above diagram is often referred to as the "**Conversion Process**". There are several different methods of handling the conversion or production process - **Job, Batch, Flow and Group/ Mass Method**. Added POM incorporates many tasks that are grouped under five main headings:

i) PRODUCT :

Marketers in a business must ensure that a business sells products that meet customer needs and wants. The role of PRODUCT in POM therefore concerns areas such as:

- Performance
- Aesthetics
- Quality
- Reliability
- Quantity

- Productioncosts
- Delivery dates

ii) PLANT

To make PRODUCT, PLANT of some kind is needed. In determining which PLANT to use, management must consider areas such as:

- Future demand
- Design and layout of factory, equipment, offices
- Productivity and reliability of equipment - Need for (and costs of) maintenance
- Health and safety of equipment
- Environmental issues

iii) PROCESSES

There are many different ways of producing a product. Management must choose the best process, or series of processes. They will consider:

- Available capacity
- Available skills
- Type of production
- Layout of plant and equipment
- Safety
- Production costs
- Maintenance requirements

iv) PROGRAMMES

The production PROGRAMME concerns the dates and times of the products that are to be produced and supplied to customers. The decisions are influenced by factors such as:

- Purchasing patterns (e.g. lead time)
- Cash flow
- Need for / availability of storage
- Transportation

v) PEOPLE

Production depends on PEOPLE, whose skills, experience and motivation vary. Key people-related decisions will consider the following areas:

- Wages and salaries
- Safety and training
- Work conditions
- Leadership and motivation
- Unionisation
- Communication

MEANING & DEFINITION:

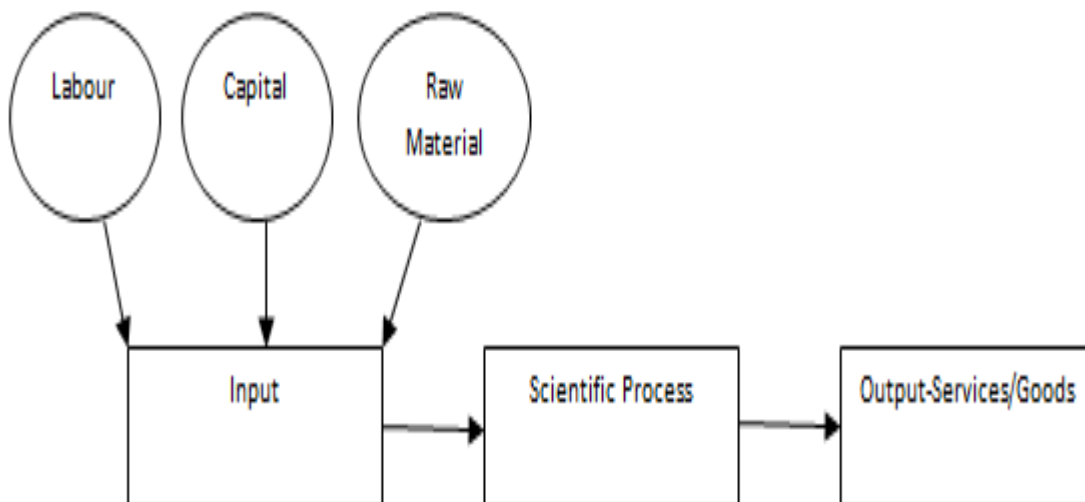
- **OPERATIONS MANAGEMENT** is an area of management concerned with designing and controlling the process of production and redesigning the business operations in the production of goods or services.

It is concerned with managing the process that converts inputs (raw materials, labour, energy) into outputs (goods and/or services).

Operations management is concerned with managing all operational function in an organization. Operations is one of the major functions in an organization along with marketing, finance and human resources.

- **PRODUCTION**

Production is a scientific process which involves transformation of raw material (input) into desired product or service (output) by adding economic value.



- **PRODUCTION MANAGEMENT:**

- Production management means planning, organising, directing and controlling of production activities. Production Management deals with decision-making related to production process.

(or)

- Production management deals with converting raw materials into finished goods or products. It brings together the 6M's i.e. men, money, machines, materials, methods and markets to satisfy the wants of the people.

- **HISTORICAL DEVELOPMENT OF PRODUCTION AND OPERATIONS MANAGEMENT:**

- For over two centuries, operations and production management has been recognized as an important factor in a country's economic growth. The traditional view of manufacturing management began in eighteenth century when Adam Smith recognized the economic benefits of specialization of labour. He recommended breaking of jobs down into subtasks and recognizes workers to specialized tasks in which they would become highly skilled and efficient.

- In the early twentieth century, F.W. Taylor implemented Smith's theories and developed scientific management. From then till 1930, many techniques were developed prevailing the traditional view. Brief information about the contributions to manufacturing management is shown in the following table.

- Production management becomes the acceptable term from 1930s to 1950s. As F.W. Taylor's works become more widely known, managers developed techniques that focused on economic efficiency in manufacturing. Workers were studied in great detail to eliminate wasteful efforts and achieve greater efficiency. At the same time, psychologists, socialists and other social scientists began to study people and human behavior in the working environment. In addition, economists, mathematicians, and computer scientists contributed newer, more sophisticated analytical approaches.

- With the 1970s emerge two distinct changes in our views. The most obvious of these, reflected in the new name operations management was a shift in the service and manufacturing sectors of the economy. As service sector became more prominent, the **change from 'production' to 'operations'** emphasized the broadening of our field to service organizations. The second, more suitable change was the beginning of an emphasis on synthesis, rather than just analysis, in management practices.

- The various contributors who have played a very important role in the formation and also the development of operations management are as under:

1. Adam Smith (1776)

– who was the very first person to draw some attention towards the scientific operations management. According to :

- • Higher skill accompanied with greater degree is achieved by the workmen who are performing work in repetition.
- • Specialization in certain works by the workmen very often results in improvement of the various steps involved in the production methodology.
- • Time is saved while changing from one activity to another.

➤ 2. Charles Babbage (1883)

The English mathematician Charles Babbage was the first one to follow the concept advocated by Adam Smith. He advocated the concept of specialization of tasks as the next stage (logically related) to the division of labor. Babbage considered specialization in tasks as a very important advantage of the division of labor.

➤ 3. F.W. Taylor (1859 to 1915)

F.W. Taylor is known as the father of scientific management – he was the one who explained the concept of functional management. Four duties of management given by Taylor are:

- * Work is to be divided between the workers and the management
- * Science of every element of the work done by man is developed in order to replace the old rule -of- thumb methods.
- * The best worker is selected for performing each particular task along with training accompanied with development of the worker on individual basis.

➤ 4. Frank B. Gilbreth (1917)

Frank B. Gilbreth is known as the founder father of work study. He laid emphasis on

explaining the importance of the correlation between the physical effort and the operators output through his two books 'Motion Study.

➤ **5. Henry Ford (1913)**

The concept of mass production and organized work stations into a conveyorised assembly line was given to the world by Henry ford.

➤ **6. Henry Gantt (1913)**

His main contribution is the “Gantt chart “– which is a very important practical tool even in today’s world, in order to chart the production schedules and also the machine load schedules.

➤ **7. F.W Harris (1914)**

The first economic lot size (EOQ) model was developed by Harris – F.W Raymond also made a very important contribution in this regard.

➤ **8. Walter Shewhart (1924)**

In 1924 Walter was the one to introduce the concept of statistical quality control.

➤ **9. F.H Dodge (1931)**

Developed the concept of sampling inspection and published statistical sampling tables.

➤ **10. L.H.C Tippett (1937)**

The phenomenon of work sampling was developed by Tippett in order to know the manpower and machine utilization and also for setting performance standards.

➤ **FUNCTIONS 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.

CONCEPT OF PRODUCTION

Production function is that part of an organization, which is concerned with the transformation of a range of inputs into the required outputs (products).

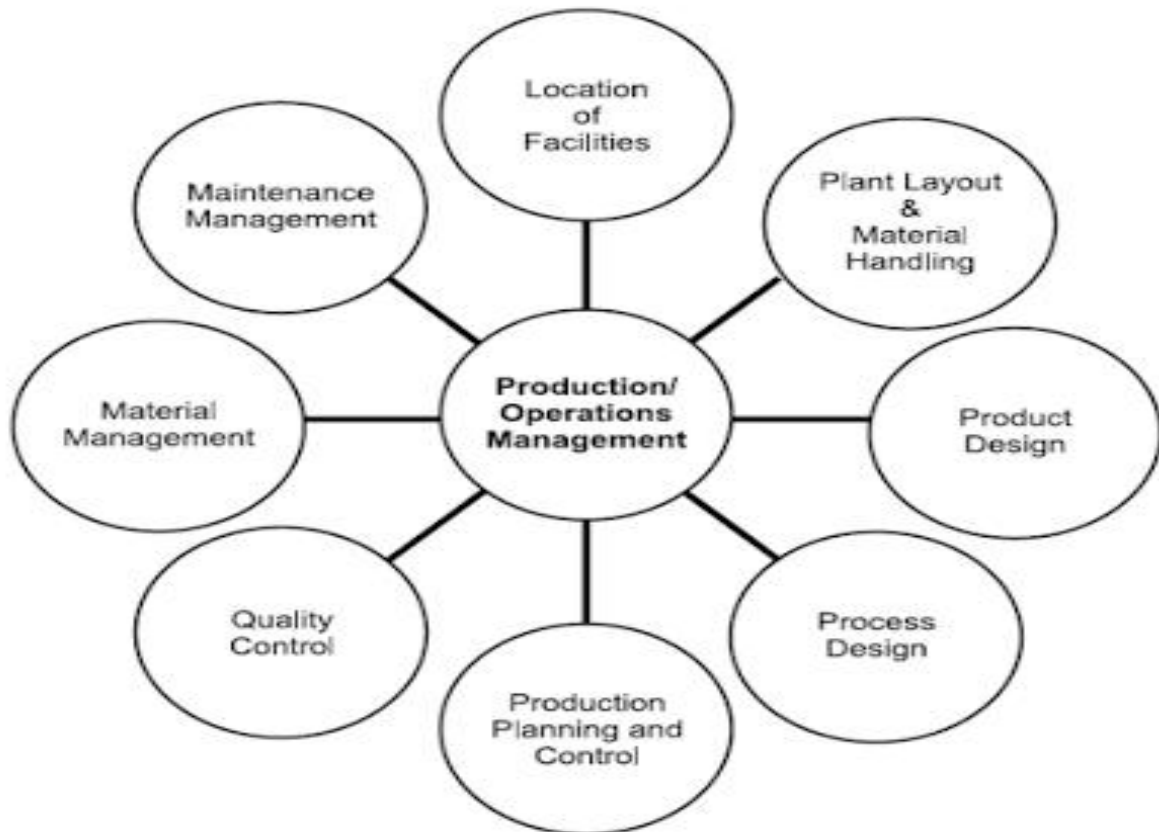
Production is defined as “the step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the product to the user.”

Some examples of production are: manufacturing custom-made products like, boilers with a specific capacity, constructing flats, some structural fabrication works for selected customers, etc., and manufacturing standardized products like, car, bus, motor cycle, radio, television, etc.

➤ SCOPE OF PRODUCTION AND OPERATIONS MANAGEMENT

Starting with the selection of location - production management covers such activities as acquisition of land, constructing building, procuring and installing machinery, purchasing and storing raw materials and converting them into saleable products. Added quality management, maintenance management, production planning and control, methods improvement and work simplification and other related areas.

1. **Facility Location** - Selecting appropriate location for the production
2. **Plant layouts and material handling** - Deciding upon the machines, equipment and necessary devices that leads to desired production. Storage of material and handling it in most effective way to avoid the wastage.
3. **Product design** - Designing the product with regards to its production.
4. **Process design** - Determination of the production process which is most relevant and efficient in the given state of affairs.
5. **Production and planning control** – of its various aspects how, when and where producing a particular product will be done.



6. **Quality control** - Controlling the production and ensuring the quality by setting the check points and taking the periodic measurements of the current performance.
 7. **Materials management** - Managing the inventories of raw material, semi-finished and finished goods such that there is no excessive money may block.
 8. **Maintenance Management** - Analysis the deviations and formulating the corrective measures to stay in track with planned quality, time-schedule and predetermined cost schedules.
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PRODUCTION PLANNING AND CONTROL:

- can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting and finishing dates for each item, to give production orders to shops and to follow up the progress of products according to orders. The main functions of production planning and control includes planning, routing, scheduling, dispatching and follow-up.

- **Planning** is deciding in advance what to do, how to do it, when to do it and who is to do it. Planning bridges the gap from where we are, to where we want to go. It makes it possible for things to occur which would not otherwise happen.

- **Routing** -is the selection of path where each part of the product will follow, which being transformed from raw material to finished products i.e., from department to department and machine to machine till raw material gets its final shape.
- **Scheduling** determines the programme for the operations. Scheduling may be defined as ‘the fixation of time and date for each operation’ as well as it determines the sequence of operations to be followed.
- **Dispatching** is concerned with the starting the processes. Dispatching is ‘release of orders and instruction for the starting of production for any item in acceptance with the route sheet and schedule charts’.
- **Follow-up-** The function is to report the daily progress of work in each shop in a prescribed proforma and to investigate the causes of deviations from the planned performance.

NATURE OF PRODUCTION MANAGEMENT

Production management is not only related to the transformation of inputs into goods and services, but it is also related to other management activities. The nature of production management can be classified under following points:

1. Production management assists in planning, organizing, co-ordinating, monitoring and controlling all the production activities. It is a part of general management .
2. It is an inter-subjective approach . Contribution made by several subjects like, economics, operational research, mathematics, statistics, human psychology, engineering, etc. have aided production management to develop a diverse and distinct approach of management.
3. Production management is not only confined to production of goods, it also includes management of service sector where no tangible goods are produced, but services are provided which are intangible

➤ **IMPORTANCE OF PRODUCTION MANAGEMENT**

1. **Higher standard of living** : Production management conducts continuous research and development (R&D). So they produce new and better varieties of products. People use these products and enjoy a higher standard of living.
2. **Generates employment** : Production activities create many different job opportunities in the country, either directly or indirectly. Direct employment is generated in the production area, and indirect employment is generated in the supporting areas such as marketing, finance, customer support, etc.

3. **Improves quality and reduces cost** : Production management improves the quality of the products because of research and development. Because of large-scale production, there are economies of large scale. This brings down the cost of production. So, consumer prices also reduce.
4. **Boosts economy** : Production management ensures optimum utilisation of resources and effective production of goods and services. This leads to speedy economic growth and well-being of the nation.

5. **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.
6. **Reputation, Goodwill and Image** : Production management helps the firm to satisfy its customers. This increases the firms reputation, goodwill and image. A good image helps the firm to expand and grow.
7. **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.

PRODUCTION MANAGEMENT V/S OPERATIONS MANAGEMENT

Factors	Production Management	Operations Management
Output:	Production management deals with manufacturing of products like (computer, car, etc)	Operations management cover both products and services.
Usage of Output	Products like computer/car are utilized over a period of time	whereas services need to be consumed immediately
Classification of work:	To produce products like computer/car more of capital equipment and less labour are required	while services require more labour and lesser capital equipment.

Customer Contact:	There is no participation of customer during production	whereas for services a constant contact with customer is required.
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STRATEGIES :

I. PRODUCTION / OPERATIONS STRATEGIES

Production/operations management (POM) is the core function in the business firm. Somehow, someplace, the goods and services that a company sells must be obtained. Basically, this involves a process of converting labor, materials, etc., into the particular combination of qualities that a selected group of customers wants.

The major decisions in the production/operations strategy are concerned with the technical core, quality, facilities, technology, and production planning and control. POM operating strategies must be coordinated with marketing strategy if the firm is to succeed. Careful integration with financial strategy components and the personnel function are also necessary.

Different Types of Production Strategies:

The different types of production strategies are grouped, listed and explained under following three categories, viz., as given in the figure:

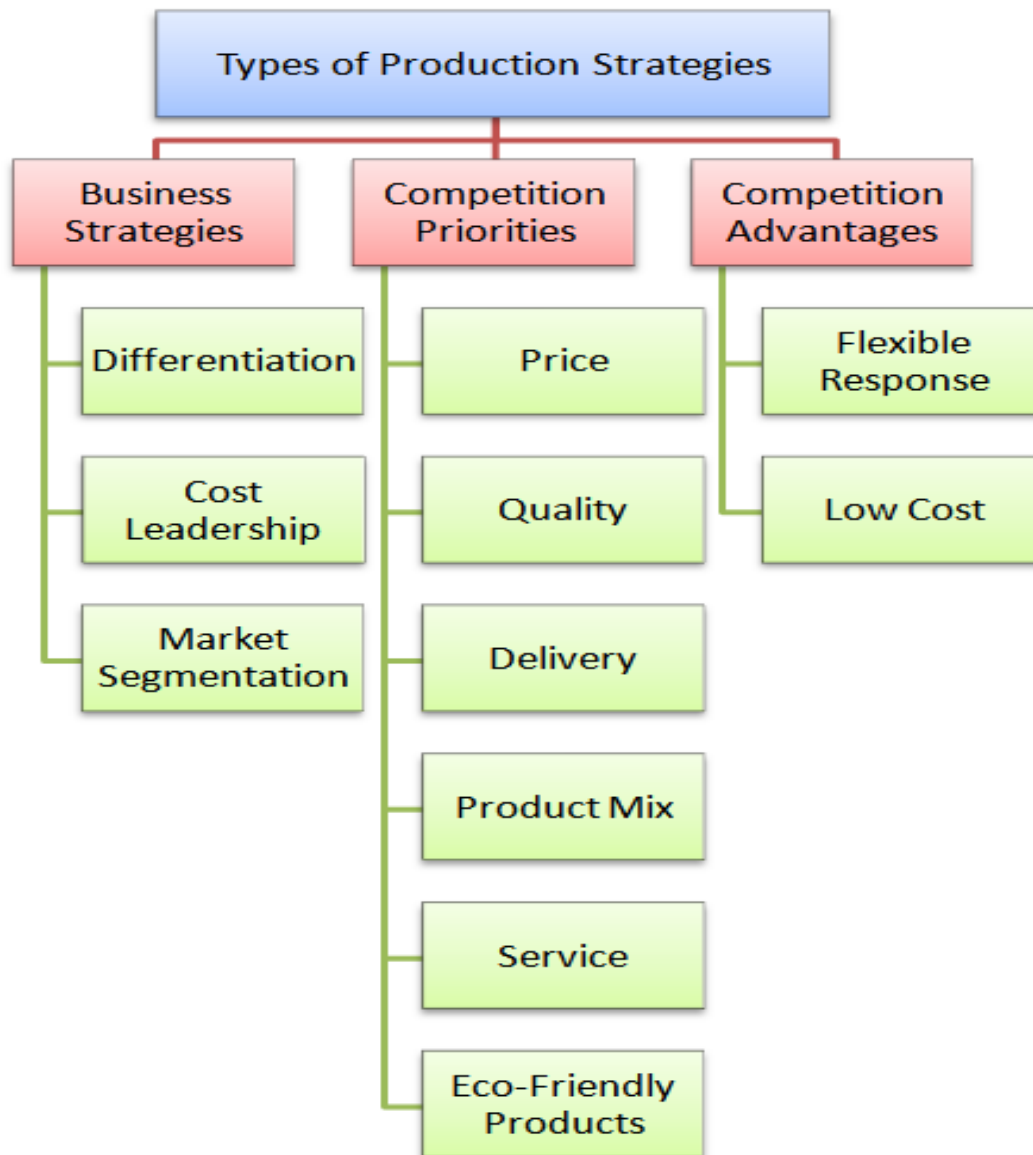
The types of production strategies listed above are discussed as follows:

1. Differentiation strategy:

Under a differentiation strategy, the company tries to be different and unique from its competitors, by means of better quality, quantity, pricing, appearance, and after sales-service, when compared to its competitors.

2. Cost leadership strategy:

Here the company tries to reduce its cost of production. This is done by producing goods on a very huge scale. By doing so, the company will get the benefits of economies of large scale. Higher the scale of production, lower will be the cost of production.



3. Market segmentation strategy:

Here the company divides the market according to the type of customers it has to focus and target. It sells different products and services to different types of customers.

4. Price or cost strategy:

Here the company sells its product at a very low price. This strategy is used when the products are homogeneous (same) in nature. That is, when the customers cannot distinguish the company's product from the competitors' products. So that the customers will purchase the company's product and not the competitors' products.

5. Quality strategy:

Here the company produces and sells high-quality goods and services. The prices of such goods and services are naturally very high. However, this strategy attracts those customers who prefer top quality products and are ready to pay necessary appropriate prices. To gain

success in the market, the company must smartly invest to make quality innovative products that are free from any defects.

6. Delivery strategy:

Here the company delivers its product and services to their customers as early as possible that too within a fixed time period, to fight cut-throat competition.

7. Product mix or flexibility strategy

Under this strategy, the company produces and sells a product mix. A product mix is a group of products, which are sold by the same company. However, only large companies with huge production capacity can use this strategy.

8. Service strategy:

Here the company uses a service to attract the customers. It gives quicker and better after-sales service. It gives around the clock, i.e. 24-hour customer service.

9. Eco-friendly products:

Here the company produces and sells environment-friendly products also called as **Green Products**. For e.g. producing and selling lead-free petrol to reduce pollution, manufacturing mercury-free television panels, etc., are some good steps to preserve nature. This is a new type of production strategy.

10. Low cost strategy:

Here the company fights massive market competition by selling its products at very lower prices. Simultaneously, it must also maintain the quality of its products.

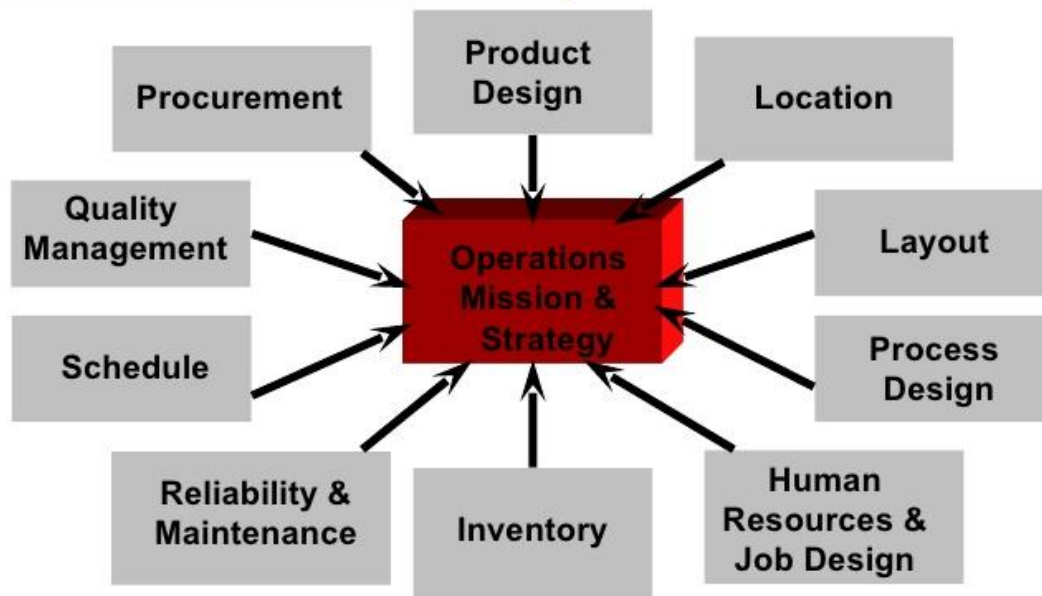
II . OPERATIOANL STRATEGY:

A plan of action implemented by a firm that describes how they will employ their resources in the production of a product or service.

(or)An operations strategy is typically driven by the overall business strategy of the organization, and is designed to maximize the effectiveness of production and support

elements while minimizing costs.

Operation Strategy - Elements



OPERATIONS STRATEGY IN GLOBAL ENVIRONMENT - REASONS TO GLOBALIZE

Many domestic business operations are deciding to change to some form of international operations. The underlying reasons, as under.

1. Reduce cost:

Many international operations seek to take the benefit of tangible opportunities to reduce their costs. Locations with lower wages, less government regulations (on environmental control, health, Safety etc) to cut the cost of taxes and tariffs, attract foreign investor

2. Improve the supply chain: The supply chain can be improved by locating facilities in the countries where unique resources are available. These resources may be expertise, labor or raw material. e.g., -World athletic shoe production, has shifted from South Korea to China, where besides low cost, the advantage of production competence is available. This is a place where 40000 people produce athletic shoes for the world

3. Provide better goods and services:

We need even better understanding the times of deliveries and of the ways business is handled in different countries. Improved understanding, as a result of local presence, helps companies to produce customized goods and services, to meet the needs.

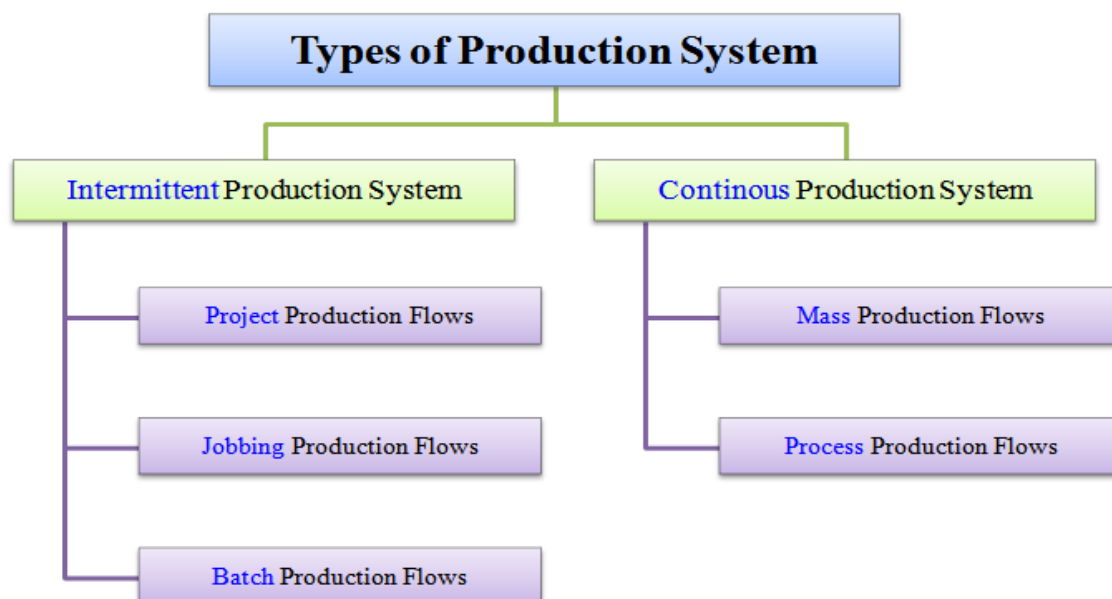
4. Understanding markets:

With the increased interaction with the foreign customers, firms learn about the various opportunities for their goods and services. e.g. Europe led the innovations of cell phones, whereas the Japanese lead with latest cell phone fads. Knowing the trends helps the firms to diversify their customer base and smooth the business cycle.

5. Learn to improve operations: Firms serve themselves and their customers, better when they are open for free flow of ideas. e.g. General Motors found that it could improve by jointly building and running its operations with the Japanese,

Global organizations thus can attract and recruit better employees by offering them more employment opportunities. They need employees in all the functional areas and areas of expertise worldwide. They can attract and retain employees by providing them growth opportunities and also by insulating them against unemployment during economic downturns. During economic downturns, they can relocate employees, who are temporarily unneeded, from one location to relatively prosperous locations. Global organizations also provide incentives for people who like to travel or take vacations in foreign countries

TYPES OF PRODUCTION SYSTEM :

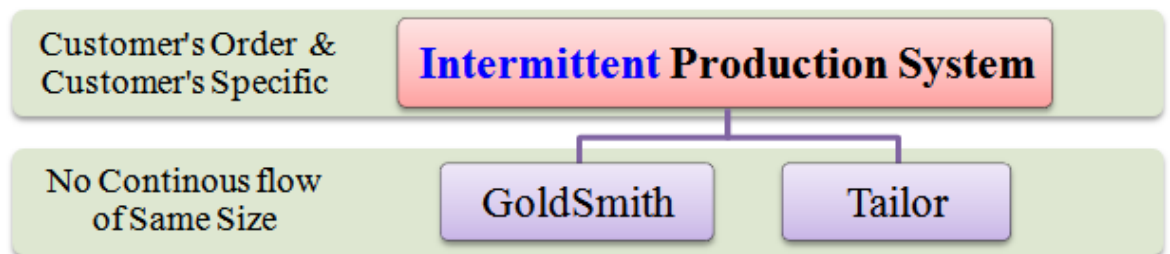


INTERMITTENT PRODUCTION SYSTEM

Intermittent means something that starts (initiates) and stops (halts) at irregular (unfixed) intervals (time gaps).

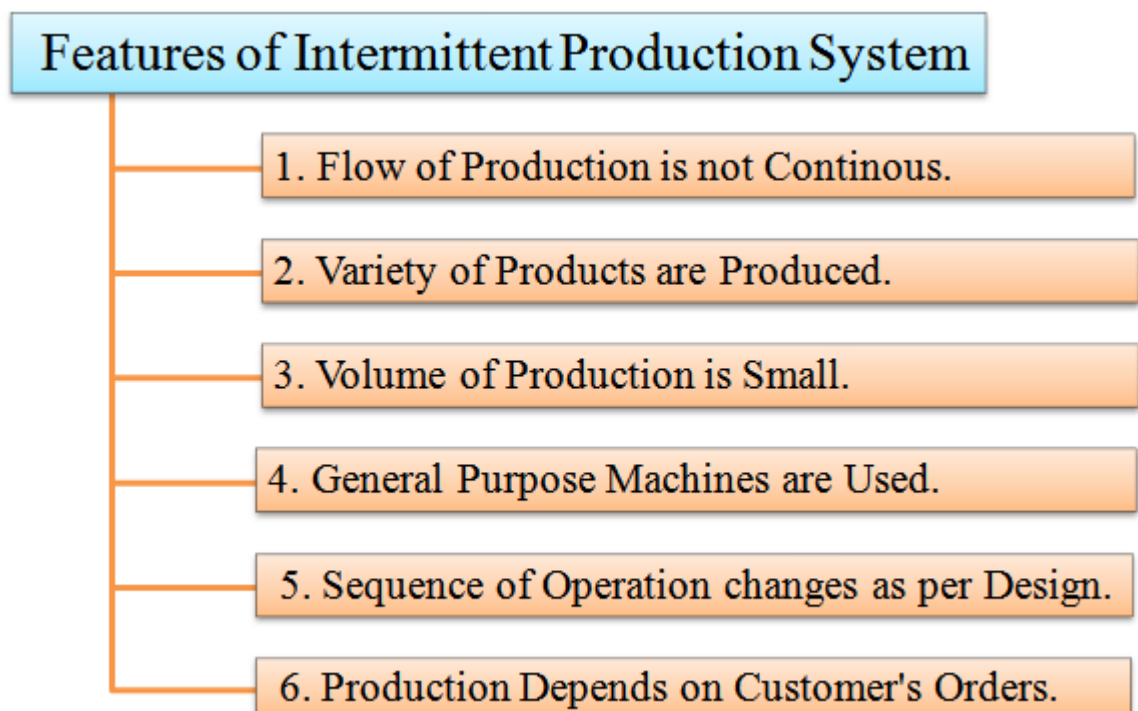
In the intermittent production system, goods are produced based on customer's orders. These goods are produced on a small scale. The flow of production is intermittent (irregular). i.e., the flow of production is not continuous. In this system, large varieties of products are produced. These products are of different sizes. The design of these products goes on changing. It keeps changing according to the design and size of the product. Therefore, this system is very flexible.

Following chart highlights the concept of an intermittent production system.



1. The work of a goldsmith is purely based on the frequency of his customer's orders. The goldsmith makes goods (ornaments) on a small-scale basis as per his customer's requirements. Here, ornaments are not done on a continuous basis.

Features of an intermittent production system are depicted below.



The characteristics of an intermittent production system are listed as follows:

1. The flow of production is not continuous. It is intermittent.
2. Wide varieties of products are produced.
3. The volume of production is small.
4. General purpose machines are used. These machines can be used to produce different types of products.
5. The sequence of operation goes on changing as per the design of the product.
6. The quantity, size, shape, design, etc. of the product depends on the customer's orders.

The types of intermittent production system include: (refer figure 1)

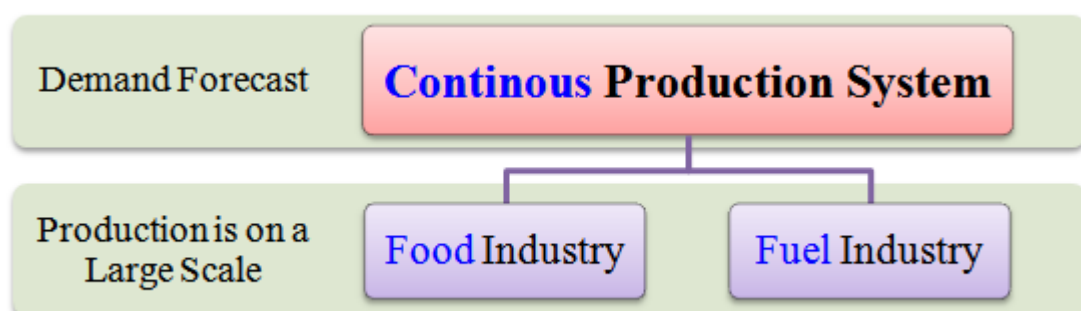
1. Project production flows,
2. Jobbing production flows, and
3. Batch production flows.

II. CONTINUOUS PRODUCTION SYSTEM:

Continuous means something that operates constantly without any irregularities or frequent halts.

In the continuous production system, goods are produced constantly as per demand forecast. Goods are produced on a large scale for stocking and selling. They are not produced on customer's orders. Here, the inputs and outputs are standardized along with the production process and sequence.

Following chart highlights the concept of a continuous production system.



Following are examples on the continuous production system.

1. The production system of a food industry is purely based on the demand forecast. Here, a large-scale production of food takes place. It is also a continuous production.
2. Similarly, the production and processing system of a fuel industry is also purely based on, demand forecast. Crude oil and other raw sources are processed continuously on a large scale to yield usable form of fuel and compensate global energy demand.

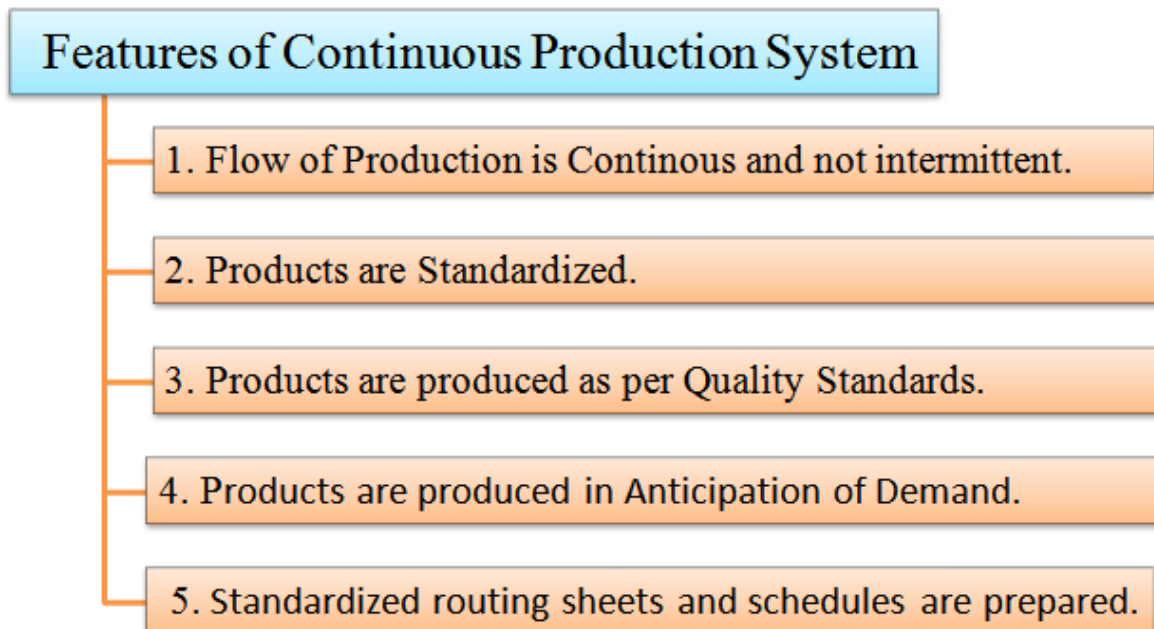
The characteristics of a continuous production system are listed as follows:

1. The flow of production is continuous. It is not intermittent.
2. The products are standardized.
3. The products are produced on predetermined quality standards.
4. The products are produced in anticipation of demand.
5. Standardized routing sheets and schedules are prepared.

The types of continuous production system include:

1. Mass production flows, and
2. Process production flows.

The features of a continuous production system are depicted below.



(For the above Figure 1, the sub process/ methods are explained below:)

Some of the most important types of production are:

(i) Job Production (ii) Batch production and (iii) Mass or flow production!

A production manager will have to choose most appropriate method for his enterprise. The final decision regarding any particular method of production is very much affected by the nature of the products and the quantity to be produced. Production methods may be broadly classified as Job Production, Batch production and Mass or Flow Production.

(i) Job Production:

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

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

Characteristics:

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

Limitations: Job production has the following limitations:

1. The economies of large scale production may not be attained because production is done in short-runs.
2. The demand is irregular for some products.
3. The use of labour and equipment may be an inefficient.
4. The scientific assessment of costs is difficult.

(ii) Batch production:

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

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

Under this production the work is divided into operations and one operation is done at a time. After completing the work on one operation it is passed on to the second operation and so on till the product is completed.

Batch production can be explained with the help of an illustration. An enterprise wants to manufacture 20 electric motors.

The work will be divided into different operations. The first operation on all the motors will be completed in the first batch and then it will pass on to the next operation. The second group of operators will complete the second operation before the next and so on. Under job production the same operators will manufacture full machine and not one operation only.

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

The batch production method possesses the following characteristics:

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

Advantages of Batch Production

- It has lower capital costs.
- It has the flexibility to produce a variety of different products.
- It works well when small production runs are needed, such as individual sandwich shops baking only the cookies they need.
- It is ideal for custom or seasonal orders.
- It reduces inventory. This can be critical when spoilage or space are issues.
- It allows a single production system to be used for making different seasonal items.

Disadvantages of Batch Production

- Reconfiguring the production system to produce something different results in downtime. In lean manufacturing language, these are wasted resources.
- The production equipment uses a lot of space. When it's idle, this space is not being utilized to make money.
- Labor is required to move items from one stage of the batch process to another, in addition to the labor required for batch manufacturing.

(iii) MASS OR FLOW PRODUCTION:

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

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

Characteristics:

1. The units flow from one operation point to another throughout the whole process.
2. There will be one type of machine for each process.
3. The products, tools, materials and methods are standardised.
4. Production is done in anticipation of demand.
5. Production volume is usually high.
6. Machine set ups remain unchanged for a considerable long period.
7. Any fault in flow of production is immediately corrected otherwise it will stop the whole production process.

Suitability of flow/mass production:

1. There must be continuity in demand for the product.
2. The products, materials and equipments must be standardised because the flow of line is inflexible.

3. The operations should be well defined.
4. It should be possible to maintain certain quality standards.
5. It should be possible to find time taken at each operation so that flow of work is standardised.
6. The process of stages of production should be continuous.

Advantages of mass production:

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

PRODUCTION SYSTEMS

The methods, procedure or arrangement which includes all functions required to accumulate (gather) the inputs, process or reprocess the inputs, and deliver the marketable output (goods). Its types includes Product, process, flexible and computer integrated

- **FLEXIBLE MANUFACTURING SYSTEM**

A flexible manufacturing system (FMS) is a method for producing goods that is readily adaptable to changes in the product being manufactured, in which machines are able to manufacture parts and in the ability to handle varying levels of production. A flexible manufacturing system (FMS) gives manufacturing firms an advantage in a quickly changing manufacturing environment.

- This flexibility is generally considered to fall into two categories, which both contain numerous subcategories.
- The first category, machine flexibility, covers the system's ability to be changed to produce new product types, and ability to change the order of operations executed on a part. The second category is called routing flexibility, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability.

Advantages

- Reduced manufacturing cost
- Lower cost per unit produced,
- Greater labor productivity,
- Greater machine efficiency,
- Improved quality,
- Increased system reliability,
- Reduced parts inventories,
- Improved efficiency
- Increase production rate

Disadvantages

- Initial set-up cost is high,
- Substantial pre-planning
- Requirement of skilled labour
- Complicated system

COMPUTER-INTEGRATED MANUFACTURING

- Computer-integrated manufacturing (**CIM**) is the manufacturing approach of using computers to control the entire production process. This integration allows individual processes to exchange information with each other and initiate actions. Although manufacturing can be faster and less error-prone by the integration of computers, the main advantage is the ability to create automated manufacturing processes
- CIM is used in automotive, aviation, space, and ship building industries. In a CIM system, functional areas such as design, analysis, planning, purchasing, cost accounting, inventory control, and distribution are linked through the computer with factory floor functions such as materials handling and management, providing direct control and monitoring of all the operations.

AGILE MANUFACTURING

- Agile manufacturing is a term applied to an organization that has created the processes, tools, and training to enable it to respond quickly to customer needs and market changes while still controlling costs and quality.
- Agile manufacturing is an approach to manufacturing which is focused on meeting the needs of customers while maintaining high standards of quality and controlling the overall costs involved in the production of a particular product.

- **LEAN MANUFACTURING**

- Lean manufacturing or lean production, often simply "**lean**", is a systematic method for waste minimization ("Muda") within a manufacturing system without sacrificing productivity.

- **Difference Between Intermittent & Continuous Production System**

Factors	Intermittent production system.	Continuous production system.
Nature of product	goods are produced based on customer orders and not for stocking.	goods are produced based on demand forecast and for stocking
Flexibility of process	Production process is flexible. The product design goes on changing.	Production process is not flexible. It is standardized. The same product is manufactured continuously.
Scale of production	Goods are produced on a small scale, so there is no economies of scale.	Goods are produced on a large scale, so there are economies of large-scale production
Per unit cost	cost per unit may be higher because production is done on a small-scale	cost per unit may be lower because production is done on large-scale.
Range of products	wide ranges of products are manufactured.	normally one particular type of product is manufactured
Location change	change in location is easy	change in location is difficult
Capital invested	capital invested is small	capital invested is very huge.

PLANT LAYOUT

Plant layout is a mechanism which involves knowledge of the space requirements for the facilities and also involves their proper arrangement so that continuous and steady movement of the production cycle takes place.

(or) “The plan of or the act of planning, an optimum arrangement of facilities, including personnel, operating equipment, storage space, materials handling equipment and all other supporting services along with the design of the best structure to accommodate these facilities”.

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

A plant layout study is an engineering study used to analyze different physical configurations for a manufacturing plant. It is also known as Facilities Planning and Layout.

OBJECTIVES OF GOOD PLANT LAYOUT:

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

1. Streamline the flow of materials through the plant.
2. Facilitate the manufacturing process.
3. Maintain high turnover of in-process inventory.
4. Minimise materials handling and cost.
5. Effective utilisation of men, equipment and space.
6. Make effective utilisation 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 GOOD 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 utilisation of resources and maximum effectiveness.
1. 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.
2. Principle of cubic space utilisation: The good layout is one that utilise both horizontal and vertical space. It is not only enough if only the floor space is utilised optimally but the third dimension, i.e., the height is also to be utilised effectively.
3. 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.

4. 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.
5. 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.
6. Principle of minimum handling: A good layout is one that reduces the material handling to the minimum

TYPES OF LAYOUTS:

ii) PROCESS LAYOUT

In manufacturing, process layout is a design for the floor plan of a plant which aims to improve efficiency by arranging equipment according to its function. The production line should ideally be designed to eliminate waste in material flows, inventory handling and management.

In process layout, the work stations and machinery are not arranged according to a particular production sequence. Instead, there is an assembly of similar operations or similar machinery in each department (for example, a drill department, a paint department).

iii) PRODUCT LAYOUT

In manufacturing, a product layout refers to a production system where the work stations and equipment are located along the line of production, as with assembly lines.

Usually, work units are moved along a line by a conveyor. Work is done in small amounts at each of the work stations on the line. To use the product layout, the total work to be performed must be dividable into small tasks that can be assigned to each of the workstations. Because the work stations each do small amounts of work, the stations utilize specific techniques and equipment tailored to the individual job they are assigned. This can lead to a higher rate of production.

iv) SYSTEMATIC LAYOUT PLANNING

The systematic layout planning (SLP) is a tool used to arrange a workplace in a plant by locating areas with high frequency and logical relationships close to each other. The process permits the quickest material flow in processing the product at the lowest cost and least amount of handling.

Levels of plant layout design

There are four levels of detail in plant layout design,

1. Site layout: shows how the building should be located in a proper way.
2. Block layout: shows the sizes of departments in the buildings.
3. Detailed layout: shows the arrangements of equipment and workstations in the departments.
4. Workstation layout: shows the locations of every part of the workstation.

FACILITY LAYOUT - PLANNING

“Plant layout is the arrangement of machines, work areas and service areas within a factory”.

—George R. Terry

“Plant layout involves the development of physical relationship among building, equipment and production operations, which will enable the manufacturing process to be carried on efficiently”. —Morris E. Hurley

FACILITY LOCATION

Facilities is defined as the workspace and equipments needed to carry out the operations of the organization. This includes offices, factories, computers, and trucks.

Facility Location is the right location for the manufacturing facility, it will have sufficient access to the customers, workers, transportation, etc

Facilities / Plant Layout

Facility layout is simply the way a facility (space with equipment's) is arranged in order to maximize processes towards the overall organizational goal.

Facility Location decisions are the strategic decisions that require large financial investments and they are irreversible in nature. A number of factors like market related factors, cost factors and qualitative factors, affects the location choice.

Models and techniques such as break-even analysis, transportation method, linear programming and Delphi method help managers in making location decisions. Since these models work on quantitative basis; therefore the influence of qualitative factors should be considered by managers to decide the location choice.

The physical disposition of the facilities of a plant is referred to as the plant layout. The basic types of layouts are:

- A process layout is the layout in which similar machinery are grouped together and are arranged in departments (e.g., hospitals – many depts..).

- In product layout the machines are arranged according to the progressive steps by which a product is made. (e.g., a car assembly plant- Based on product).
- In a fixed layout, all the necessary men, materials, and equipment are brought to a fixed location where the product is actually manufactured. (e.g., jumbo jet, Cranes)
- A hybrid or combination layout constitutes combination of two or three types of layouts.

Factors Influencing Facility Location

If the organization can find the right location for the manufacturing facility, it will have sufficient access to the customers, workers, transportation, etc.

- **Customer Proximity (Nearness):** Facility locations are selected closer to the customer as to reduce transportation cost and decrease time in reaching the customer.
- **Business Area:** Presence of other similar manufacturing units around the business area makes favourable for facility establishment.
- **Availability of Skill Labour:** Education, experience and skill of available labour are important to determine facility location.
- **Free Trade Zone/Agreement:** Free trade agreement among countries provides an incentive to establish business, in particular, country.
- **Suppliers:** Continuous and quality supply of the raw materials is another critical factor in determining the location of manufacturing facility.
- **Environmental Policy:** In current globalized world pollution, control is very important, therefore understanding of environmental policy for the facility location is another critical factor.

Facility Location for production and service operations can have a great impact on investment and operating costs and perhaps the price at which goods or services can be offered. Even though **facility location** is a factor of importance, ordinarily many alternative locations can be equally good. Therefore, it is common to rate alternative locations on such subjective factors as

- Labor supply
- Type of labor
- Labor union activity
- Community attitude
- Appearance
- Transportation

- Availability of utilities
- Recreational facilities

Site Location

- A site large enough to accommodate present floor plan needs and room for expansion, parking, transportation facilities and the like. Normally, a site size five times the actual plant area is regarded as the minimum.
- A provision for necessary transportation facilities, utilities and waste disposal.
- A soil structure that can carry the required bearing foundation loads.

MATERIALS MANAGEMENT:

Materials management is that aspect of management function which is primarily concerned with the acquisition, control and use of materials needed and flow of goods and services connected with the production process having some predetermined objectives in view.

The main objectives of materials management are:

- ◆ To minimise material cost.
- ◆ To purchase, receive, transport and store materials efficiently and to reduce the related cost.
- ◆ To cut down costs through simplification, standardisation, value analysis etc.
- ◆ To trace new sources of supply and to develop cordial relations with them in order to ensure continuous supply at reasonable rates.

LINE BALANCING

Line Balancing is levelling the workload across all processes in a cell or value stream to remove bottlenecks and excess capacity

TYPES OF LINE BALANCING:

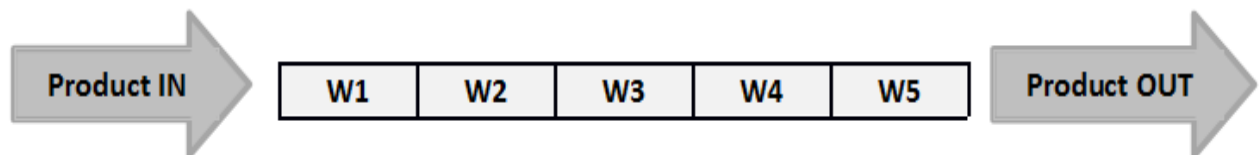
- Static Balance - Static Balance denotes long-term differences in capacity over a period of several hours or longer. Static imbalance results in underutilization of workstations, machines and people.

- Dynamic Balance - refers to short-term differences in capacity such as over a period of minutes, hours at most. Dynamic imbalance occurs from product mix changes and difference in work time dissimilar to product mix.

The intent of Line balancing is to match the output rate to the production plan. This will help organization to make sure on-time delivery and avoids build-up of surplus inventory.

Line balancing is usual practice to resolve problems occurred in assembly line. It is a technique to reduce imbalance between workers and workloads. This can be performed by equalizing the amount of work in each station and assign the smallest number of workers in the particular workstation. Here the job is divided into small portion called “job element”.

The assembly line has 5 workers (work stations) stationed on the line as follows where back tracking is not allowed.



Thus the very purpose of line balancing is to assign workloads to each assigned work station in a manner that the every works stations has approximately same amount of work to be done.

Objectives of Line Balancing:

- Manage the workloads among assemblers.
- Recognize the location of bottleneck.
- Decide number of workstation.
- Decrease production cost.

Benefits of Assembly Line Balancing in organization.

- Improved process efficiency
- Increased production rate
- Reduced total processing time
- Minimum or Zero Ideal Time
- Potential increase in profits and decrease in costs

Unit II

Production Planning and control- meaning- functions-Master production Schedule- Material Requirement planning- Capacity requirement planning- Models, Process planning – Maintenance management concepts.

PRODUCTION PLANNING AND CONTROL

DEFINITION:

It (PPC) can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting and finishing dates for each item, to give production orders to shops and to follow up the progress of products according to orders.

The main functions of production planning and control includes planning, routing, scheduling, dispatching and follow-up.

- **Planning** is deciding in advance what to do, how to do it, when to do it and who is to do it. Planning bridges the gap from where we are, to where we want to go. It makes it possible for things to occur which would not otherwise happen.
- **Routing** -is the selection of path where each part of the product will follow, which being transformed from raw material to finished products i.e., from department to department and machine to machine till raw material gets its final shape.
- **Scheduling** determines the programme for the operations. Scheduling may be defined as ‘the fixation of time and date for each operation’ as well as it determines the sequence of operations to be followed.
- **Dispatching** is concerned with the starting the processes. Dispatching is ‘release of orders and instruction for the starting of production for any item in acceptance with the route sheet and schedule charts’.
- **Follow-up-** The function is to report the daily progress of work in each shop in a prescribed proforma and to investigate the causes of deviations from the planned performance.

PRODUCTION PLANNING AND CONTROL- IN PRODUCTION SYSTEMS

- i) **ASSEMBLY LINE** consists of work stations or arrangement of labour and equipment in a sequence. At each work station, a pre decided task is completed. This facilitates the production in large quantities. On an assembly line, the materials move continuously at a

uniform average rate. At different work stations, a portion of work is done. Industries such as toys, automobiles, televisions and computers are all assembly line productions. Assembly line productions can be manual or through conveyor belts carrying materials at a pre decided rate so that there is sufficient time at each work station to perform the allotted task. The conveyor belts are of belt type, chain type, overhead type or screw type.

PRODUCTION PLANNING AND CONTROL IN MASS PRODUCTION:

ii) Mass production

Mass production refers to the process of creating large numbers of similar products efficiently. Mass production is the manufacture of large quantities of standardized products, frequently utilizing assembly line technology.

Mass production pertains to a large quantity of production with standardized products having more or less, the same features. This single standard product is manufactured on a continuous basis over a period of time. The determining factor is the demand on the basis of which continuous or batch type production is chosen.

Standardization of products, processes, materials, machines, uninterrupted flow of materials are the main characteristics of this system. Example: - petrochemical industry, cement industry, steel industry, sugar industry, cigarette industry etc.

Features of Mass Production System

- o It includes manufacturing of high volume standardized products.
- o There is a smooth flow material from one work station to another workstation.
- o Production time of production unit as a whole is short (i.e. because of specialization principle).
- o Closely spaced work station reduce material handling.
- o Production planning and control is simple.
- o Work in progress inventory is less.

NOTE: Production planning and control is possible under mass production only with the help of line balancing.

Example of Mass production systems:

Production of biscuits in a factory can be taken as an example of mass production. At every stage a particular operation is performed using a specific machine. As is shown below,

packs of identical biscuits are produced in an industrial unit

Stage: 1: MIXING: Flour + fat + sugar + bicarbonate + additives

Stage: 2: MOULDING: Dough is laminated in a laminator

Stage: 3: GAUZE ROLLS: Laminated dough is cut as per size and shape

Stage: 4: BAKING: Biscuits cut into shapes are baked in the oven

Stage: 5: COOLING: Biscuits are cooled in conveyors once they are baked

Stage: 6: PACKAGING: The final product is then packed into pouches and cartons

Advantages of Mass Production:

1. There is a smooth flow of material from one work station to the next.
2. There are in built inventories at each work station because output of one work station becomes the input of the next.
3. Production time is shorter in assembly line productions.
4. The material is more efficiently handled since work stations are spaced closely together.
5. Training cost is lesser.
6. Production planning and control is simpler.

Disadvantages of Mass Production:

1. Since the proper functioning of all the machines is required in an assembly line production, maintenance is a challenge.
2. Assembly lines are rigid inflexible set ups. Any change in the design layout proves difficult.
3. The production speed is determined by the slowest machine.
4. Assembly line set ups are capital intensive since they require installation of specific types of machine

ii) BATCH MANUFACTURING:

Batch production includes jobs that move through the steps of production in groups, such as by dozen or by hundreds. The units are all operated at the same time per batch. Batch production allows for efficient use of equipment by moving batches around in patterns to different areas of specialty.

iv) JOB ORDER PRODUCTION:

Job order production is the process of manufacturing unique products for specific customers. It is also called job order manufacturing or custom production because each order

or job is a customize order placed by the customer. i.e Job order production is an authorised order for the production of goods or services

Factories with job order production tend to use general purpose machines, which means the company receives good value for their expense, and employees that use them develop a wide variety of skills. However, costs for setup changes tend to be higher than other types of production, and raw materials can be varied and costly.

Many manufacturers specialize in mass-producing custom products. Customers come to the manufacturer with a specific design or product in mind and the manufacturer develops and creates the custom product. A good example of a custom manufacturer is a print shop or studio. A customer might visit his local print shop with a design for 100 graduation invitations. This design has a custom logo, font, and picture of the graduate. Printing these invitations would be considered one job because the print shop would have to setup its presses one time in order to print all 100 invitations. The process of designing and printing custom invitations is considered job order production.

Characteristics of Job Order Production

- (i) Flow of material and parts from one location to another is intermittent or discontinuous.
- (ii) Division of labour is not economical.
- (iii) Each job order is different from the previous as regards its type, specification, quality and quantity.
- (iv) Product design takes a lot of time.
- (v) Prior planning becomes difficult.
- (vi) Schedule is prepared for each component of the product, giving the starting and finishing time.
- (vii) High degree of control is essential.
- (viii) The number of items to be manufactured is very small; it may be even one item.

MASTER PRODUCTION SCHEDULE

A **Master Production Schedule (MPS)** is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded.

A Master Production Schedule is a Schedule of the completions of the end items and these completions are very much planned in nature. Master production schedule acts as a very

distinct and important linkage between the planning processes. With the help of this schedule, one can know the requirements for the individual end items by date and quantity.

In companies, MPS are generally produced in order to know the number of each product that is to be made over some planning horizon. This schedule forms a very unique part of the company's sales program which deals with the planned response to the demands of the market.

A master production schedule is also in management language referred to as the master of all the schedules as this schedule provides the production, planning, purchasing & top management, the most needed information required for planning and control of the whole manufacturing process or the operation.

MASTER PRODUCTION SCHEDULE (MPS) – ADVANTAGES:

- Anticipated build schedule for manufacturing end products (or product options)
- A statement of production, not a statement of market demand
- MPS takes into account capacity limitations, as well as desires to utilize capacity fully
- Stated in product specifications – in part numbers for which bill of material exist
- Since it is a build schedule, it must be stated in terms used to determine component part needs and other requirements; not in monetary or other global unit of measure
- Specific products may be groups of items such as models instead of end items

MATERIALS MANAGEMENT

DEFINITION:

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 minimum cost.

(ii) Materials Management is the planning, directing, controlling and coordinating those activities which are concerned with materials and inventory requirements, from the point of their inception to their introduction into the manufacturing process.

It begins with the determination of materials quality and quantity and ends with its issuance to production to meet customer's demand as per schedule and at the lowest cost.

(or) Material management is an approach for planning, organizing, and controlling all those activities principally concerned with the flow of materials into an organisation.

The scope of Materials Management include material planning and control, production planning, Purchasing, inventory control, in-plant materials movement, and waste management.

It is a business function for planning, purchasing, moving, storing material in a optimum way which help organisation to minimise the various costs like inventory, purchasing, material handling and distribution costs.

The fundamental objectives of **5 Rs of Materials Management, are**

of the right quality

in the right quantity

at the right time

from the right source

at the right price

KEY OBJECTIVES OF MM:

To buy at the lowest price with desired quality and service

To maintain a high inventory turnover , by reducing excess storage , carrying costs and wastages.

To maintain continuity of supply , preventing interruption of the flow of materials and services to users.

To maintain the quality level which permits efficient and effective operation

To minimize the overall cost of by improving the efficiency of operations and procedures

To hire, develop, motivate and train personnel.

To develop and maintain good supplier relationships.

To achieve a high degree of cooperation and coordination with user departments

To maintain good records and controls that provide an audit to ensure efficiency and honesty

To participate in Make or Buy decisions

FUNCTIONS OF MATERIALS MANAGEMENT:

Materials planning and control: Materials required for any operation are based on the sales forecasts and production plans. Planning and control is done for the materials taking into account the materials not available for the operation and those in hand or in pipe line & monitoring the performance in relation to production and sales.

Purchasing: Basically, the job of a materials manager is to provide , to the user departments

right material at the right time in right quantity of right quality at right price from the right source.

Stores : Once the material is delivered , its physical control , preservation , minimisation of obsolescence and damage through timely disposal and efficient handling, maintenance of records, proper locations and stocking is done in Stores.

Inventory control : One of the powerful ways of controlling the materials is through Inventory control. It covers aspects such as setting inventory levels, doing various analyses such as ABC , XYZ etc ,fixing economic order quantities (EOQ), setting safety stock levels, lead time analysis and reporting.

Other Functions of materials management under following heads:

- (i) Planning and programming for materials purchase.
- (ii) Stores and Stock control.
- (iii) Receiving and issue of the material.
- (iv) Transportation and material handling of the material.
- (v) Value engineering and value analysis.
- (vi) Disposal of scrap and surplus materials.

Emphasis on the acquisition aspect

Inventory control and stores management

Material logistics, movement control and handling aspect

Purchasing, supply , transportation , materials handling etc

Supply management or logistics management

OBJECTIVES OF MATERIALS MANAGEMENT:

(i) Material Selection:

Correct specification of material and components is determined. Also the material requirement in agreement with sales programme are assessed. This can be done by analysing the requisition order of the buying department. With this standardisation one may have lower cost and the task of procurement, replacement etc. may be easier.

(ii) Low operating costs:

It should endeavor to keep the operating costs low and increase the profits without making any concessions in quality.

- (iii) Receiving and controlling material safely and in good condition.

- (iv) Issue material upon receipt of appropriate authority.
- (v) Identification of surplus stocks and taking appropriate measures to produce it.

The outcome of all these objectives can be listed as given below:

- (i) Regular uninterrupted supply of raw-materials to ensure continuity of production.
- (ii) By providing economy in purchasing and minimising waste it leads to higher productivity.
- (iii) To minimise storage and stock control costs.
- (iv) By minimising cost of production to increase profits.
- (v) To purchase items of best quality at the most competitive price.

MATERIAL REQUIREMENT PLANNING:

Material requirement planning is a scientific way of determining the requirements starting with raw materials, consumables, spare parts and all other materials that are required to meet the given production plan for a certain period. Material planning is derived from the over all organisational planning and hence it is always a sub-plan of the broad organisational plan. What it does is forecasting and initiating for procurement of materials.

FACTORS AFFECTING MATERIAL PLANNING:

- 1) **Macro factors :** Global factors such as price trends, business cycles, government's import and export policies etc are called the Macro factors.
- 2) **Micro factors :** The factors existing within the organisation such as corporate policy on Inventory holding, production plan, investments, working capital etc.

TECHNIQUES OF MATERIALS PLANNING :

- 1) Materials Requirement Planning (MRP)
- 2) Requirement based on past consumption

I. MATERIAL REQUIREMENTS PLANNING (MRP):

Material requirements planning is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Most MRP systems are software-based. The three objectives are:

- Ensure materials that are available for production and products that are available for delivery to customers.
- Maintain the lowest possible material and product levels in store
- Plan manufacturing activities, delivery schedules and purchasing activities.

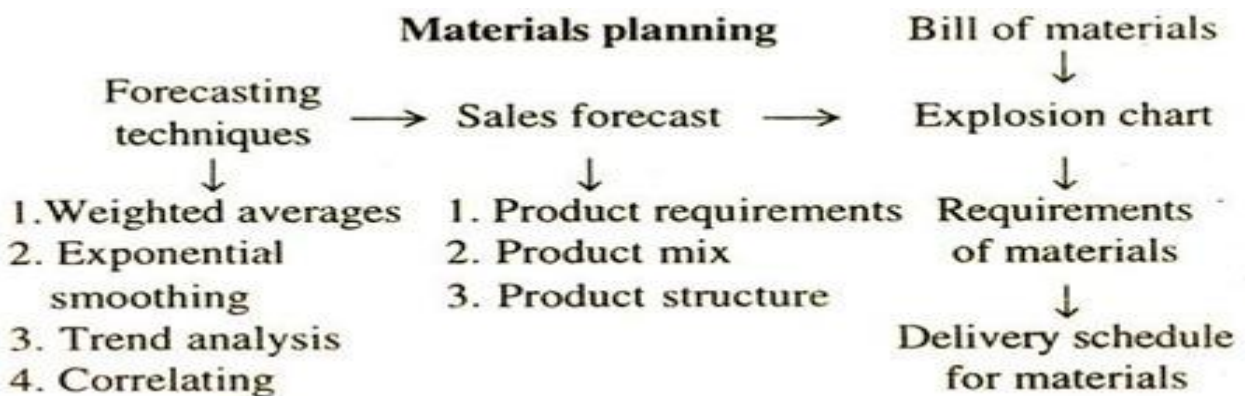
Thus the planning for materials management is aimed at determining the demand for the end-products. This is possible only through forecasting. There are various techniques for forecasting. These techniques are equally applicable to demand forecasting.

The techniques are:

- (i) Moving averages method.
- (ii) Exponential smoothing and Time series.

After demand forecast the exercise of materials planning starts. Requirements for various materials are ascertained from the demand forecast. For this purpose, the use of computers is very effective for “exploding” bill of materials with demand forecasts. The bill of materials is prepared and issued by the planning or engineering department in a standard form.

An explosion chart is just a series of bills of materials grouped together in a matrix form so that combining the requirements for different components can be done. it is quite natural to find that some materials are in short supply and some in excess.



(II) PAST CONSUMPTION ANALYSIS:

For continuously needed materials and the materials where no bill of materials is possible, this technique of analysis is adopted- The past consumption data is analysed and a projection for the future on the basis of past experience and future need is made. To prepare such a projection, “average” or “mean” consumption and the “standard deviation” are taken as bases and as guidelines for each item.

Material Handling - Principles, Operations and Equipment

Raw materials form a critical part of manufacturing as well as service organization. In any organization, the amount of material handling is done in one form or the other. This movement is either done manually or through an automated process. Therefore, manual

material handling is of prime concern for health and safety professional, and they must determine practical ways of reducing health risk to the workers.

MATERIAL HANDLING

- Material handling is a systematic and scientific method of moving, packing and storing of material in appropriate and suitable location.
- Manual material handling ranges from movement of raw material, work in progress, finished goods, rejected, scraps, packing material, etc. These materials are of different shape and sizes as well as weight.

OBJECTIVES OF MATERIAL HANDLING:

- It should be able determine appropriate distance to be covered.
- Facilitate the reduction in material damage as to improve quality.
- Reducing overall manufacturing time by designing efficient material movement
- Improve material flow control
- Creation and encouragement of safe and hazard-free work condition
- Improve productivity and efficiency
- Better utilization of time and equipment

Manual material handling significantly increases health hazard for the workers in from lower back injuries. In the current competitive and globalized environment, it is important to control cost and reduce time in material handling. An efficient material handling process promotes:

- Design of proper facility layout
- Promotes development of method which improves and simplifies the work process
- It improves overall production activity.
- Efficient material handling reduces total cost of production.

Principles of Material Handling

- **Orientation Principle:** It encourages study of all available system relationships before moving towards preliminary planning. The study includes looking at existing methods, problems, etc.
- **Planning Principle:** It establishes a plan which includes basic requirements, desirable alternates and planning for contingency.
- **Systems Principle:** It integrates handling and storage activities, which is cost effective into integrated system design.

- **Unit Load Principle:** Handle product in as large a unit load as practical.
- **Space Utilization Principle:** Encourage effective utilization of all the space available
- **Standardization Principle:** It encourages standardization of handling methods and equipment.
- **Ergonomic Principle:** It recognizes human capabilities and limitation by design effective handling equipment.
- **Energy Principle:** It considers consumption of energy during material handling.
- **Ecology Principle:** It encourages minimum impact upon the environment during material handling.
- **Mechanization Principle:** It encourages mechanization of handling process wherever possible as to encourage efficiency.
- **Flexibility Principle:** Encourages of methods and equipment which are possible to utilize in all types of condition.
- **Simplification Principle:** Encourage simplification of methods and process by removing unnecessary movements
- **Gravity Principle:** Encourages usage of gravity principle in movement of goods.
- **Safety Principle:** Encourages provision for safe handling equipment according to safety rules and regulation
- **Computerization Principle:** Encourages of computerization of material handling and storage systems
- **System Flow Principle:** Encourages integration of data flow with physical material flow
- **Layout Principle:** Encourages preparation of operational sequence of all systems available
- **Cost Principle:** Encourages cost benefit analysis of all solutions available
- **Maintenance Principle:** Encourages preparation of plan for preventive maintenance and scheduled repairs
- **Obsolescence Principle:** Encourage preparation of equipment policy as to enjoy appropriate economic advantage.

▪



CAPACITY REQUIREMENT PLANNING

- **Capacity** would be the ability of a given system to produce output within the specific time period. In general, terms capacity is referred as maximum production capacity, which can be attained within a normal working schedule.
- **Capacity planning** is the process of determining the production capacity needed by an organization to meet changing demands for its products.

In capacity planning, design capacity is the maximum amount of work that an organization is capable of completing in a given period. Effective capacity is the maximum amount of work that an organization is capable of completing in a given period due to constraints such as quality problems, delays, material handling, etc

- **Capacity planning** is essential to determine the optimum utilization of resource and plays an important role decision-making process, for example, extension of existing operations, modification to product lines, starting new products, etc.
- The ultimate goal of capacity planning is to meet the current and future level of the requirement at a minimal wastage.

TYPES OF CAPACITY PLANNING:

i) Strategic Capacity Planning

A technique used to identify and measure overall capacity of production is known as strategic capacity planning. Strategic capacity planning is essential as it helps the organization in meeting the future requirements of the organization.

ii) Long Term Capacity: It is dependent on various other capacities like design capacity, production capacity, sustainable capacity and effective capacity.

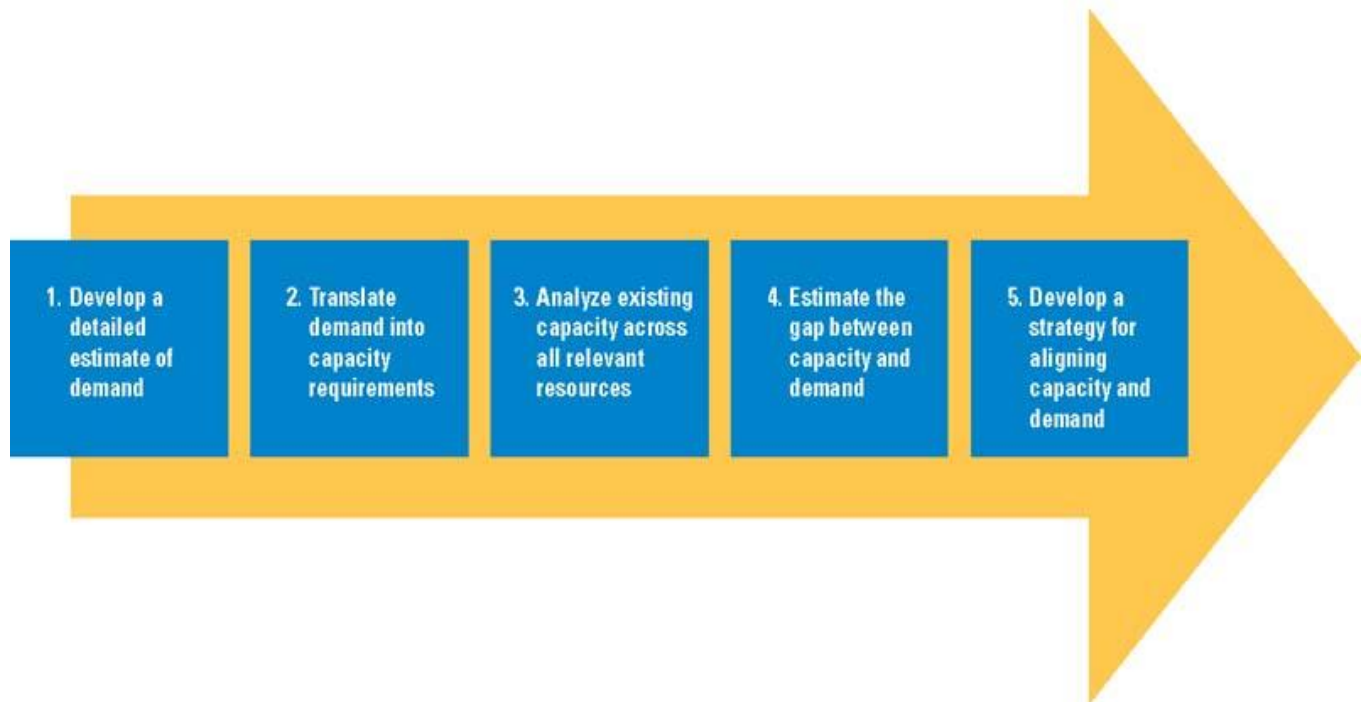
iii) Medium Term Capacity: The strategic capacity planning undertaken by organization for 2 to 3 years of a time frame is referred to as medium term capacity planning.

iv) Short Term Capacity: The strategic planning undertaken by organization for a daily weekly or quarterly time frame is referred to as short term capacity planning.

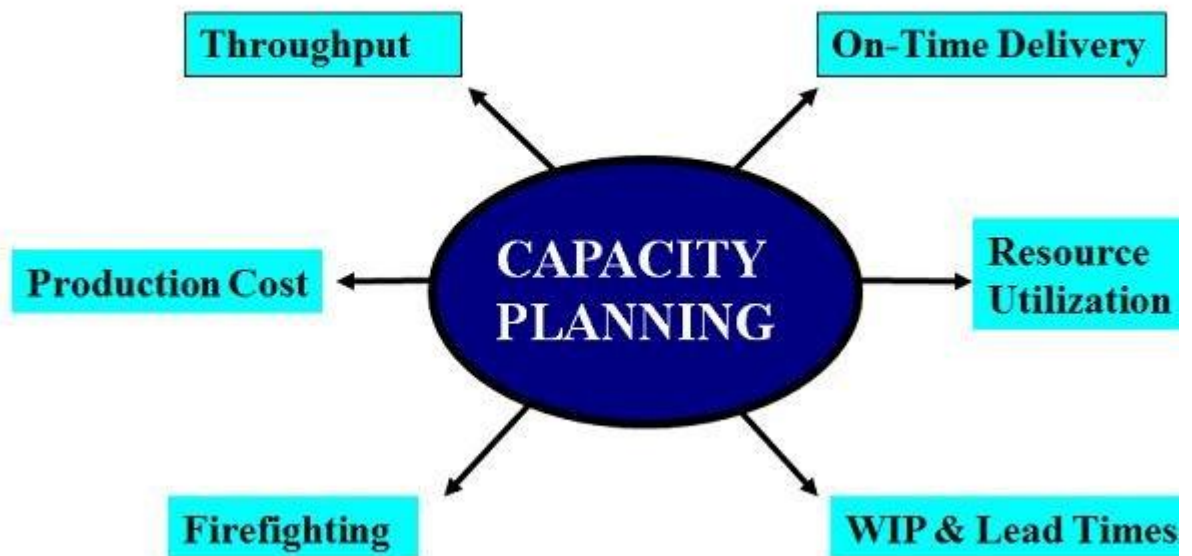
FACTORS AFFECTING CAPACITY PLANNING:

Effective capacity planning is dependent upon factors like production facility (layout, design, and location), product line or matrix, production technology, human capital (job design, compensation), operational structure (scheduling, quality assurance) and external structure (policy, safety regulations)

FIGURE 1.
Stages of the capacity planning process



Possible improvements from CP



Importance of Capacity Decisions

1. Impacts ability to meet future demands
2. Affects operating costs
3. Major determinant of initial costs
4. Involves long-term commitment
5. Affects competitiveness
6. Affects ease of management
7. Globalization adds complexity
8. Impacts long range planning

5-4

MAINTENANCE MANAGEMENT

Maintenance- is concerned with day-to-day problem of keeping the physical plant in good operating condition.

Maintenance is primarily concerned with a day to day problem of machinery equipment in maintaining good working condition. It is very essential to ensure a continuous production flow by utilizing maximum capacity of plant.

Maintenance Management- Concerned with planning, organising and directing there sources in order to control the availability and performance of the industrial plants to some specified level.

Categories→Two categories of maintenance-

1. Maintaining buildings, parking lots, lawns, fences, services and utilities.
2. Maintaining equipments, machinery, material handling

Objectives:

- **Minimizing loss of productive time**
 Minimizing loss of productive Cost
- **Minimizing the repair time & repair cost**
- **Minimizing the loss due to production stoppage**
- **Efficient use of maintenance personnel & equipments**
- **To keep all productive assets in good working**
- **To maximize efficiency & economy**
- **To improve the quality of products & to improve productivity**

Unit III

Materials management – An Overview of materials planning – materials Planning and inventory Control, types of inventory and inventory control – Inventory control systems- Materials Planning, Budgeting and Materials requirement Planning, Purchase Management- Stores Management.

MATERIALS MANAGEMENT

DEFINITION:

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 minimum cost.

(ii) Materials Management is the planning, directing, controlling and coordinating those activities which are concerned with materials and inventory requirements, from the point of their inception to their introduction into the manufacturing process.

It begins with the determination of materials quality and quantity and ends with its issuance to production to meet customer's demand as per schedule and at the lowest cost.

(or) Material management is an approach for planning, organizing, and controlling all those activities principally concerned with the flow of materials into an organisation.

The scope of Materials Management include material planning and control, production Purchasing, inventory control, in-plant materials movement, and waste management.

It is a business function for planning, purchasing, moving, storing material in a optimum way help organisation to minimise the various costs like inventory, purchasing, material handling distribution costs.

The fundamental objectives of **5 Rs of Materials Management, are**

of the right quality

in the right quantity

at the right time

from the right source

at the right price

KEY OBJECTIVES OF MM:

To buy at the lowest price with desired quality and service

To maintain a high inventory turnover , by reducing excess storage , carrying costs and wastages.

To maintain continuity of supply , preventing interruption of the flow of materials and services to users.

To maintain the quality level which permits efficient and effective operation

To minimize the overall cost of by improving the efficiency of operations and procedures

To hire, develop, motivate and train personnel.

To develop and maintain good supplier relationships.

To achieve a high degree of cooperation and coordination with user departments

To maintain good records and controls that provide an audit to ensure efficiency and honesty

To participate in Make or Buy decisions

FUNCTIONS OF MATERIALS MANAGEMENT:

Materials planning and control: Materials required for any operation are based on the sales forecasts and production plans. Planning and control is done for the materials taking into account the materials not available for the operation and those in hand or in pipe line & monitoring the performance in relation to production and sales.

Purchasing: Basically, the job of a materials manager is to provide , to the user departments right material at the right time in right quantity of right quality at right price from the right source.

Stores: Once the material is delivered, its physical control, preservation , minimisation of obsolescence and damage through timely disposal and efficient handling, maintenance of records, proper locations and stocking is done in Stores.

Inventory control: One of the powerful ways of controlling the materials is through Inventory control. It covers aspects such as setting inventory levels, doing various analyses such as ABC , XYZ etc ,fixing economic order quantities (EOQ), setting safety stock levels, lead time analysis and reporting.

Other Functions of materials management under following heads:

- (i) Planning and programming for materials purchase.
- (ii) Stores and Stock control.
- (iii) Receiving and issue of the material.
- (iv) Transportation and material handling of the material.

- (v) Value engineering and value analysis.
- (vi) Disposal of scrap and surplus materials.

Emphasis on the acquisition aspect

Inventory control and stores management

Material logistics, movement control and handling aspect

Purchasing, supply, transportation, materials handling etc

Supply management or logistics management

OBJECTIVES OF MATERIALS MANAGEMENT:

(i) Material Selection:

Correct specification of material and components is determined. Also the material requirement in agreement with sales programme are assessed. This can be done by analysing the requisition order of the buying department. With this standardisation one may have lower cost and the task of procurement, replacement etc. may be easier.

(ii) Low operating costs:

It should endeavor to keep the operating costs low and increase the profits without making any concessions in quality.

(iii) Receiving and controlling material safely and in good condition.

(iv) Issue material upon receipt of appropriate authority.

(v) Identification of surplus stocks and taking appropriate measures to produce it.

The outcome of all these objectives can be listed as given below:

(i) Regular uninterrupted supply of raw-materials to ensure continuity of production.

(ii) By providing economy in purchasing and minimising waste it leads to higher productivity.

(iii) To minimise storage and stock control costs.

(iv) By minimising cost of production to increase profits.

(v) To purchase items of best quality at the most competitive price.

QUALITY CONTROL

Quality Control (QC) may be defined as ‘a system that is used to maintain a desired level of quality in a product or service’. It is a systematic control of various factors that affect the quality of the product.

It is the entire collection of activities which ensures that the operation will produce the optimum quality products at minimum cost.

MEANING:

- Inventory control means to monitor the stock of goods used for production, distribution and captive (self) consumption.
- Inventory Control means maintaining the inventory at a desired level. The desired-level keeps on fluctuating as per the demand and supply of goods.

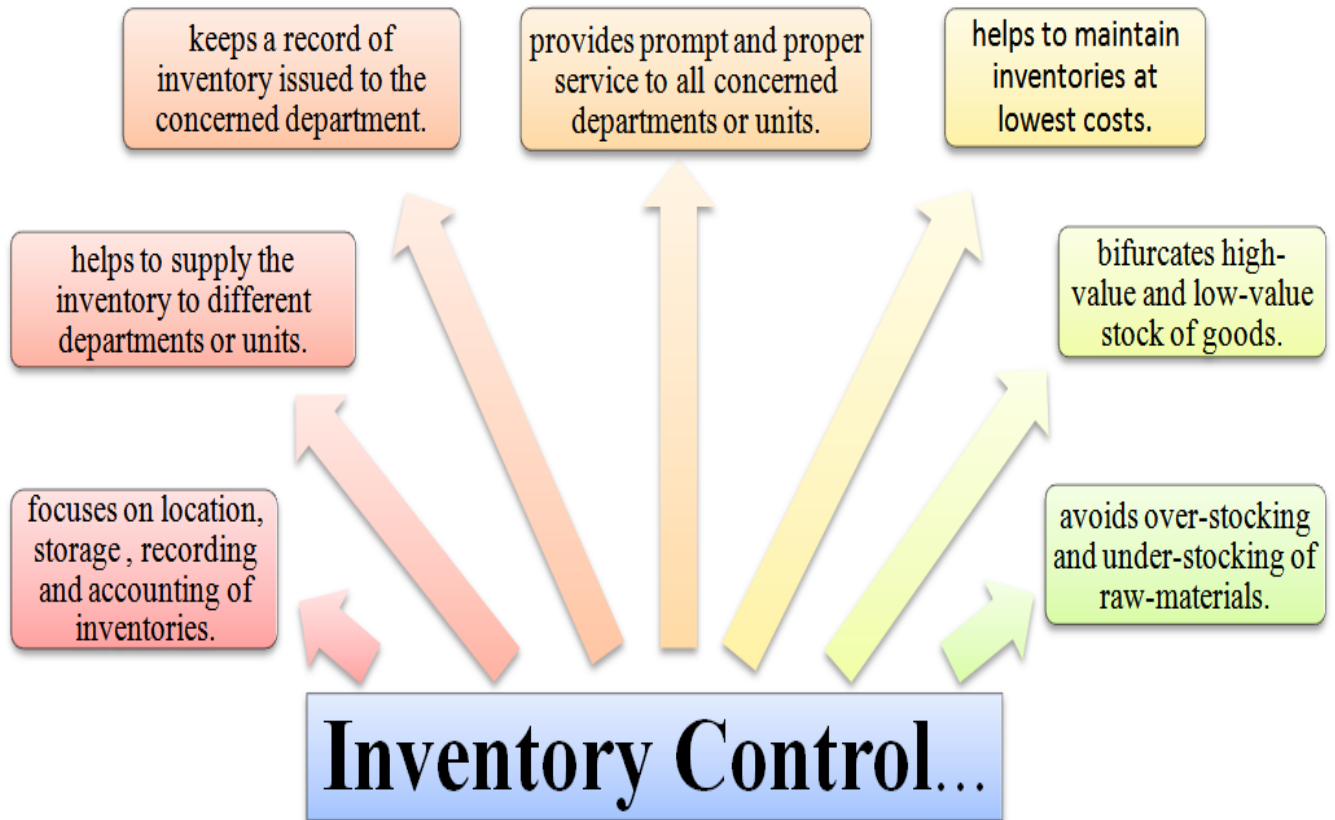
DEFINITION:

"Inventory control is a method where all stocks of goods are properly and promptly issued, accounted, and preserved in the best interest of an entity that handles its inventory.

(or) "Inventory control is the process whereby the investment in materials and parts carried in stocks is regulated, within pre-determined limits set in accordance with the inventory policy established by the management."

OBJECTIVES OF QUALITY CONTROL:

- ◆ To improve the companies income by making the production more to the customers i.e., by providing long life, greater usefulness, maintainability, etc.
- ◆ To reduce companies cost through reduction of losses due to defects.
- ◆ To produce optimal quality at reduced price.
- ◆ To ensure satisfaction of customers with productions or services or high quality level, to build customer goodwill, confidence and reputation of manufacturer.
- ◆ To make inspection prompt to ensure quality control.
- ◆ To check the variation during manufacturing.



FEATURES - INVENTORY CONTROL:

1. Inventory Control mainly focuses on location, storage, recording the quantity, and accounting for the amount of inventories.
2. It helps to supply inventories to different departments or units whenever demand requisition is raised. Mostly, it supplies inventories to the production department.
3. It keeps a record of inventory issued to the concerned department located at a specific place.
4. It provides prompt and proper service to all concerned departments or units.
5. It also helps to maintain inventories at lowest costs.
6. It separates high-value and low-value stock of goods.
7. It also avoids over-stocking and under-stocking of raw-materials.

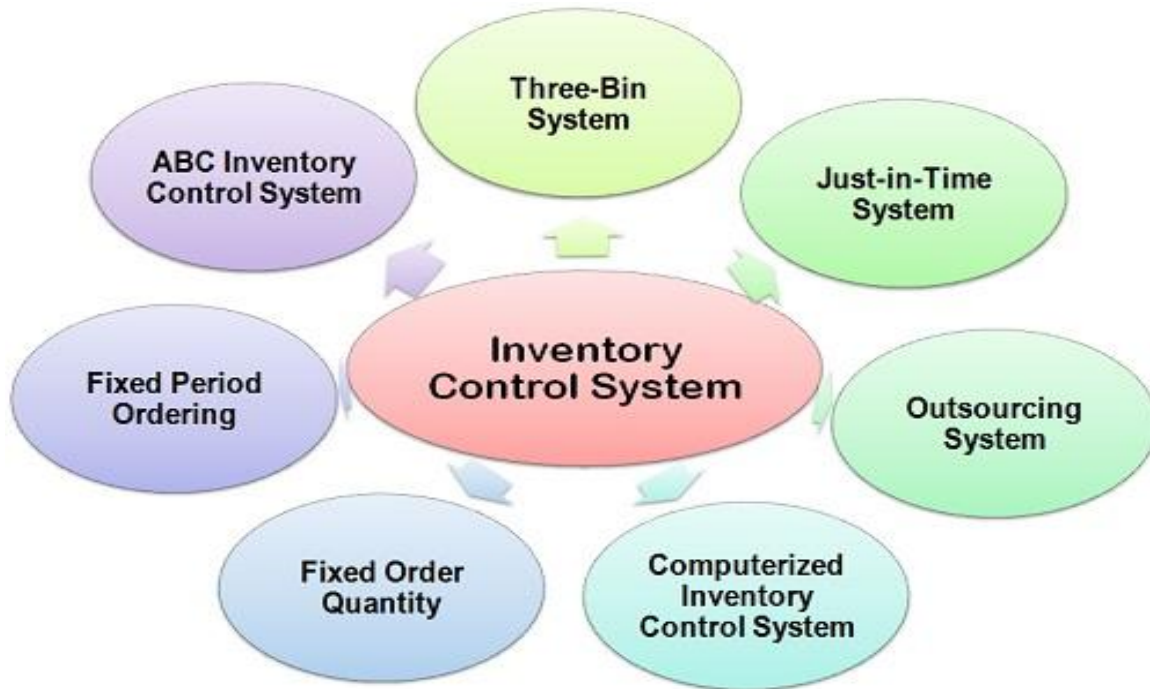
How to Achieve Inventory Control?

The inventory control can be achieved by:

1. Purchasing items of the right-quantity, at the right-place and at right-time.
2. Providing a suitable, secure, and sufficient place for storage.
3. Developing a proper inventory identification system.
4. Maintaining an up-to-date record keeping.
5. Making proper requisition procedures.

INVENTORY CONTROL SYSTEM

The **Inventory control system** is maintained by every firm to manage its inventories efficiently. Inventory is the stock of products that a company manufactures for sale and the components or raw materials that make up the product. Hence, an inventory comprises of the buffer of raw material, work-in-process inventories and finished goods.

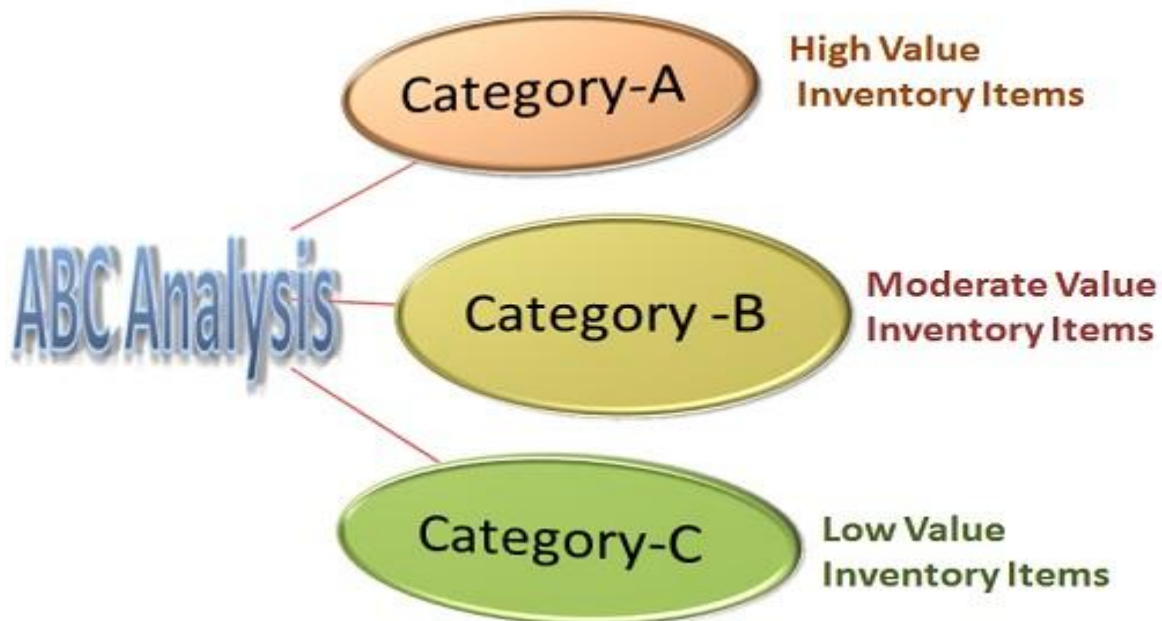


Following are the popular Inventory Control Systems that are being used by big manufacturers and the retail units:

1. ABC Inventory Control System
2. Three-Bin System
3. Just-in-Time (JIT) System
4. Outsourcing Inventory System
5. Computerized Inventory Control System
6. Fixed Order Quantity
7. Fixed Period Ordering

1. ABC Inventory Control System

The ABC Inventory Control System is applied by those firms that have to maintain several types of inventories. Ideally, it is not desirable to keep the same degree of control over all the inventory types, since each vary in terms of its value of annual consumption. Thus, the ABC Inventory Control System is used to determine the importance of each item of the stock in terms of its value of annual consumption and are categorized as A, B, and C.



- The items of high value are categorized as “A” and generally consists of 15%-25% of inventory items; that accounts for 60%-75% of annual usage value. The firm keeps strict control over these inventory items.
- The Category “ B”, is comprised of those items that are of relatively less value or has moderate importance and consists of 20%-30% of inventory items, that accounts for 20%-30% of annual usage value. A reasonable control is kept on the “B” category inventory items.
- The least important items of the inventory are categorized as “C”. It consists of 40%-60% of inventory items; that accounts for 10%-15% of annual usage value. Due to a low value of these items, a simple or an ordinary control is kept on them.

2. THREE-BIN SYSTEM

The **Three-Bin System** is like a two-bin system, wherein the third bin of inventory is reserved with the supplier. In other words, a manufacturing firm keeps a stock of inventory in two bins, and at the same time, the supplier of the inventory will keep one bin reserved at his location.

The Three-bin is built on the concept of Kanban system, a system used by the Japanese manufacturers, who regulate the supply of the components through the use of a card, displaying the set of specifications and instructions. This card is shown by the work centres when they wish to draw inventory from the supply bins.

All the three bins, one at the shop floor, another at the back store and the third bin at the supplier's location are well equipped with a Kanban card, to track the movement of inventory.

Once the inventory is used from the bin placed on the shop floor, it gets replenished from the bin stored back store. Later the bin in the back store is sent to the supplier to get it replenished from the inventory reserved with the supplier. Then, the supplier will manufacture more inventory to fill the empty bin placed with him.

Thus, the three-bin system is followed to have a secured flow of inventories throughout the production of the finished goods

3. JUST-IN-TIME SYSTEM

The **Just-in-Time or JIT** is an inventory management system wherein the material, or the products are produced and acquired just a few hours before they are put to use. The Just-in-time system is adopted by the firms, to reduce the unnecessary burden of inventory management, in case the demand is less than the inventory raised.

The objective of Just-in-time is to increase the inventory turnover and reduce the holding cost and any other costs associated with it. This concept is again popularized by the Japanese firms, who place an order for the material, the same day the product is to be produced. Thus, the JIT system eliminates the necessity to carry large inventories and incur huge carrying cost and other related costs to the manufacturer.

The JIT requires a proper understanding between the manufacturer and the supplier in terms of the delivery and the quality of the material.

4. OUTSOURCING INVENTORY SYSTEM

The **Outsourcing Inventory System** is adopted by the firms to reduce the burden of manufacturing the components of the finished goods in-house i.e. within the organization. Thus, a system of buying the products or components from outside vendors rather than manufacturing internally is called as Outsourcing Inventory system.

Tata Motors is the prominent example that uses the outsourcing inventory system. It has developed several ancillary units around its manufacturing plants to get the parts and components in time.

5. COMPUTERIZED INVENTORY CONTROL SYSTEM

A **Computerized Inventory Control System** is the integration of sub-functions involved in the management of inventory into a single cohesive system. It is a software installed on the computer system that enables a firm to keep a check on the inventory levels

by performing the automatic counting of inventories, recording withdrawals and revising the stock balance.

It is very difficult for any firm to maintain a large stock of inventories, and therefore, many firms have adopted the JIT system in terms of Minimum and Maximum limit for the stock. There is an inbuilt system for placing orders in computer systems that automatically generates to the supplier when the minimum level of the stock or the reorder point is reached.

The benefits of a computerized inventory control system can be derived, when the business integrates its inventory control system with the other systems such as accounting and sales, that helps in better control of inventory levels.

5. **FIXED ORDER QUANTITY**

The **Fixed Order Quantity** is the inventory control system, wherein the maximum and minimum inventory levels are fixed, and maximum and fixed amount of inventory can be refilled at a time when the inventory level reaches the auto set reorder point or the minimum stock level.

The Fixed Order Quantity system is followed by many firms since it helps to reduce the reorder mistakes, manage the storage capacity efficiently and prevent the unnecessary blockage of funds, which can be used elsewhere. Also, this method ensures the regular replacement of inventory items, which are currently being used in the production process.

The Fixed Order Quantity method assumes that all the variables are known with certainty and remains constant. Such variables could be the sales, unit cost, holding cost, Lead time, stock out cost, etc. But, however, this assumption could not be true in the real life situations and despite this, the method is frequently applied by the firms and yields excellent results.

6. **Fixed Period Ordering**

The **Fixed Period Ordering** is an inventory control system, wherein the order for the refillment of inventory items is sent periodically. It is also called as **Fixed Period Deficit Ordering system**, because every time the order is placed, the order quantity is different.

Thus, fixed period ordering is a method wherein the firm places an order with the supplier for the supply of different quantities of material at a fixed time interval. This enables a firm to take into consideration the sales and the customer's preferences in a particular period before placing the replacement order with the supplier.

The fixed period ordering system is helpful for a firm in the following ways:

- The large fluctuations in the demand patterns can be handled efficiently.
- The seasonal variations are considered before placing an order.

- The inventory can be managed more efficiently, by continually checking it against the pre-set reorder level.
- Best suited for the “A” category inventory items, which are of high value.
- A longer lead time is manageable.

Thus, Fixed ordering system enables a firm to procure that much inventory which is required in a particular period and helps in reducing the unnecessary expenditure in the form of funds blocked in inventory items of no use.

What is JIT Inventory Management?

JIT inventory management describes a process in which merchants carry only the stock they need. Ideally, products should be flowing in just as quickly as customer demand takes them out. Additionally, a fully functioning JIT inventory model ensures merchants never run out of stock during peak periods.

JIT inventory management is quickly becoming a more viable solution for retailers, as it eliminates many of the issues associated with stock outs and overstocks while also providing additional benefits for the retailer.

Disadvantages of JIT system:

1. Complexity in planning

As the name suggests JIT “Just in Time” it is in time procurement and management of stock. It requires accuracy in planning and effective procurement of stock for a particular customer order, avoiding customer dissatisfaction.

2. Lack of working capital

Just in Time stock means no stock in godown which means a decrease in working capital i. e. no stock in current assets. It means a decrease in current ratio. The investors may be deterred by this effort to invest their money in company.

3. Supply chain failures

For every additional order new stock should be ordered every time. A new contract would be made causing in additional time costs. Furthermore, an unnecessary delay in procuring the stock can cause in supply chain failure of the procuring company.

4. No opportunity costs

No stock means there would be no opportunity costs, no alternative use. If a company requires an order for a small quantity of stock, it should purchase the same as it does not have any such quantity of stock in its warehouse thus increasing the ordering costs.

5. Compromise on quality

In time purchasing the core target is to dispatch the finished good to vendor in this way the quality of stock purchased may be surrendered voluntarily.

6. Industry specific

JIT approach is industry and economy specific. Toyota like industries use it however, Pepsi, Macdonald's like companies do not follow JIT system of inventory.

Other disadvantages are:

- **Risk of running out of stock**
- **Lack of control over time frame**
- **More planning required**

Advantages of JIT:

Less space needed: With a faster turnaround of stock, no need as much warehouse or storage space to store goods. This reduces the amount of storage an organisation needs to rent or buy, freeing up funds for other parts of the business.

Waste reduction: A faster turnaround of stock prevents goods becoming damaged or obsolete while sitting in storage, reducing waste. This again saves money by preventing investment in unnecessary stock, and reducing the need to replace old stock.

Smaller investments: JIT inventory management is ideal for smaller companies that don't have the funds available to purchase huge amounts of stock at once. Ordering stock as and when it's needed helps to maintain a healthy cash flow.

Advantages

Lower stock holding means a reduction in storage space which saves rent and insurance costs

As stock is only obtained when it is needed, less working capital is tied up in stock

There is less likelihood of stock perishing, becoming obsolete or out of date

Avoids the build-up of unsold finished product

Disadvantages

There is little room for mistakes as minimal stock is kept for re-working faulty product

Production is very reliant on suppliers and if stock is not delivered on time, the whole production schedule can be delayed

There is no spare finished product available to meet unexpected orders, because all product is made to meet actual orders – however, JIT is a very responsive method of production

that can occur with sudden changes in demand

Less time is spent on checking and re-working

the product of others as the emphasis is on

getting the work right first time

BUDGETING:

Budgeting is a process. This means budgeting is a number of activities performed in order to prepare a budget. A budget is a quantitative plan used as a tool for deciding which activities will be chosen for a future time period.

In a business, the budgeting for operations will include the following:

- preparing estimates of future sales
- preparing estimates of future cash collections and disbursements
- preparing estimates of the future day-to-day activities of the organization
- summarizing these estimates into an income statement and balance sheet

ADVANTAGES OF BUDGETING:

- **Planning orientation.** The process of creating a budget takes management away from its short-term, day-to-day management of the business and forces it to think longer-term. This is the chief goal of budgeting, even if management does not succeed in meeting its goals as outlined in the budget - at least it is thinking about the company's competitive and financial position and how to improve it.
- **Profitability review.** It is easy to lose sight of where a company is making most of its money, during the scramble of day-to-day management. A properly structured budget points out what aspects of the business produce money and which ones use it, which forces management to consider whether it should drop some parts of the business, or expand in others.
- **Assumptions review.** The budgeting process forces management to think about why the company is in business, as well as its key assumptions about its business environment. A periodic re-evaluation of these issues may result in altered assumptions, which may in turn alter the way in which management decides to operate the business.
- **Performance evaluations.** You can work with employees to set up their goals for a budgeting period, and possibly also tie bonuses or other incentives to how they perform. You can then create budget versus actual reports to give employees feedback regarding how they are progressing toward their goals. This approach is most common with financial goals, though operational goals (such as reducing the product rework rate) can also be added to the budget

for performance appraisal purposes. This system of evaluation is called responsibility accounting.

- Funding planning. A properly structured budget should derive the amount of cash that will be spun off or which will be needed to support operations. This information is used by the treasurer to plan for the company's funding needs.
- Cash allocation. There is only a limited amount of cash available to invest in fixed assets and working capital, and the budgeting process forces management to decide which assets are most worth investing in.
- Bottleneck analysis. Nearly every company has a bottleneck somewhere, and the budgeting process can be used to concentrate on what can be done to either expand the capacity of that bottleneck or to shift work around it

MATERIAL REQUIREMENT PLANNING:

Material requirement planning is a scientific way of determining the requirements starting with raw materials, consumables, spare parts and all other materials that are required to meet the given production plan for a certain period. Material planning is derived from the overall organisational planning and hence it is always a sub-plan of the broad organisational plan. What it does is forecasting and initiating for procurement of materials.

FACTORS AFFECTING MATERIAL PLANNING:

- 1) **Macro factors:** Global factors such as price trends, business cycles, government's import and export policies etc are called the Macro factors.
- 2) **Micro factors :** The factors existing within the organisation such as corporate policy on Inventory holding, production plan, investments, working capital etc.

TECHNIQUES OF MATERIALS PLANNING:

- 1) Materials Requirement Planning (MRP)
- 2) Requirement based on past consumption

II. MATERIAL REQUIREMENTS PLANNING (MRP):

Material requirements planning is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Most MRP systems are software-based. The three objectives are:

- Ensure materials that are available for production and products that are available for delivery to customers.
- Maintain the lowest possible material and product levels in store

- Plan manufacturing activities, delivery schedules and purchasing activities.

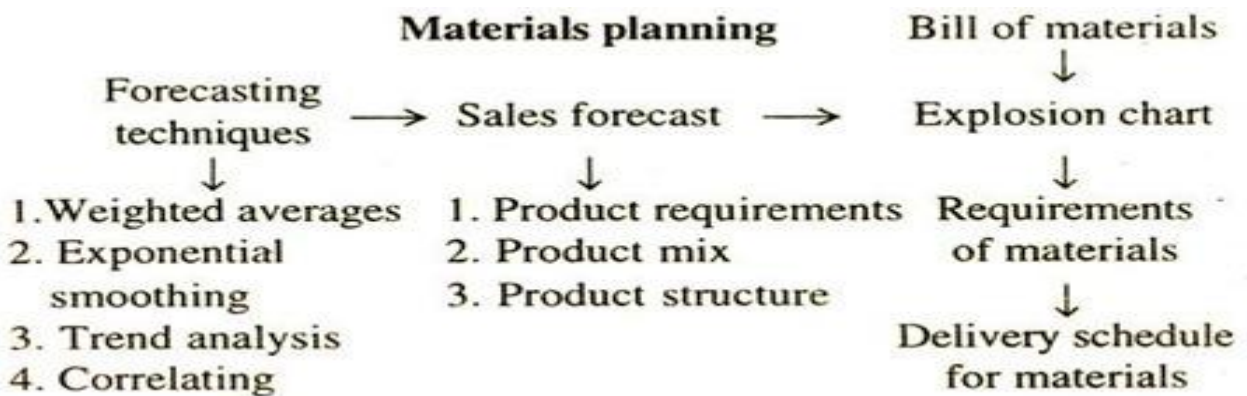
Thus the planning for materials management is aimed at determining the demand for the end-products. This is possible only through forecasting. There are various techniques for forecasting. These techniques are equally applicable to demand forecasting.

The techniques are:

- (i) Moving averages method.
- (ii) Exponential smoothing and Time series.

After demand forecast the exercise of materials planning starts. Requirements for various materials are ascertained from the demand forecast. For this purpose, the use of computers is very effective for “exploding” bill of materials with demand forecasts. The bill of materials is prepared and issued by the planning or engineering department in a standard form.

An explosion chart is just a series of bills of materials grouped together in a matrix form so that combining the requirements for different components can be done. it is quite natural to find that some materials are in short supply and some in excess.



(II) PAST CONSUMPTION ANALYSIS:

For continuously needed materials and the materials where no bill of materials is possible, this technique of analysis is adopted- The past consumption data is analysed and a projection for the future on the basis of past experience and future need is made. To prepare such a projection, “average” or “mean” consumption and the “standard deviation” are taken as bases and as guidelines for each item.

PURCHASING & PURCHASING MANAGEMENT

- **Purchasing** is the function of buying Goods & Services from External Source to an Organization.

- The key issues involved in purchasing are:
 - ⊗ Quantity
 - ⊗ Quality
 - ⊗ Time
 - ⊗ Place

PURCHASING MANAGEMENT:

- **Purchasing management** is a department in an organization responsible for purchasing activities

OBJECTIVES OF PURCHASING

- Φ Purchase of satisfactory material.
- Φ Proper negotiations with suppliers.
- Φ Co-ordination with other departments.
- Φ Timely deliveries.
- Φ Continuous and regular supply.
- Φ Minimized wastages.
- Φ Quality
- Φ To control the qty. of material
- Φ Information about new material and processes, which can reduce the cost of production and improve the performance of the product.

OBJECTIVES OF PURCHASING MANAGEMENT

- To purchase the required material at minimum price by the company policies.
- to keep department expenses low.
- Development of good & new suppliers.
- Development of good relation with the existing suppliers.
- training & development of personal employees in department.
- to maintain proper & up to date records of all transactions.
- Participating in development of new material and products.
- to contribute in product improvement.
- to take Economic "MAKE OR BUY" decisions.
- to develop policies & procedure.
- to provide an uninterrupted flow of materials and services for company operations
- to find reliable alternative sources of supply
- to buy at the most economic order quantities
- to buy the best value: a combination of right quality at the best price with the best supplier service
- to maintain good relations with vendors

PRINCIPLES OF PURCHASING MANAGEMENT OR (8 R'S)

- Buying Material at **Right QUALITY**.

- In the **Right QUANTITY**.
- From the **Right SOURCE**.
- At the **Right PRICE**.
- Right service ...**
- Delivered at the **Right PLACE** in.
- At the **Right TIME**.
- With **Right** mode of **TRANSPORT**.
- With **Right CONTRACT**.
- With **Right payment terms**

PRINCIPLES OF PURCHASING



FUNCTIONS OF PURCHASING MANAGEMENT:

The purchasing function involves more than obtaining the best price. It also involves buying the best value, which means buying:

- the right quantity and quality
- at the best price
- from suppliers who are reliable and provide good service
- Cost Control
- Price Stability
- Supply Chain Management

- Customer Satisfaction

One way to obtain the best value on a purchase is to set purchasing objectives and carefully follow the procurement cycle. It is as follows:

The Procurement Cycle:

Effective procurement consists of a series of steps which form a cycle. The steps in the cycle can be described as follows:

- 1. Determine needs.** Before buying anything, it is necessary to know the need to buy and quantity to buy, what quality to buy etc.
- 2. Select the supplier(s).** When there are many suppliers to choose from, it is not simple to choose those who will give the best value - not only in price but in service, and quality as well.
- 3. Negotiate the purchase.** In addition to specifying quantities and obtaining agreement on price, this can involve guarantees, method of payment, containers and packaging, delivery dates and other details of the purchase. Proper documentation of the purchase agreement is essential.
- 4. Follow-up.** The quality of product and service as well as the accuracy of quantities to determine the improvements, if any, are needed for the future.

STORE-KEEPING:

Meaning:

- 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.
- After the completion of purchase procedure, the next important aspect Of materials management is storekeeping. A storehouse is a building provided for preserving materials, which stores the 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.

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 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.,

Working of the stores:

There are four sections in the process of storekeeping viz.

- (a) Receiving section,
- (b) Storage section,
- (c) Accounting section, and
- (d) Issue section

STORES MANAGEMENT :

A professionally managed Stores has a process and a space within, to receive the incoming materials (Receiving Bay), keep them for as long as they are not required for Custody and then to move them out of stores for Issue. In a manufacturing firm this

The task of storekeeping relates to safe custody and preservation of the materials stocked, to their receipts, issue and accounting.

The basic job of the Stores Manager hence is to receive the goods and act as a caretaker of the materials and issue them as and when Production demands it. The organization has to spend money on space i.e. expenditure on land, building and roads, equipment, machinery and other facilities provided such as electricity, people i.e. salaries and wages, insurance, maintenance costs, stationary, communication expenses and the cost to maintain the inventory etc. All of these get added to the organisational overheads and finally get reflected in the costing of the finished product. However, it is an essential function in any manufacturing or marketing organization. This basic reason has propelled the evolution of philosophies such as JIT, JIT II etc.

Thus, the basic functions, to manage a stores, carried out are:

Receiving of incoming consignments (goods)

Safe keeping of goods (Custody)

Disposal of undesirable goods

Inventory Management

House keeping and record maintenance

It all starts with a suitable Lay out design of stores. Depending upon the nature of items used for processing, the lay out and type of stores are selected. For storing costly material, a closed and restricted type of stores shall be needed.

However, irrespective of the type and lay out, any Stores would have, as its starting activity, receiving and accounting of the incoming goods. This part of Stores is known as **Receiving Bay**.

A stage comes when the material is needed for use. Stores thus releases the material from its custody to the user department and the process is called 'issue of goods. In the long drawn process of preserving the materials till its use, some materials might get obsolete and unserviceable and may require removal from stores, in order to clear space for other incoming goods. This activity is known as **Disposal of goods** for which auction etc is done.

Inventory control / management thus is a vitally important aspect of any stores function. One of the basic functions of stores is **to account for every material** received in stores by maintaining proper records of all the incoming, stored and outgoing materials so that proper accounting and audit is maintained.

Material handling therefore is another vital function. Just as Lay out of a Stores is designed considering the nature of material Stores has to handle, material movement equipment and implements also are

Once the material has been received and cleared through inspection and accepted for use, it needs safe custody till it's actually used.

It calls for a separate physical storage space , open or closed, as per need. It maintains all documents that are able to trace an item , show all its details and preserve it up to its shelf life in the manner prescribed or till it is issued for use.

This part of Stores is called **Custody**. Thus the role of Custody is to receive and preserve the material and then to issue it

important.

Example like

Over head Cranes, Trolley etc inside the Stores and trucks, Dumpers and Railway Stores equipment to handle materials.

DIFFERENT TYPES OF STORES

A) Closed stores – Closed systems are utilized when close control and accounting for inventories are desirable. In such cases, storage area are kept locked and entry is limited to store employees. Closed systems typically include stores operations, and involve repair parts, consumables, tools, and materials or components where ongoing control and accuracy is essential.

B) Open stores – There are instances where the cost of closely controlling inventories incurs losses in an uncontrolled environment. In such cases, inventory storage areas may be left open to the point of use for efficient user access.

C) Random access – Here the goods are stored in available space of suitable size. Locating items in random access storage usually requires a computerized system. Random access systems tend to be used in conjunction with a closed stores system.

D) Automated warehouse – A large variety of automatic storage and retrieval systems (ASRS) are being used today, as they have the capability of bringing goods from storage & placing them in computer entry.

E) Contractor operated system : Here the supply contractors have branches built next door to industrial plants, for the sole purpose of supplying all needs of the plants for storing.

UNIT IV: Quality Control- Purposes, Quality assurance- Acceptance sampling - Statistical Quality Control – Control for variables and attributes- Quality Circles - Total Quality Management -ISO 9000.

QUALITY ASSURANCE (QA)

INTRODUCTION:

In developing products and services, quality assurance is any systematic process of checking to see whether a product or service being developed is meeting specified requirements. Many companies have a separate department devoted to quality assurance. A quality assurance system is said to increase customer confidence and a company's credibility, to improve work processes and efficiency, and to enable a company to better compete with others.

Quality assurance was initially introduced in World War II when munitions were inspected and tested for defects after they were made. Today's quality assurance systems emphasize catching defects before they get into the final product.

Quality has been defined as fitness for use, conformance to requirements, and the pursuit of excellence. Even though the concept of quality has existed from early times, the study and definition of quality have been given prominence only in the last century.

1920s: quality control. Following the Industrial Revolution and the rise of mass production, it became important to better define and control the quality of products. Originally, the goal of quality was to ensure that engineering requirements were met in final products. Later, as manufacturing processes became more complex, quality developed into a discipline for controlling process variation as a means of producing quality products.

1950s: quality assurance and auditing. The quality profession expanded to include the quality assurance and quality audit functions. The drivers of independent verification of quality were primarily industries in which public health and safety were paramount.

1980s: total quality management (TQM). Businesses realized that quality wasn't just the domain of products and manufacturing processes, and total quality management (TQM) principles were developed to include all processes in a company, including management functions and service sectors.

Quality management today. There have been many interpretations of what quality is, beyond the dictionary definition of "general goodness." Other terms describing quality include reduction of variation, value-added, and conformance to specifications.

DEFINITION:

- Quality assurance (QA) is a way of preventing mistakes & defects in manufactured products and thereby to avoid problems when delivering it to customers.
- ISO 9000 defines QA as "part of quality management focused on providing confidence that quality requirements will be fulfilled".
- This defect prevention in quality assurance differs from defect detection and rejection in quality control, and it focuses on quality.

Quality Management:

Quality has been defined as fitness for use and the pursuit of excellence.

A system of quality management includes all activities of the overall management function that determine the quality in policy, objectives, and responsibilities and their implementation.

Difference between quality assurance and quality control.

Quality assurance	Quality control
“part of quality management focused on providing confidence that quality requirements will be fulfilled.” The confidence provided by quality assurance is twofold—internally to management and externally to customers, government agencies, regulators, certifiers, and third parties.	is that “part of quality management focused on fulfilling quality requirements.”
quality assurance relates to how a process is performed or how a product is made	quality control is more the inspection aspect of quality management.

Quality Control comprises the following:

Inspection is the process of measuring, examining, and testing to gauge one or more characteristics of a product or service and the comparison of these with specified requirements to determine conformity. Products, processes, and various other results can be inspected to make sure that the object meets its specifications.

Some of the importance or benefits of quality control are: 1. Encourages quality consciousness 2. Satisfaction of consumers 3. Reduction in production cost 4. Most effective utilisation of resources.

1. Encourages quality consciousness:

The quality control 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 much reduced.

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 in the minds of people.

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 a better industrial atmosphere by increasing morale of employees leading to better understanding and closeness between employer-employee.

9. Effective advertisement:

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

10. 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 & thereby increasing sales.

ACCEPTANCE SAMPLING

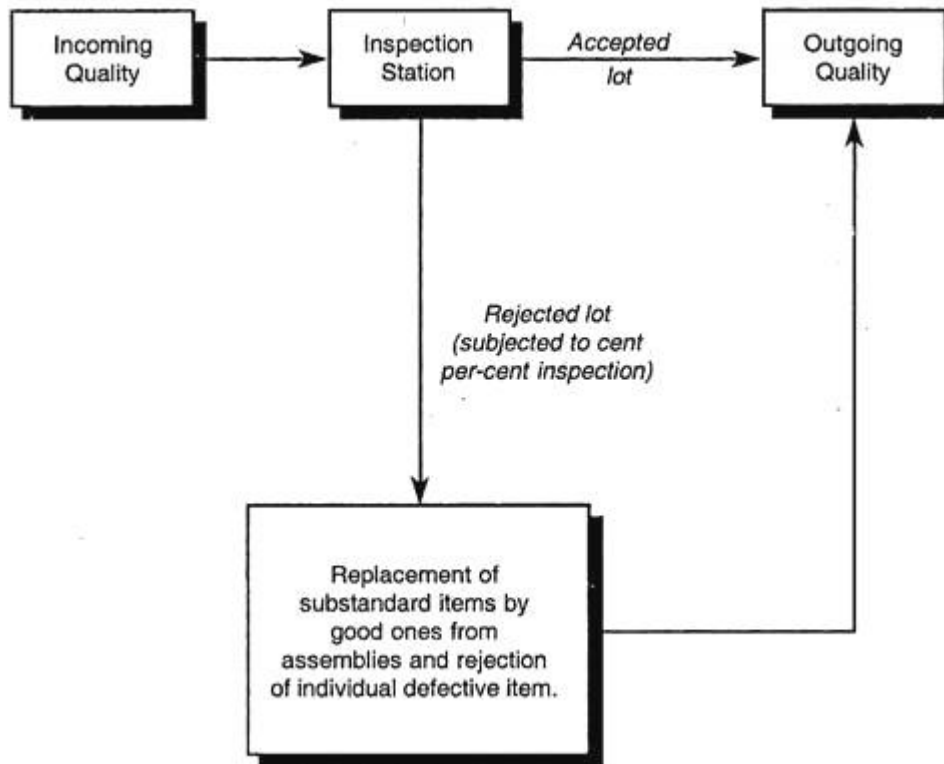
Acceptance sampling is the sampling that uses statistical sampling to determine whether to accept or reject a production lot of material. It is one of the quality control technique used in industry.

(or) Acceptance sampling is a major component of quality control and is useful when the cost of testing is high. It is a compromise between doing 100% inspection and no inspection at all.

(or) Acceptance sampling is "the middle of the road" approach between no inspection and 100% inspection. There are two major classifications of acceptance plans: by attributes ("go, no-go") and by variables.

The lot is accepted if the number of defects falls below where the acceptance number or otherwise the lot is rejected

For example, if we purchase a bag of potatoes, only a few potatoes can be observed from the whole bag however we draw an inference about the whole bag by only inspecting a few. If these look alright, it is assumed that all the potatoes in that bag will be alright.



The basic concept of sampling lies in testing the samples for acceptance or rejection. Some products such as electric bulbs, radio valves, razor blades, bolts etc. require to be subjected to destructive tests so as to ascertain their life.

ADVANTAGES OF ACCEPTANCE SAMPLING

- (i) Items of destructive nature during inspection can be inspected by sampling only.
- (ii) Economy of time and money in comparison to 100% inspection.
- (iii) Problem of inspection fatigue occurring in 100% inspection is eliminated.
- (iv) Small inspection staff required.
- (v) Due to quick inspection, scheduling and delivery times are improved.
- (vi) Can exert more effective pressure on quality improvement than the rejection of individual items.

LIMITATIONS OF ACCEPTANCE SAMPLING:

Since the conclusion is based on a sample, there is always some likelihood or risk of making wrong inference about the quality of the lot. This is termed as producer's risk or consumer's risk.

The success of the scheme depends on randomness of samples, quality characteristics to be tested, lot size, acceptance criteria etc.

STATISTICAL PROCESS CONTROL (SPC)

SPC is an industry-standard methodology for measuring and controlling quality during the manufacturing process. Quality data in the form of Product or Process measurements are obtained in real-time during manufacturing. This data is then plotted on a graph with pre-determined control limits.

Control limits are determined by the capability of the process, whereas **specification limits** are determined by the client's needs

Data that falls within the control limits indicates that everything is operating as expected. If data falls outside of the control limits, this indicates that something within the process should be changed to fix the issue before defects occur.

Thus SPC helps to:

- Dramatically reduce variability and scrap
- Scientifically improve productivity
- Reduce costs
- Uncover hidden process personalities
- Instantly react to process changes
- Make real-time decisions on the shop floor

STATISTICAL QUALITY CONTROL:

Statistics :

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

Quality :

Quality is defined as fitness for purpose of a product.

Control :

Control is a system to suggest when to inspect, how often to inspect, how much to inspect etc.

- Control determines quality characteristics of an item with prescribed quality standards and separates defective item from non-defective ones.

Statistical Quality Control (SQC) is used to describe the set of statistical tools used to analyze the 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.

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.
And other tools (quoted above)

Cause-and-effect diagram :Identifies many possible causes for a problem and sorts ideas into useful categories.

Check sheet: A structured, prepared form for collecting and analyzing data; a generic tool that can be adapted for a wide variety of purposes.

Control charts: Graphs used to study how a process changes over time.

Histogram: The most commonly used graph for showing frequency distributions, or how often each different value in a set of data occurs.

Pareto chart: Shows on a bar graph which factors are more significant.

Scatter diagram: Graphs pairs of numerical data, one variable on each axis, to look for a relationship.

Stratification: A technique that separates data gathered from a variety of sources so that patterns can be seen

Benefits -Statistical Quality Control

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

Techniques of Applying Statistical Quality Control :

Important techniques of applying statistical quality control are: (A) Quality Control Charts and (B) Acceptance Sampling.

(A) Quality Control Charts:

A quality control chart is a graphic presentation of the expected variations in quality. Certain presumptions are taken into consideration before drawing these charts e.g., inherent nature of certain variables in a product, tolerance limits and probability of chance in variations etc.

Quality control charts are very helpful in spotting the causes responsible for variations from the set standards on the basis of information disclosed by these charts. Different types of quality control charts may be used for recording different types of analysis. B) Acceptance Sampling:

This is another technique of statistical quality control. This is also referred as 'Sampling Inspection plan.' This method is usually followed after goods have been produced or are in the final stage of production. Thus, it can be said that it is a post mortem of the quality of the product that has already been produced.

Under this method, a sample of the product produced is selected at random to study in detail whether the product conforms to the pre-determined standards or not. A limited percentage of defective products are allowed.

OBJECTIVE OF STATISTICAL QUALITY CONTROL

Quality Control is very important for a every company. Quality control includes service quality given to customer, company management leadership, commitment of management, continuous improvement, fast response, actions based on facts, employee participation and a quality driven culture.

The main objectives of the quality control module are to control of material reception, internal rejections, clients, claims, providers and evaluations of the same corrective actions are related to their follow-up. These systems and methods guide all quality activities. The development and use of performance indicators is linked, directly or indirectly, to customer requirements and satisfaction, and to management

Advantages of Statistical Quality Control:

Following are the important benefits derived from the technique of statistical quality control:

(1) Lesser cost of inspection:

Statistical quality control is based on sampling technique which involves lesser cost of inspection thereby cost of production is considerably reduced.

(2) Increase in profits:

By minimising rejections, statistical quality control ensures the production of standard products which bring higher profits for the producer.

(3) Setting tolerance limits:

Quality control charts clearly lay down the tolerances limits beyond which the product is to be rejected. The results shown by these charts are more authentic and correct.

(4) Develops quality consciousness:

Statistical quality control is greatly helpful in developing the feeling of quality consciousness among the workers working in an organisation. This improves their functioning and reduces the number of defective operations undertaken by them,

(5) Enhances reputation of the concern:

By adopting the techniques of statistical quality control, pre-determined quality of the product is achieved and consumers get desired quality products. This brings good name to the firm and increases its goodwill among the people.

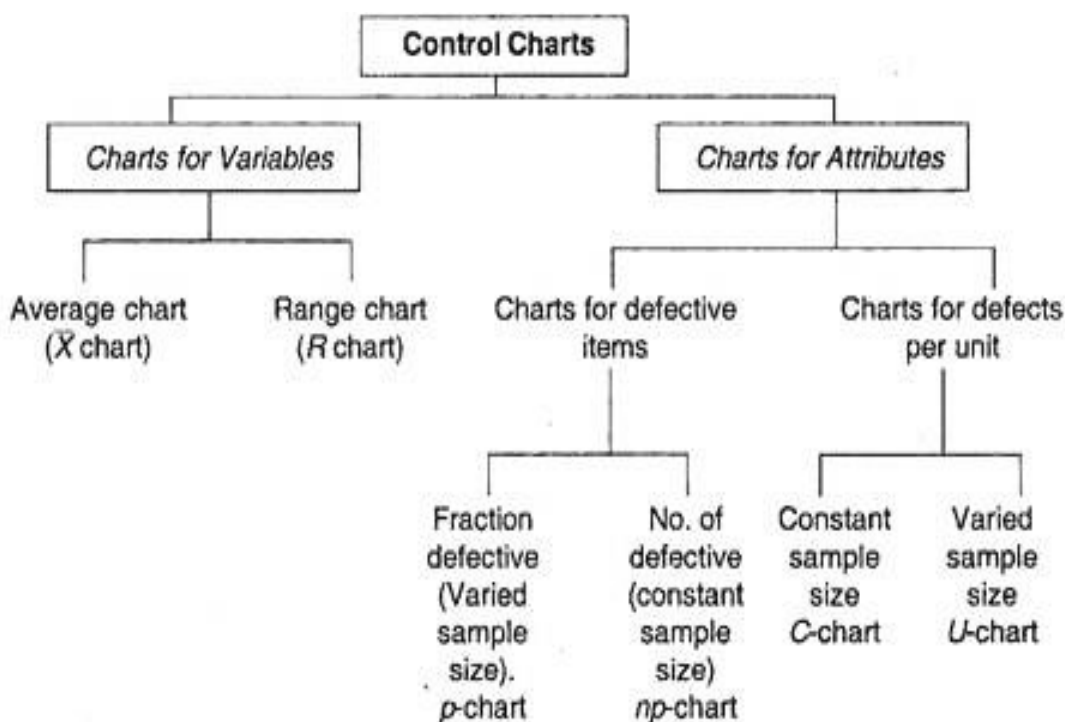
(6) Improved relations between vendor and customers:

It is greatly helpful in improving relations between supplier and the purchaser of material, by clearly fixing the tolerance limits with regard to quality of the goods supplied. This minimises the possibility of any dispute between both the parties.

Besides the above mentioned benefits, statistical quality control ensures smooth and unrestricted production by removing breakdown of machinery and work stoppages as it greatly helps in detection of the troubles soon, which are immediately corrected without delay.

Control Charts for Variables and Attributes

Control charts for attributes monitor attribute data and Control charts for variables monitor variable data.



Control Charts for Variables:

A number of samples of component coming out of the process are taken over a period of time. Each sample must be taken at random and the size of sample is generally kept as 5 but 10 to 15 units can be taken for sensitive control charts.

For each sample, the average value \bar{X} of all the measurements and the range R are calculated . The grand average $\bar{\bar{X}}$ (equal to the average value of all the sample average , \bar{X}) and R (\bar{R} is equal to the average of all the sample ranges R) are found and from these we can calculate the control limits for the \bar{X} and R charts.

Process Out of Control:

After computing the control limits, the next step is to determine whether the process is in statistical control or not. If not, it means there is external causes that throws the process out of control. This cause must be traced and removed so that the process may return to operate under stable statistical conditions.

QUALITY CIRCLES

The quality control circle or more popularly known as quality circle concepts were formed in Japan in 1960 and in United States it started in 1977. Gradually it caught the attention world over and most of the developed and developing countries are using this concept to their benefits.

Definition of Quality Circle:

Quality circle is “a voluntary group of people who meet together on a regular basis to identify, analyze and solve quality, productivity, cost reduction, safety and other problems in their works area, leading to improvement in their performance and enrichment of their work life”

A Quality circle is defined as a small group of employees who voluntarily cooperate to solve problems relating to:

- i. production, wastage of materials,
- ii. quality of raw material, tool, semi-finished and finished goods,
- iii. work-environment, energy consumption,
- iv. scheduling, delay,
- v. maintenance,
- vi. safety and anything that acct these factors

Characteristics of Quality Circle

The quality circle thus has the following characteristics:

1. A small group of people who do similar work:The quality circle essentially consists of people who do similar work. But it does not imply that the circle cannot consult the specialists or others. In fact, ideas and solutions can be sought from any corner.

2. The members in the circle should not be many

It is argued that smaller the circle better the coordination and homogeneity. The circle should look like a team and not a committee. It should consists of members between three and ten depending upon the size of the department. As suggestions for removing any snag or improving the productivity are invited from every member of the department no one would feel neglected or side tracked.

3. Voluntarily meeting together

People are invited to join the quality circle but they are not compelled. The members feel the need to meet together to discuss and devise ways to improve the functioning of their areas concerned. Hence, joining a quality circle is voluntary and not forced upon.

4. Meeting regularly every week

The duration and frequency of meetings even vary in Japan (where this concept originated), it is favored to have meetings at least an hour every week.

5. Under the leadership of their own supervisor

The quality circle is purely concerned with work-related problems. Therefore, supervisors of the work area prove to be the best persons to lead the group, as they are thorough with the functioning of the department. The idea of electing or selecting the leader from the quality circle members is not encouraged as it does not work out effectively.

6. Identification, Analysis and Solutions

The circle identify their own problems in their own work area. The circle members are not encouraged to highlight the fault of others.

7. Presenting Solutions to Management

After collection of data, working out new ideas in consultation with all kinds of people, the members come to a conclusion which if implemented will deliver the goods.

OBJECTIVES OF A QUALITY CIRCLE:

The perception of quality circles is ‘Appropriateness for use’ and the tactic implemented is to avert imperfection in services rather than their verification and elimination later. Quality circle is not a task force because it can be made a permanent feature of the organization. The objectives of a quality circle can be broadly characterized as given below:

- To contribute actively towards the improvement and development of the organization.
- To exist within the prevailing organizational structure to overcome the barriers so as to foster an open exchange of ideas.
- To develop a positive attitude and a feel of a sense of involvement in the decision making process amongst the employees
- To help employees to respect humanity and to build a happy work place worthwhile to work.
- To display human capabilities completely and to draw out the numerous possibilities in a long run.
- To improve the quality of products and services.
- To improve various competencies. This is also one of the goals in all organizations.
- To reduce the cost and the wasteful efforts in the long run.
- To improve efficiencies which in turn reduce the lead time resulting in an improvement in meeting customers due dates.

BENEFITS OF QUALITY CIRCLES:

- Team Work: It helps to eradicate inter-team conflicts and clashes and enhance the concept of team spirit.
- Positive Attitude: Employees start working with a positive attitude towards work, assuming it as their own work. They develop a “Can Do” and “I care” attitude.
- Personality advancement: Quality circle practice helps to learn new skills and also brings out the hidden potential of employees.
- Positive working environment: It improves the organizational working environment and involves employees in every process, right from a small decision to a big deal.
- Increased productivity: It helps in increasing overall productivity of organization by improvement of work processes and reduction of excessive costs. They increase operational efficiency, improve quality, and promote innovation.

ADVANTAGES OF QUALITY CIRCLES:

The following are some of the advantages of Quality Circles.

1. It infuses team spirit among the workers.
2. It improves decision making ability.
3. It improves employee communication at all levels of the organization.
4. It improves problem solving ability.
5. It improves leadership skill.
6. It builds confidence / trust.

7. It incorporates a sense of belonging to their organization.
8. It creates a sense of corporate loyalty and corporate pride.
9. It improves the relationship between managers and the work force.
10. It improves quality, production and productivity.
11. It improves the self image of the employees.
12. It reduces cost of production.
13. It enhances customer satisfaction.
14. It increases demand for product/services of the organization.
15. There is greater job security and more employment opportunity

PROBLEMS OF QUALITY CIRCLE PROGRAMMES:

1. As the circle membership is voluntary, a member can drop out when he/she wishes so. This option may be even be exercised to force other members to come to his/her terms.
2. The selection of a problem to be tackled first may generate more heat among the circle members. A strong-willed member may bulldoze his/her ideas straining the relationship.
3. The quality circle takes up a problem which is difficult to solve, thus, wasting their time and energy.
4. The departmental managers often prove less supportive, as the members of quality circle come to limelight often.
5. Fixing-up meeting time becomes difficult due to fluctuating working demand.
6. The circle may form an impression that the management is not implementing its suggestions whole heatedly and is dilly-dallying the idea which may have a dampening effect on the circle, demoralizing them.
7. The quality circle may feel after some time that it has run out of problems which in effect implies that it is not brainstorming according to the rules.

TOTAL QUALITY MANAGEMENT (TQM)

TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives.

TQM views an organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers.

The simple objective of TQM is “Do the right things, right the first time, every time.”

TQM is infinitely variable and adaptable. Although originally applied to manufacturing operations, and for a number of years only used in that area, TQM is now becoming recognized as a generic management tool, just as applicable in service and public sector organizations. TQM is the foundation for activities, which include:

- Meeting customer requirements
- Improvement of teams
- Reducing product and service costs
- Systems to facilitate improvement
- Employee involvement and empowerment
- Recognition and celebration
- Challenging quantified goals and benchmarking
- Focus on processes / improvement plans
- Specific incorporation in strategic planning

This shows that TQM must be practiced in all activities, by all personnel, in manufacturing, marketing, engineering, R&D, sales, purchasing, HR, etc.

CONCEPT OF CONTINUOUS IMPROVEMENT BY TQM

TQM is mainly concerned with continuous improvement in all work, from high level strategic planning and decision-making, to detailed execution of work elements on the shop floor. It stems from the belief that mistakes can be avoided and defects can be prevented. It leads to continuously improving results, in all aspects of work, as a result of continuously improving capabilities, people, processes, technology and machine capabilities.

Continuous improvement must deal not only with improving results, but more importantly with improving capabilities to produce better results in the future. The five major areas of focus for capability improvement are demand generation, supply generation, technology, operations and people capability.

PRINCIPLES OF TQM

TQM can be defined as the management of initiatives and procedures that are aimed at achieving the delivery of quality products and services. A number of key principles can be identified in defining TQM, including:

- Executive Management – Top management should act as the main driver for TQM and create an environment that ensures its success.
- Training – Employees should receive regular training on the methods and concepts of quality.

- Customer Focus – Improvements in quality should improve customer satisfaction.
- Decision Making – Quality decisions should be made based on measurements.
- Methodology and Tools – Use of appropriate methodology and tools.
- Continuous Improvement – Companies should continuously work towards improving manufacturing and quality procedures.
- Employee Involvement – Employees should be encouraged to be pro-active in identifying and addressing quality related problems.

TQM – Benefits & Advantages:

- Strengthened competitive position
- Adaptability to changing or emerging market conditions and to environmental and other government regulations
- Enhances Higher productivity
- Enhances the market image
- Elimination of defects and waste
- Reduced costs and better cost management
- Higher profitability
- Improved customer focus and satisfaction
- Increased customer loyalty and retention
- Increased job security
- Improved employee morale
- Enhanced shareholder and stakeholder value
- Improved and innovative processes

TQM - Disadvantages

- Can be difficult to implement

The benefits of total quality management are endless, helping your organization get results

ISO 9000

What Is the ISO 9000 Standards Series?

ISO 9000 is a series, or family, of standards. The ISO 9000 family of standards also contains an individual standard named ISO 9000. This standard lays out the fundamentals of quality management systems (QMS).

ISO 9000 Series standards

ISO 9000 certification

Individuals and organizations **cannot** be certified to ISO 9000. ISO 9001 is the only standard within the ISO 9000 family to which organizations can certify.

ISO 9000:2000

ISO 9000:2000 refers to the ISO 9000 update released in the year 2000.

The Technical Committee responsible for the ISO 9000 family, developed specifications for the ISO 9000:2000 revisions, leading to a significant advancement of the standards of in quality management.

The ISO 9000:2000 revision had five goals:

1. Meet stakeholder needs
2. Be usable by all sizes of organizations
3. Be usable by all sectors
4. Be simple and clearly understood
5. Connect quality management system to business processes

ISO 9000:2000 was again updated in 2008 and 2015. ISO 9000:2015 is the most current version.

ISO 9000 PRINCIPLES OF QUALITY MANAGEMENT

The ISO 9000:2015 and ISO 9001:2015 standards are based on seven quality management principles that senior management can apply for organizational improvement:

1. Customer focus
 - Understand the needs of existing and future customers
 - Align organizational objectives with customer needs and expectations
 - Meet customer requirements
 - Measure customer satisfaction
 - Manage customer relationships
 - Aim to exceed customer expectations

Learn more about the customer experience and customer satisfaction.
2. Leadership
 - Establish a vision and direction for the organization

- Set challenging goals
- Model organizational values
- Establish trust
- Equip and empower employees
- Recognize employee contributions
- 3. Engagement of people
 - Ensure that people's abilities are used and valued
 - Make people accountable
 - Enable participation in continual improvement
 - Evaluate individual performance
 - Enable learning and knowledge sharing
 - Enable open discussion of problems and constraints
- 4. Process approach
 - Manage activities as processes
 - Measure the capability of activities
 - Identify linkages between activities
 - Prioritize improvement opportunities
 - Deploy resources effectively
- 5. Improvement
 - Improve organizational performance and capabilities
 - Align improvement activities
 - Empower people to make improvements
 - Measure improvement consistently
 - Celebrate improvements
- 6. Evidence-based decision making
 - Ensure the accessibility of accurate and reliable data
 - Use appropriate methods to analyze data
 - Make decisions based on analysis
 - Balance data analysis with practical experience
- 7. Relationship management
 - Identify and select suppliers to manage costs, optimize resources, and create value
 - Establish relationships considering both the short and long term
 - Share expertise, resources, information, and plans with partners
 - Collaborate on improvement and development activities

- Recognize supplier successes

ADVANTAGES OF ISO 9000

- Increased marketability—The ISO 9000 registration provides businesses with markedly heightened credibility with current and prospective clients alike. Basically, it proves that the company is dedicated to providing quality to its customers, which helps to establish their presence in international markets.
- Reduced operational expenses—The improved efficiencies can help companies to save both time and money. "The cost of scrap, rework, returns, and the employee time spent analyzing and troubleshooting various products are all considerably reduced by initiating the discipline of ISO 9000.
- Better management control—The ISO 9000 registration process requires so much documentation and self-assessment that many businesses can increase their benefit.
- Increased customer satisfaction—Since the ISO 9000 certification process is for final product quality it results in higher levels of customer satisfaction.
- Improved customer service—The process of securing ISO 9000 registration often serves to refocus company priorities on pleasing their customers in all respects, including customer service areas.
- Attractiveness to investors—Business consultants and small business owners alike agree that ISO-9000 certification can be a potent tool in securing funding from venture capital firms.

DISADVANTAGES OF ISO 9000

- Owners and managers do not have an adequate understanding of the ISO 9000 certification process or of the quality standards themselves
- Funding for establishing the quality system is inadequate
- Heavy emphasis on documentation—The ISO 9000 certification process relies heavily on documentation of internal operating procedures in many areas
- Length of the process—Business executives and owners familiar with the ISO 9000 registration process warn that it is a process that takes many months to complete.

UNIT V

Economics – Meaning – importance – work study method study. Time and motion study – work measurements work sampling – industrial safety

Definition and Concept of Work Study:

Work study, as defined by British Standard Institution, is 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 effect the efficiency of the situation being reviewed, in order to seek improvements.

Actually, work study investigates the work done in an organisation and it aims at finding the best and most efficient way of using available resources, i.e., men, material, money and machinery. Every organisation tries to achieve best quality production in the minimum possible time.

The time required to manufacture an item depends upon the manufacturing procedure; and one phase of work study known as Method study aims at finding the best possible manufacturing procedure which involves, least time and does not cause fatigue to the workers.

In brief, method study or motion study aims at finding the best way of doing a job. Method Study may be defined as the systematic investigation (i.e., recording and critical examination) of the existing method of doing a job in order to develop and install an easy, rapid, efficient, effective and less fatiguing procedure for doing the same job and at lower costs.

This is generally achieved by eliminating unnecessary motions involved in a certain procedure or by changing the sequence of operation or the process itself.

Once the method study has developed an improved procedure for doing a job, the work Measurement or Time Study will find the time allowed to complete the job by that procedure. Work Measurement may be defined as the application of different techniques to measure and establish the time required to complete the job by a qualified worker at a defined level of performance. The time necessary to complete a job is determined from number of observations.

Need for Work Study:

Principles of work study used to be employed even long ago, in order to explore improvements, when industry was simple and involved lesser problems; of course a systematic procedure was not there. Today the industries with all their complexities and

modernization naturally demand a more systematic approach like the work study in its present form.

Work study finds applications in:

1. Industries (Production operations, research and development),
2. Marketing, sales and distribution,
3. Offices, stores and warehouses,
4. Material handling,
5. Design,
6. Building and other constructions,
7. Transport,
8. Hospital,
9. Army, and
10. Agriculture, etc.

Advantages of Work Study:

- (a) Uniform and improved production flow,
- (b) Higher productive efficiency,
- (c) Reduced manufacturing costs,
- (d) Fast and accurate delivery dates,
- (e) Better employee-employer relations,
- (f) Better service to customers,
- (g) Job security and job satisfaction to workers,
- (h) Better working and other conditions, and
- (i) Higher wages to workers.

Objectives of (or Advantages Obtained Through) Method Study:

- (1) Improved working processes and standardized procedures,
- (2) Better work place layout; neat and clean environments and working conditions,
- (3) Less fatigue to operators,
- (4) Better product quality,
- (5) Effective utilization of men, materials and machinery,
- (6) Efficient and fast material handling,
- (7) Reduced health hazards,
- (8) Efficient planning of the section, and
- (9) Streamlined working procedures.

Objectives of (or Advantages Achieved Through) Work Measurement:

Work Measurement:

- (1) Determines the time required to do a job; thus it compares alternative methods and establishes the fastest method;
- (2) Decides man power required for a job; it helps in man power economy;
- (3) Decides equipment requirements;
- (4) Provides information for effective production planning and maintenance procedures;
- (5) Aids in calculating exact delivery dates;
- (6) Decides realistic labour budgeting and provides a basis for standard costing system;
- (7) Provides a basis for fair and sound incentive schemes; and
- (8) Results in effective labour control.

Irrespective of the advantages mentioned above, the introduction of work study has always been looked by the supervisors, workers or union with suspicion. They probably feel insecure and think that work study will result in reduction in their salaries. Even otherwise a sudden change is never appreciated therefore workers and union should be taken into confidence and properly convinced before introducing work study.

Operation Analysis:

Operation Analysis is a detailed study of different operations involved in doing a work. Operation analysis becomes necessary in order to investigate the shortcomings of the existing method and to develop an improved procedure.

Operation analysis suggests, whether some elements, should be eliminated or combined or their sequence should be altered in order to obtain effective utilization of existing manpower and machinery with the minimum fatigue incurred by the workers. The analysis mainly considers the movements of the limbs and aims at finding a simpler and economical method of doing the job.

Before the procedural steps of a task are analyzed and the motions (of an operator) are studied or eliminated, an operation chart is constructed. Figure 9.7 shows an operation chart of the existing method of assembling nuts and bolts.

As a next step, the different motions involved are subjected to specific and detailed questioning with a view to eliminate unnecessary motions, and to arrange the remaining motions in a better sequence. Principles of motion economy serve as a very good guide in developing a better and improved method.

The chart of the existing method is tested as per the rules of motion economy and the following points are noted:

Operation : Nut & Bolt assembly.
 Name of the worker.....
 Location.....
 Method : Present/Proposed

Left Hand Description	Symbols	Right Hand Description
Idle		Goes to bin-1
		Grasps a bolt
		Carries to left hand
Grasps and holds the bolt		Releases to left hand
		Goes to bin-2
		Grasps a nut
		Carries to left hand
		Screws nut on the bolt
Releases nut-bolt assembly		Grasps the assembly
Idle		Transfers assembly to bin-3

- (1) The distribution of work between the two hands is not balanced. Right hand is overloaded.
- (2) The two hands do not follow opposite motions.
- (3) Gravity has not been utilized for delivering the material to its destination, etc.

Besides assessing the present method a per the principles of motion economy, it is also subjected to following questions (whichever are applicable) with regard to:

(a) Worker:

1. Is he mentally and physically fit?
2. Does he incur unnecessary fatigue?
3. Does he need training to improve?
4. Does he get suitable salary?

(b) Set-Up:

1. Are tools and other equipment readily available?
2. Can the set-up be modified or can the number of set-ups be decreased?

(c) Material:

1. Is material of the proper specification i.e., composition, diameter, width, thickness of weight?
2. Can it be substituted by a less costly material?
3. Can scrap be minimized?

(d) Material Handling:

1. Can materials be transferred in big (unit) lots, thereby reducing the number of handlings?
2. Is it possible to avoid back tracking of the material?
3. Can the distances, by which the material is moved, be cut short?

(e) Operations:

1. Can some operations be eliminated?
2. Can some operations be made automatic?
3. How, re-sequencing of the operations will effect?
4. Is it possible to combine some operations?

(f) Tools and Fixtures:

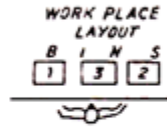
1. Are they available in good condition?
2. Are they suitably located and prepositioned?
3. Is it advantageous to modify existing jigs and fixtures for better productivity?

(g) Working Conditions:

1. Is light and ventilation adequate?
2. Are the operations and working conditions safe?
3. Are facilities of wash rooms, etc., available?

Considering the existing method in the light of motion economy principles and questions mentioned above, a proposed method for the same task is as follows.

Operation : Nut and Bolt Assembly
 Name of the worker.....
 Location.....
 Method : Present/Proposed



(3) It is a cavity in the work table, under which runs a conveyor to take each assembly at its destination.

Left hand description	Symbols	Right hand description
Goes to bin-1 Grasps a bolt Brings over the cavity or space cut in the work table (3) Holds and grasps the bolt. Releases the assembly to drop on a conveyor through cavity-3.		Goes to bin-2 Grasps a nut Brings over cavity-3 Screws the nut Releases the assembly to drop on a conveyor through cavity-3.

Analysis of Motion:

The motions or movements of the limbs of a worker play a major part in the fabrication or manufacture of the products. By carefully observing a worker while he is doing an operation, a number of movements made by him which appear to be unnecessary and unproductive can be identified and eliminated.

Analysis of an operation, when carried out in terms of individual motions of a worker is known as motion analysis.

The purpose of motion analysis is to design an improved method which eliminates unnecessary motions and employs human efforts more productively. In doing so the principles of motion economy prove to be very helpful.

Steps involved in Motion Analysis are:

- (a) Select the operation to be studied.
- (b) List and chart various motions performed by the operator.
- (c) Identify the productive and idle motions.
- (d) Eliminate the unnecessary and non-productive motions.
- (e) Redesign the existing operating procedure by employing minimum number of motions in the most appropriate sequence and in accordance with the principles of motion economy.
- (f) Impart necessary instructions to the worker so that he develops proper habit cycle.
- (g) Check once again the procedure in the light of step (e) above.

(h) The procedure may be standardized.

Therbligs:

Therbligs were suggested by Gilbreth. Therbligs are used to describe the basic elements of movements or fundamental hand motions of the work cycle. Every therblig is represented by a symbol, a definite colour and with a word or two to-record the same. For example, thereblig Grasp has symbol U, red colour and is denoted by the word G. A simo chart employs therbligs which are of microscopic nature, whereas a process chart uses symbols like operation, inspection, transportation, etc., which are macroscopic. A single operation may consist of many therbligs; for example,

<i>Macroscopic motion</i>	<i>Microscopic motion (therbligs)</i>
1. Operation of picking away a screw driver.	1. Reach hand for screw driver (transport empty). 2. Grasp the same (Grasp). 3. Take away the screw driver (transport loaded).

Though it looks cumbersome to deal with and to chart microscopic motions, yet they possess decided advantages over macroscopic motions.

1. One macroscopic motion may contain a number of microscopic motions. At times, it may not be possible to eliminate completely a macromotion but an unnecessary micromotion can definitely be avoided.
2. Since microsystem is very detailed, it is simpler to understand what precisely the worker is doing.
3. Therblig colours make the charts more meaningful.

Various Therbligs along with their definition, symbols and colours are given below:

Sl. No.	Therblig	Symbol	Colour	Definition
1.	Assemble		A Violet	Putting objects together.
2.	Disassemble		DA Light violet	Separating different parts of an assembled unit.
3.	Avoidable delay		AD Lemon yellow	A delay within operator's control.
4.	Unavoidable delay		UD Yellow	A delay on which operator has no control.
5.	Transport loaded		TL Green	Moving an article from one place to another.
6.	Transport empty		TE Olive green	Moving (a body member, say hand) empty.
7.	Search		SH Black	Hunting for an object.
8.	Plan		PN Brown	Mental reaction before action.
9.	Rest		R Orange	An allowance, idleness or pause to overcome fatigue incurred during previous work.
10.	Position		P Blue	Turning to line up, orient or change position.
11.	Find		F Grey	Mental reaction at end of search.

TIME AND MOTION STUDY

Meaning of Time and Motion Study:

Time study is defined as 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 analysing the data to determine the time necessary for carrying out the job at a defined level of performance.

Motion study implies dividing the work into fundamental elements or basic operations of a job or a process with the object of eliminating unnecessary or defective elements in a job. After investigating all movements in a job, process or operation it finds out the most scientific and systematic method of performing the operation or completing the job.

Thus, time study fixes the standard time for a job or a process while motion study eliminates wasteful motions or the movement of a worker on the job. Both are complimentary to each other.

Objectives of Time and Motion Study:

Objectives of time and motion study are:

1. They eliminate unnecessary motions, fatigue, and seek to improve human efforts in doing a job.
2. They bring about improvement in method, procedure, techniques and processes relating to a job.
3. They make effective utilisation of materials, machines, human resources.
4. They also improve layout and design of plant and equipment and working environment.

Benefits of Time and Motion Study:

The following benefits are derived by the Management from time and motion study:

1. Optimum utilisation of materials, plant, labour and financial resources is possible.
2. Labour requirements can be properly assessed.
3. Determination of fair wage rates and effective wage incentive schemes can be determined.
4. Setting of labour cost standards and control of the labour cost are possible.
5. Labour budgets can be prepared.
6. Job can be standardised.
7. Improvement in work methods by making comparison between time taken to complete a job and time taken to complete the same type of job under different methods.
8. Effective cost control and proper planning can be made with the help of time and motion study.

Treatment of Some Items of Motion Study:

(i) Overtime:

Overtime is the work put in by a worker beyond normal working hours. The wage rate for overtime is generally 1½ times of usual rate. It is double or triple if the work is performed on any holiday or Sunday or on weekly holiday. In costing, the cost of overtime premium must be separated from regular earnings.

Additional payment for overtime may be charged to the:

- (i) Job directly if overtime is worked at the customer's request with the object of completing the job within a specified period;
- (ii) To the department which has been responsible for causing delay;
- (iii) To the Costing Profit & Loss Account if overtime is necessary to make up the time lost due to breakdown of machinery, power failure etc.;
- (iv) To the prime cost if the work is on a peak load due to seasonal rush in the factory.

Of late, it has been a regular feature to grant overtime work to the workers for the reasons beyond the control of the management, so it will be logical and rational to charge the extra payment for overtime direct to production.

(ii) Holiday and Vacation Pay:

Workers enjoy some holidays like Independence Day, Republic Day, Mahatma Gandhiji's birthday and other Festival holidays with full pay. Production on these days remains suspended. Though payment for holidays is unproductive, the expense is treated as direct labour cost and charged to production.

(iii) Leave with Pay:

According to the Factories Act. workers are entitled to annual leave with pay for some days as specified. This leave is known as earned leave. Moreover, they are entitled to casual leave, medical leave, special leave etc. with full pay. Practically speaking, the wages paid to workers for the period in which they do not contribute to production may be treated as unproductive wages.

It is not generally treated as a direct charge to a product or to a job but is treated as factory overhead and recovered through departmental overhead rates. Alternatively, an inflated rate of direct wages cost can be applied to absorb both normal wages and an appropriate portion of leave with pay.

(iv) Attendance Bonus:

Sometimes workers are paid extra wages for their regular and punctual attendance. This extra payment of wage is known as attendance bonus. It is generally treated as direct wages and

charged to a product or job. But it can also be treated as factory overhead and may be recovered through departmental overhead rates.

(v) Apprentices' Wages:

In many factories it is the practice that new workers have to work as apprentice for some time before they are absorbed in regular work-force. As they are novice they are less efficient than the skilled and regular workers.

During training period they are likely to cause more scrap and wastes. Moreover, they take more time than normal to complete a job assigned to them. For the reasons stated earlier they are paid a lower rate of wage per hour.

The wages paid to them are treated as production overhead and should be charged to the annual output by including it in the factory overheads. But, if learners' wages can be easily identified with a job, they should be treated as direct wages.

(vi) Shift Premium:

When there is an unusual pressure of work, workers may be asked to work in the evening or night shifts. Generally, higher rate of wages or additional payment is made for night shift work.

This additional payment can be treated in two ways:

1. Where workers are asked to work in night shift at the request of the customers to complete their job within a specified time, extra payments are charged directly to the job concerned.
2. When the workers are paid extra for working in night shifts in order to increase the output of a whole or to make up production backlog, the premium element should be separated from direct wages and is to be treated as a production overhead.

(vii) Fringe Benefits:

An employee's pay roll generally consists of basic wages, dearness allowance, house rent allowance, city compensatory allowance etc. Besides these, a variety of benefits are provided to the workers. These benefits are known as fringe benefits. Fringe benefits are not directly related to the direct efforts of the employee.

Fringe benefits may comprise:

- (i) Holiday pay;
- (ii) Leave pay;
- (iii) Sick pay;
- (iv) Employer's contribution to provident fund;
- (iv) State insurance and medical benefits;
- (v) Gratuity;

- (vi) Good attendance bonus;
- (vii) Cheap canteen supplies etc.

Treatment in Cost Accounts:

The expenses in way of fringe benefits cannot be treated as direct labour cost and, as such, cannot be allocated to cost units as direct cost. They may be treated as items of departmental overhead and booked to standing order numbers allotted to each type of such expenditure.

If the amounts are not uniform in each accounting period, an amount is estimated in advance for the whole year and a proportionate charge is made for each period.

In some companies, however, cost of fringe benefits related to direct labour are charged as an additional direct labour cost. Horngren suggests that the latter approach is conceptually preferable because these costs are a fundamental part of acquiring labour services.

(viii) Idle Time:

Idle time is the difference between the time for which workers are paid and the time for which the workers do work. So, idle time represents the time for which the employer makes payment but from which the employer does not gain anything in terms of production.

Virtually, during idle time, the workers remain idle and contribute nothing to the production.

Idle time includes some unavoidable losses like time taken in travelling between the factory gate and the department in which the worker concerned is engaged; time lag between the completion of one job and the commencement of the next; tea breaks, tiffin breaks; personal needs and the time when production is stopped or interrupted for machine maintenance.

The wastage of time for the above reason or reasons cannot be avoided and the employer has to bear the financial loss arising out of such reasons. Idle time that results from unavoidable causes is treated as normal idle time. Abnormal idle time is the result of causes which are avoidable.

The following are the examples of abnormal idle time:

- (i) Time lost through the breakdown of machinery due to inefficiency or bad maintenance or for power failure which is frequent in our country;
- (ii) Time lost through non-availability of materials;
- (iii) Time lost due to stoppage of work on account of strikes, fire etc.;
- (iv) Bottlenecks in production;
- (v) Time lost for waiting for instruction from the superior.

These above causes are also known as administrative and productive causes. Idle time due to productive and administrative causes can be avoided if little care is taken in respect of

maintenance of machineries ; proper store control, performance of purchase department and coordination between store and purchase department.

All the above factors responsible for controllable and avoidable idle time can be regulated in favour of increased production if every aspect is planned well ahead.

(ix) Casual Workers:

A worker who is employed on a temporary basis is known as casual worker. A casual worker is employed as a substitute of- a worker who is on leave or may be employed to perform a specific job for a short period of time. When casual worker is employed on production job, job card should be issued in his name and work done by him should be certified by the authority i.e. by the foreman or by the supervisor.

In the event casual workers are employed for miscellaneous indirect jobs, time sheets should be issued and a proper check on them should be kept. At the time of termination of service prior intimation to this effect should be sent to time keeping and wage departments so that no over-payment is made.

(x) Out Workers:

Out workers are sent to sites or customers' premises for performing work. A close control over the work performed and payment made to these workers is necessary. If the workers employed are few in number and for a short period of time, the record for their attendance may be kept by the foreman in charge.

When the number of such workers is large and the duration of work for which they have been deputed is long, clock system for recording their attendance may be installed.

MEANING AND DEFINITION OF WORK MEASUREMENT:

Work measurement is concerned with the determination of the amount of time required to perform a unit of work. Work measurement is very important for promoting productivity of an organization. It enables management to compare alternate methods and also to do initial staffing. Work measurement provides basis for proper planning.

Since it is concerned with the measurement of time it is also called 'Time Study'. The exact examination of time is very essential for correct pricing. To find the correct manufacturing time for a product, time study is performed. To give competitive quotations, estimation of accurate labour cost is very essential. It becomes a basis for wage and salary administration and devising incentive schemes.

Work measurement has been defined by British Standard Institution 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**". This time is called standard or allowed time. Time

study may also be defined as “**the art of observing and recording the time required to do each detailed element of an industrial operation**”.

OBJECTIVES OF WORK MEASUREMENT:

1. To compare the times of performance by alternative methods.
2. To enable realistic schedule of work to be prepared.
3. To arrive at a realistic and fair incentive scheme.
4. To analyse the activities for doing a job with the view to reduce or eliminate unnecessary jobs.
5. To minimise the human effort.
6. To assist in the organisation of labour by daily comparing the actual time with that of target time.

Uses of Work Measurement:

1. Work measurement is used in planning work and in drawing out schedules.
2. Work measurement is used to determine standard costs.
3. Work measurement is used as an aid in preparing budgets.
4. It is used in balancing production lines for new products.
5. Work measurement is used in determining machine effectiveness.
6. To determine time standards to be used as a basis for labour cost control.
7. To establish supervisory objectives and to provide a basis for measuring supervisory efficiency.
8. To determine time standards to be used for providing a basis for wage incentive plans.

Techniques of Work Measurement:

Work measurement is investigating and eliminating ineffective time. It not only reveals the existence of ineffective time. But it can be used to set standard times for carrying out the work so that ineffective time does not evolve later. It will be immediately found out by the increased standard time. For the purpose of work measurement, work may be regarded as repetitive work and non-repetitive work.

The principal techniques of work measurement are classified under the following heads:

1. Time Study
2. Work Sampling
3. Pre-determined Motion Time System
4. Analytical Estimating

Work sampling is the statistical technique for determining the proportion of time spent by workers in various defined categories of activity (e.g. setting up a machine, assembling two parts, idle...etc.). It is as important as all other statistical techniques because it permits quick analysis, recognition, and enhancement of job responsibilities, tasks, performance competencies, and organizational work flows. Other names used for it are 'activity sampling', 'occurrence sampling', and 'ratio delay study'.

In a work sampling study, a large number of observations are made of the workers over an extended period of time. For statistical accuracy, the observations must be taken at random times during the period of study, and the period must be representative of the types of activities performed by the subjects.

One important usage of the work sampling technique is the determination of the standard time for a manual manufacturing task. Similar techniques for calculating the standard time are time study, standard data, and predetermined motion time systems.

Characteristics of work sampling study

The study of work sampling has some general characteristics related to the work condition:

1. One of them is the sufficient time available to perform the study. A work sampling study usually requires a substantial period of time to complete. There must be enough time available (several weeks or more) to conduct the study.
2. Another characteristic is multiple workers. Work sampling is commonly used to study the activities of multiple workers rather than one worker.
3. The third characteristic is long cycle time. The job covered in the study has relatively a long cycle time.
4. The last condition is the non-repetitive work cycles. The work is not highly repetitive. The jobs consist of various tasks rather than a single repetitive task. However, it must be possible to classify the work activities into a distinct number of categories.

Steps in conducting a work sampling study

There are several recommended steps when starting to prepare a work sampling study:

1. Define the manufacturing tasks for which the standard time is to be determined.
2. Define the task elements. These are the defined broken-down steps of the task that will be observed during the study. Since a worker is going to be observed, additional categories will likely be included as well, such as "idle", "waiting for work", and "absent".
3. Design the study. This includes designing the forms that will be used to record the observations, determining how many observations will be required, deciding on the number

of days or shifts to be included in the study, scheduling the observations, and finally determining the number of observers needed.

4. Identify the observers who will do the sampling.
5. Start the study. All those who are affected by the study should be informed about it.
6. Make random visits to the plant and collect the observations.
7. After completing the study, analyze and present the results. This is done by preparing a report that summarizes and analyzes all data and making recommendations when required.

Determining the number of observations needed in work sampling

After the work elements are defined, the number of observations for the desired accuracy at the desired confidence level must be determined. The formula used in this method is:

standard error of proportion

percentage of idle time

percentage of working time

number of observations

Additional applications of work sampling

Work sampling was initially developed for determining time allocation among workers' tasks in manufacturing environments. However, the technique has also been applied more broadly to examine work in a number of different environments, such as healthcare and construction. More recently, in the academic fields of organizational psychology and organizational behaviour, the basic technique has been developed into a detailed job analysis method for examining a range of different research questions.

INDUSTRIAL SAFETY

Industrial safety in the context of occupational safety and health refers to the management of all operations and events within an industry, for protecting its employees and assets by minimizing hazards, risks, accidents and near misses. The relevant laws, compliance and best practices in the industry have most of the issues addressed for the best protection possible. Employers are to make sure that these are strictly adhered to to have maximum safety.

Industrial safety covers a number of issues and topics affecting safety of personnel and equipment in a particular industry. The following topics are generally discussed:

1. General Safety - General aspects of safety which are common to all
2. Occupational Safety and Health - Particularly associated with the occupation
3. Process and Production Safety - Safety in the process and production etc.

4. Material Safety - Safety of the materials used in the production
5. Workplace Safety - Safety issues directly related to the workplace
6. Fire Safety - Fire safety, in particular the risks associated to the industry
7. Electrical Safety - In general and in particular, arising from the equipment used
8. Building and Structural Safety - Safety in general including installations as per existing building code
9. Environmental Safety - Issues of environmental safety (direct or indirect impact of the industry)