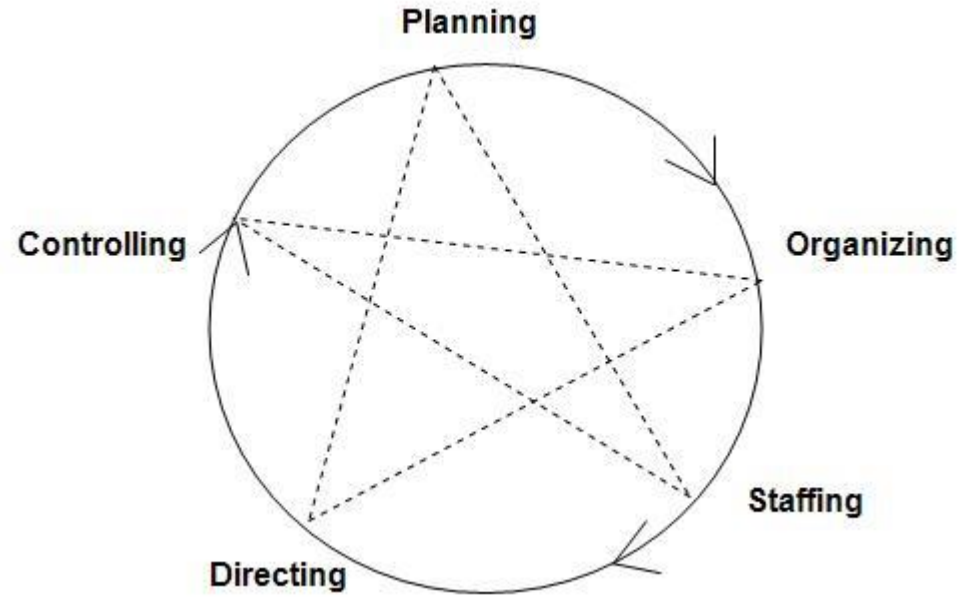
Unit 1

Concepts of Management and Organization:

Functions of Management: Management has been described as a social process involving responsibility for economical and effective planning & regulation of operation of an enterprise in the fulfillment of given purposes. It is a dynamic process consisting of various elements and activities. These activities are different from operative functions like marketing, finance, purchase etc. Rather these activities are common to each and every manger irrespective of his level or status. According to Henry Fayol, "To manage is to forecast and plan, to organize, to command, & to control". Whereas Luther Gullick has given a keyword '**POSDCORB**' where P stands for Planning, O for Organizing, S for Staffing, D for Directing, Co for Co-ordination, R for reporting & B for Budgeting. But the most widely accepted are functions of management given by KOONTZ and O'DONNEL i.e. **Planning**, **Organizing**, **Staffing**, **Directing** and **Controlling**.

For theoretical purposes, it may be convenient to separate the function of management but practically these functions are overlapping in nature i.e. they are highly inseparable. Each function blends into the other & each affects the performance of others.



Planning

It is the basic function of management. It deals with chalking out a future course of action & deciding in advance the most appropriate course of actions for achievement of pre-determined goals. According to KOONTZ, "Planning is deciding in advance - what to do, when to do & how to do. It bridges the gap from where we are & where we want to be". A plan is a future course of actions. It is an exercise in problem solving & decision making. Planning is determination of courses of action to achieve desired goals. Thus, planning is a systematic thinking about ways & means for accomplishment of pre-determined goals. Planning is necessary to ensure proper utilization of human & non-

human resources. It is all pervasive, it is an intellectual activity and it also helps in avoiding confusion, uncertainties, risks, wastages etc.

Organizing

It is the process of bringing together physical, financial and human resources and developing productive relationship amongst them for achievement of organizational goals. According to Henry Fayol, "To organize a business is to provide it with everything useful or its functioning i.e. raw material, tools, capital and personnel's". To organize a business involves determining & providing human and non-human resources to the organizational structure. Organizing as a process involves:

- Identification of activities.
- Classification of grouping of activities.
- Assignment of duties.
- Delegation of authority and creation of responsibility.
- Coordinating authority and responsibility relationships.

Staffing

It is the function of manning the organization structure and keeping it manned. Staffing has assumed greater importance in the recent years due to advancement of technology, increase in size of business, complexity of human behavior etc. The main purpose o staffing is to put right man on right job i.e. square pegs in square holes and round pegs in round holes. According to Kootz & O'Donell, "Managerial function of staffing involves manning the organization structure through proper and effective selection, appraisal & development of personnel to fill the roles designed un the structure". Staffing involves:

- Manpower Planning (estimating man power in terms of searching, choose the person and giving the right place).
- Recruitment, Selection & Placement.
- Training & Development.
- Remuneration.
- Performance Appraisal.
- Promotions & Transfer.

Directing

It is that part of managerial function which actuates the organizational methods to work efficiently for achievement of organizational purposes. It is considered life-spark of the enterprise which sets it in motion the action of people because planning, organizing and staffing are the mere preparations for doing the work. Direction is that inert-personnel aspect of management which deals directly with influencing, guiding, supervising, motivating sub-ordinate for the achievement of organizational goals. Direction has following elements:

- Supervision
- Motivation

- Leadership
- Communication

Supervision- implies overseeing the work of subordinates by their superiors. It is the act of watching & directing work & workers.

Motivation- means inspiring, stimulating or encouraging the sub-ordinates with zeal to work. Positive, negative, monetary, non-monetary incentives may be used for this purpose.

Leadership- may be defined as a process by which manager guides and influences the work of subordinates in desired direction.

Communications- is the process of passing information, experience, opinion etc from one person to another. It is a bridge of understanding.

Controlling

It implies measurement of accomplishment against the standards and correction of deviation if any to ensure achievement of organizational goals. The purpose of controlling is to ensure that everything occurs in conformities with the standards. An efficient system of control helps to predict deviations before they actually occur. According to *Theo Haimann*, "Controlling is the process of checking whether or not proper progress is being made towards the objectives and goals and acting if necessary, to correct any deviation". According to Koontz & O'Donell "Controlling is the measurement & correction of performance activities of subordinates in order to make sure that the enterprise objectives and plans desired to obtain them as being accomplished". Therefore controlling has following steps:

a. Establishment of standard performance.
b. Measurement of actual performance.
c. Comparison of actual performance with the standards and finding out deviation if any.
d. Corrective action.

EVOLUTION OF MANAGEMENT THOUGHT

The practice of management is as old as human civilization. The ancient civilizations of Egypt (the great pyramids), Greece (leadership and war tactics of Alexander the great) and Rome displayed the marvelous results of good management practices.

The origin of management as a discipline was developed in the late 19^{th} century. Over time, management thinkers have sought ways to organize and classify the voluminous information about management that has been collected and disseminated. These attempts at classification have resulted in the identification of management approaches. The approaches of management are theoretical frameworks for the study of management. Each of the approaches of management

are based on somewhat different assumptions about human beings and the organizations for which they work.

Taylor's Scientific Management

Frederick Winslow Taylor well-known as the founder of scientific management was the first to recognize and emphasis the need for adopting a scientific approach to the task of managing an enterprise. He tried to diagnose the causes of low efficiency in industry and came to the conclusion that much of waste and inefficiency is due to the lack of order and system in the methods of management. He found that the management was usually ignorant of the amount of work that could be done by a worker in a day as also the best method of doing the job. As a result, it remained largely at the mercy of the workers who deliberately shirked work. He therefore, suggested that those responsible for management should adopt a scientific approach in their work, and make use of "scientific method" for achieving higher efficiency. The scientific method consists essentially of

Observation

Measurement

Experimentation and

Inference.

Henry Fayol's 14 Principles of Management:

The principles of management are given below:

Division of work: Division of work or specialization alone can give maximum productivity and efficiency. Both technical and managerial activities can be performed in the best manner only through division of labour and specialization.

Authority and Responsibility: The right to give order is called authority. The obligation to accomplish is called responsibility. Authority and Responsibility are the two sides of the management coin. They exist together. They are complementary and mutually interdependent.

Discipline: The objectives, rules and regulations, the policies and procedures must be honoured by each member of an organization. There must be clear and fair agreement on the rules and objectives, on the policies and procedures. There must be penalties (punishment) for non-obedience or indiscipline. No organization can work smoothly without discipline - preferably voluntary discipline.

Unity of Command: In order to avoid any possible confusion and conflict, each member of an organization must received orders and instructions only from one superior (boss).

Unity of Direction: All members of an organization must work together to accomplish common objectives.

Emphasis on Subordination of Personal Interest to General or Common Interest: This is also called principle of co-operation. Each shall work for all and all for each. General or common interest must be supreme in any joint enterprise.

Remuneration: Fair pay with non-financial rewards can act as the best incentive or motivator for good performance. Exploitation of employees in any manner must be eliminated. Sound scheme of remuneration includes adequate financial and nonfinancial incentives.

Centralization: There must be a good balance between centralization and decentralization of authority and power. Extreme centralization and decentralization must be avoided.

Scalar Chain: The unity of command brings about a chain or hierarchy of command linking all members of the organization from the top to the bottom. Scalar denotes steps.

Order: Fayol suggested that there is a place for everything. Order or system alone can create a sound organization and efficient management.

Equity: An organization consists of a group of people involved in joint effort. Hence, equity (i.e., justice) must be there. Without equity, we cannot have sustained and adequate joint collaboration.

Stability of Tenure: A person needs time to adjust himself with the new work and demonstrate efficiency in due course. Hence, employees and managers must have job security. Security of income and employment is a pre-requisite of sound organization and management.

Esprit of Co-operation: Esprit de corps is the foundation of a sound organization. Union is strength. But unity demands co-operation. Pride, loyalty and sense of belonging are responsible for good performance.

Initiative: Creative thinking and capacity to take initiative can give us sound managerial planning and execution of predetermined plans.

Espirit de corps: This means team work; implying that there is unity in strength.

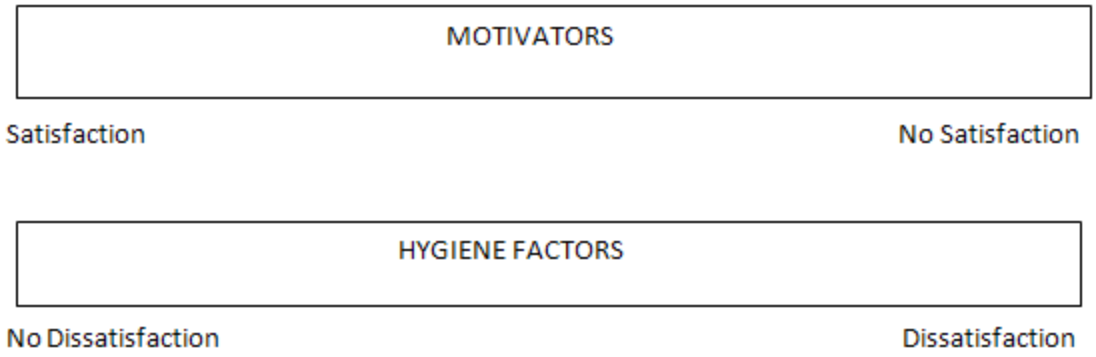
Douglas McGregor:
J Douglas McGregor presented two sets of assumptions managers make about the nature of their employees, these sets are named as theory X and theory Y.
Under theory X, it is assumed that
1. Employees are inherently lazy.
2. They require constant guidance and support
3. Sometimes they require even coercion and control
4. Given an opportunity, they would like to avoid 'responsibility
5. They do not show up any ambition but always seek security

To explain theory X, McGregor elaborated Taylor's observations about workers using the rule of thumb approach.

Theory Y focuses a .totally different set of assumptions about the employees. Theory Y states that
1. Some employees consider work as natural as play or rest
2. These employees are capable of directing and controlling performance on their own.
3. They are much committed to the objectives of the organisation
4. Higher rewards make these employees more committed to organisation
5. Given an opportunity, they not only accept responsibility but also look for opportunities to outer form others
6. most of them are highly imaginative, creative, and display ingenuity in handling organisational issues

Herzberg's Two-Factor Theory of Motivation

Herzberg developed a two-factor theory of motivation-hygiene factors (also called dissatisfiers) and motivators.



Hygiene factors are the basic requirements such as company policies and procedures, salary, security, supervision, working conditions, personal and social life, and so on. If these are provided, it may not lead to happiness. But if these are not provided, it may lead to unhappiness. In other words, hygiene factors do not motivate. These set minimum criteria for normal functioning of the organisation. If these are provided, people can work in the organisation in the normal way. But if these are not provided, it results in dissatisfaction. The other set comprising motivators refers to the higher order needs such as-recognition on the job front, awards and rewards, challenging assignments, promotion, and so forth. All these needs are built around the nature and content. if the job. Where these, at least a few, are taken care of, it leads to satisfaction. If not, it may not result in satisfaction. But it does not definitely end up in dissatisfaction.

Maslow's Hierarchy of Needs Theory:

1. **Physiological needs-** These are the basic needs of air, water, food, clothing and shelter. In other words, physiological needs are the needs for basic amenities of life.

2. **Safety needs-** Safety needs include physical, environmental and emotional safety and protection. For instance- Job security, financial security, protection from animals, family security, health security, etc.
3. **Social needs-** Social needs include the need for love, affection, care, belongingness, and friendship.
4. **Esteem needs-** Esteem needs are of two types: internal esteem needs (self- respect, confidence, competence, achievement and freedom) and external esteem needs (recognition, power, status, attention and admiration).
5. **Self-actualization need-** This include the urge to become what you are capable of becoming / what you have the potential to become. It includes the need for growth and self-contentment. It also includes desire for gaining more knowledge, social- service, creativity and being aesthetic. The self- actualization needs are never fully satiable. As an individual grows psychologically, opportunities keep cropping up to continue growing.

Designing organisational structures

Organization and Organising Very often, these terms are used interchangeably, which is not correct. Organization is different from organising. Organising is one of the functions of management whereas organization ", refers to the institution wherein the management functions are performed. Organising is the means to achieve the plans. If planning involves making a road map for the chosen destination, then organising is the means by which you reach your chosen destination. Organising is a process of

- Determining, grouping, and structuring the activities.
- creating roles for effective performance at work
- allocating necessary authority and responsibility for results
- Determining detailed procedures and systems for different problem areas such as coordination. Communication, decision-making, motivation, conflict resolution, and so on.

BASIC CONCEPTS RELATED TO ORGANISATION

The following concepts provide an insight into the functioning of organizations:

Organizational Hierarchy: The hierarchy in a business refers to the layers of management from the top management down to managers or supervisors of the lowest rank. In small businesses, usually, there are few layers of hierarchy. For instance, in sole trader type of organization, the owner makes and implements all decisions. He acts as both the manager and the worker. The top

management comprises directors or chief executive. It is concerned with formulating strategic, long term plans, and policy decisions within the organization. It is the responsibility of the top management to ensure that the subordinates implement these plans and decisions. A clear chain of command runs from the top level to the lowest level, through each department, in the organization. Orders pass through this chain of command. The data required for certain decisions such as sales, revenues, output, staff turnover, and the like is forwarded to the top management through periodical reports. .. Employees in a hierarchy have varying degrees of authority. Higher levels in the hierarchy are characterized by higher responsibility and authority. Managers need to have authority over their subordinates in order to implement decisions and policies. They have to direct their staff regarding what to do and what is expected of them.

Authority and Responsibility: Authority is the power to give commands and to use discretion vested in that particular position or job. If the person is removed from the job, he or she loses the authority. Responsibility is the obligation on the part of the subordinate to complete the given job. If a manager has only authority, he may misuse it. As a control measure, the employee is held responsible for the results also. Authority can be transferred to lower positions but not responsibility. The authority and responsibility should always be commensurate and coexistent with each other. Otherwise, the performance of the managers goes unchecked. Where the authority exceeds responsibility, it may lead to misutilization of authority. The manager can get away with it. On the contrary, where the responsibility exceeds authority, the manager feels frustrated. It is because he is held responsible for more tasks. The authority delegated to him is not in proportion to the responsibility. He has no adequate authority to get the tasks completed.

Delegation of Authority The process of transferring authority from the top to the lower levels in the organization is called delegation. Although a task may be delegated or passed down the chain of command from a manager to a subordinate, the manager continues to be responsible for making sure that his/her instructions are carried out. The organization is said to be centralized when the authority to take decisions is held by the corporate office. If the authority is delegated to the regional offices, then the organization is said to be decentralized.

TYPES OF ORGANISATION:

An organization can be classified on the basis of authority relationships or on the basis of its departments. The types of organisation based on authority relationships are: (a) Line organisation, (b) Line and staff organisation, (c) Functional organisation, (d) Committee organisation, and (e) Matrix organisation. The organisation can also be divided into the following groups based on its activities or departments: (a) Functional organisation, (b) Product organisation, (c) Regional or geographical organisation, (d) Customer organisation, (e) Committee organisation, and (f) Matrix organisation. This classification is more or less need based. In other words, there is no standard list of the types of organisation.

Line organization: Line organisation is also called military or scalar organisation. It is said to be the oldest and most traditional type of organisation, which is widely used even today. This is called line organisation because managers in this organisation have direct responsibility for the results. Based on authority relationships, a line organization structure can be drawn as shown in Figure 5.3. Consider this example. An engineer, setting up a consultancy, employs a few young graduate engineers and draughts men to prepare designs and drawings, plans, and specifications. The line organisation is the most suitable in this case

Line and staff organisation: This concept is drawn from earlier civilizations and armies. In this organization, we have both the line managers and the staff managers. Staff managers support the functions of the line managers. The word 'staff' means a stick for support. The staffs managers are specially appointed to give advice, suggest, or assist the line managers in their day to day matters. The line manager may require legal up- dates and counseling, and for this process, he is provided with a competent specialist who can offer valuable suggestions in the matters of policy-making and providing the latest rules and regulations on a given issue. The line managers can take the support of their staff managers to get a full view of the issue under consideration.

Functional organization: FW Taylor suggested functional organization in his theory of scientific management in support of his 'one best way' of doing things. Taylor observed that one single foreman was overburdened with all the operations such as task setting, time recording, quality inspection, disciplinary jobs and so on. He divided this job into eight functional fore men four dealing with the planning task and four dealing with the implementation task. In other words, the planning and implementation tasks are divided to ensure the division of labour.

Committee organization: A committee is formed when two or more persons are appointed to work as a team to arrive at a decision on the matters referred to it. It is intended to utilize the knowledge, skills, and experiences of all the concerned parties. Particularly, in large organizations, problems are too big to be handled by one single expert. Here, the finance committee is responsible for executive council directly.

Matrix Organization: This is also called project organization. It is a combination of all relationships in the organization-vertical, horizontal and diagonal. It is mostly used in complex projects. It provides a high degree of operational freedom, flexibility and adaptability for both the line and the staff managers in performing their respective roles. The main objective of matrix organization is to secure a higher degree of coordination than what is possible from conventional methods.

Virtual Organization: Virtual organizations facilitate competitiveness particularly when these organisations are part of the global economy. Here, there can be alliances and partnerships with other organizations almost all over world. It is a flexible Organisation structure that removes the traditional boundaries. It allows easy reassignment and reallocation of resources to take quick advantage of shifting opportunities in global markets. To avoid disintegration and to attain the

effective needed focus, the lead virtual organisations must have a shared vision, strong brand and high trust culture.

Cellular Organization: Organisation structured around the units/cells that complete the entire assembly processes are called cellular' organisations. In the modem organizations, cellular Organisations have been replacing the continuous line or linear production process systems. In cellular organisations, workers manufacture total product or subassemblies in teams (cells). Every team (cell) of workers has the responsibility to improve or maintain the quality and quantity of its products. Each team is free to reorganize itself to improve performance and product quality. These cells comprise self- managed teams. They monitor themselves and also correct where necessary on their own. Cellular Organisations are characterized by much smaller staff all over the Organisation with middle management positions reduced and lean management members at the top. It is both a lean and flat structure.

Team Structure: A structure in 'which the entire organisation is made up of work groups or teams is known as team structure. Team structures are both permanent and also temporary in nature as situation demands. Traditional Organisations are characterized by vertical structures and modern Organisations are identified by the horizontal i.e., team structures. 'We report to each other' is the main feature of team structure. It leads to boundary less Organization in a borderless world. In team structures, we find cross functional teams meant for improving lateral relations, solving problems, completing special projects and accomplishing routine tasks. A cross functional team comprises members from different functional departments such as marketing, finance, HR, production etc. Project teams are convened for a particular task or project and these get dissolved once task is completed. The intention here is to quickly bring together the people with the needed talents and focus their efforts intensely to solve a problem or take advantage of a special opportunity. Here-employees are more involved and empowered because of reduced barriers among functional areas. Sometimes, when there is pressure is on teams to perform.

Boundaryless Organisation: As the name indicates, a boundaryless Organisation eliminates internal boundaries among subsystems and external boundaries with external environment. It is a combination of team and network structures with the addition of temporariness. Such type of Organisation structure is characterized by spontaneous team work and communication; this replaces formal chain of command. It is a dynamic Organisation structure wherein organisational needs are met through a judicious mix of outsourcing contracts and alliances as and when needed. The key features of boundary less Organisation include knowledge sharing, absence of hierarchy and bureaucracy, empowerment voluntary participation of expert members, technology utilization and temporariness. The focus is on mustering necessary talent and competencies required for the achievement of a task: without any bureaucratic restrictions. Creativity, quality, timeliness, increase in speed and flexibility are the benefits the boundary less Organisation yields. It also reduces inefficiencies. The boundary less organisations is highly flexible and responsive. These draw on talent wherever it is found. Sometimes, they are ineffective due to problems in communication.

Inverted Pyramid: This is an alternative to the traditional chain of command. This is a structure which is narrow at the top and wide at the base. It includes a few levels of management. For instance, sales people and sales support staff sit on the top as the key decision makers for all the issues related to sales and dealing with the customers. Since the sales staffs are in touch with the customer and aware of the requirements of the customers, they are given all the freedom to follow their own best judgment at all levels.

Lean Organisation: A lean organization is committed to its customers and works to minimize waste by focusing all of its resources on producing the best possible value for customers. Investments are carefully considered and only made when it is clear that a long-term financial advantage exists in doing so. Fluff is cut away until all that is left are departments and employees who directly affect the finished product. Any organization can be made lean as long as the organization's mission remains in clear focus

Flat Organizational Structure: Many small companies use a flat organizational structure, where very few levels of management separate executives from analysts, secretaries and lower-level employees. Flat organizations work best when a company has less than 20 employees, especially if the company employs one or two employees per department. One advantage of using a flat organizational structure for management is that decisions can be made relatively quickly. The flat organizational lacks the typical bureaucracy of taller organizational structures--those with many levels of management.

UNIT 2

Plant Location

Plant location is a strategic decision. Several factors influence this decision: The main objective of any business is to optimize its costs and revenues, that is, minimize its costs and maximize its returns. The plant should be located in such a place where the large-scale economics accrue. Optimum size and optimum location go hand in hand. It should not be-mistaken that a plant will get maximum benefit if the raw materials. labour and other factors cost the lowest. It is necessary that all the factors governing plant location are optimized. To ensure a balanced development of all the regions, every state announces an incentive package to attract new industry. It assures, from time to time, special infrastructure facilities such as continuous water and power supply, and so on, and announces financial .incentives like subsidies, tax rebate, tax holiday, and other concessions. These are provided to all such units located in a developing area. At times, this offer from the government may be very lucrative from the point of view of subsidy and other incentives. Plant location is more a corporate decision than an engineering one. Other reasons for locating plants at specific sites can be governed by personal considerations. Usually, the promoters of the plant want to locate the unit in the places of their interest such as native place, and so forth. However an entrepreneur has to necessarily understand the different factors that influence the location of a plant and their relative merits and demerits. This will facilitate a balanced and careful decision. Such a significant decision should not be carried out by flimsy factors such as likes and dislikes.

Factors affecting plant location

1. Closeness to raw materials : Normally the proportion of the cost of raw material to the cost of 'production is significant for every product, If the plant is located close to the supply points of the raw material, the cost of procurement can be minimized, particularly if the raw material is fragile, Perishable, bulky, or heavy. For this reason the rice mills are located close to the paddy fields. This will save a good amount of transportation costs. If the raw material is an imported one, it is better to locate the plant close to the ports. The location should be such that the supply of raw material should be continuous and uninterrupted. There are cases where industries obtain raw material at less than the market price because of the financial linkages such as financing the agricultural activities during season. ITC Agro-tech finances the agricultural operations of the farmers and procures the sunflower seeds at leS5than the market price to manufacture sunflower oil. Here, raw materials include both primary and secondary material, inputs. The unavailability of raw materials generally differs from place to place. However, m View of efficient methods of transportation, plants consider raw material factor less significance, Also, if the plant is very large in size, it may not depend upon one source of raw material.
2. Nearness to the markets: If the plant is located close to the markets, the cost of transportation can be minimized. This also helps the producers to have direct knowledge

of the requirements of the Customers t he knowledge about the profiles of customer segments enables the plant to mould its sates strategies accordingly. The customer profile can be described in terms of age, sex, distribution of customers over given geographical area, number of households, size of households, extent of mobility, occupational pattern, income characteristics, consumption pattern, and so on.

3. Fuel and power. The power sector has advanced so much in terms of technology that this ceases to be a vital factor affecting location decisions. Almost every rural area is well connected by power lines, and thus, power supply is not u problem at all. The real problem is the continuous supply of power. Without any wide fluctuations m voltage. In view of the diesel and electric power, industries' can be located all over. However, if the factor, is dependent on a particular fuel, its better to locate the plant close to its availability. For instance, if the factory is coal-based, the plant is better located near coal mines.
4. Transport: Though per unit cost of transportation looks insignificant, the total transportation cost the company incurs is sizeable. Water transport continues to be the cheapest or lowest in terms of costs, this is the reason why the seaport cities grew more industrial in the past. In recent times because of technological advances, the transportation time is reduced and timely delivery is also guaranteed and defectively monitored. However, this continues to be a crucial factor in a vast country like India. To ensure that the products reach every nook and comer of the country, it is advantageous to locate the plant at such a place, which is well connected by different modes of transport.
5. Availability of labour: Labour is mobile. Hence, the location decisions are not significantly affected by the availability of unskilled labour. Availability of skilled labour in an area would depend on the educational facilities, current level of employment, and the wage rate in the area. It is also true to say that the industries, the more are the educational facilities around. For instance, India, in general, and Bangalore and Hyderabad, in particular, made a niche market for software talent all over the world. This is the main reason why must of the software firms are located in these cities though knowledge firms, prima facie, need not be bound by such factors.
6. Agglomeration economies: If the plant is located in an industrial area, it is likely that it can avail certain special benefits, this result in cost savings, which accrue to a firm as a result of expansion and concentration of industries in a region. As a result, the plant enjoys economies both internal and external.
7. Natural and climatic factors: In some cases, location of industry is simply the result of certain natural factors. Shipbuilding is located in Visakhapatnam and Mazgaon Docks in Bombay as these are deeper harbors, besides having well-developed markets for labour, raw material and machinery in its neighborhood.
8. Government influence: As already noted, the Government has its own strategy for a balanced regional development. To encourage the entrepreneurs in locating their plants in the backward and less developed areas, it announces fiscal and other incentives from time

to time. It may withdraw the incentives, once it is satisfied that a particular area has reached an optimum stage of development in terms of industries.

9. Political interference: this applies more in case of location of public enterprises. Many a time, political considerations override the economic rationale in assigning an industry to a particular location.
10. Other considerations: These include pollution levels of an. area and the safety factor. These days, environmental hazards and pollution levels are given serious thought in location decisions; Government has also notified certain areas as hazard-prone or pollution-affected. License can be procured only when the industrial units are located in places far from human habitation**.**

PLANT LAYOUT

Plant layout can be defined as the process of determining a spatial location for a collection of physical production facilities suitable to manufacture a product or provide a service. It is concerned with arranging

1. The manufacturing and servicing departments in the factory site

2. The machinery within these departments

3. The layout of individual work places

Before the production facilities are set up, it is necessary to study how best the plant layout can be arranged to minimize the bottlenecks in the production process

Types of Plant Layout
The following are the popular types of plant layout:

(1) Process layout (2) Product layout (3) Combined layout (4) Static product layout or Project layout (5) Cellular layout (6) Job Shop layout. Each layout is explained in brief in the following paragraphs:

Process layout: It is also called functional layout. All machines performing similar type of operations are grouped at one location in the process layout e.g. all lathes, milling machines, cutting machines etc in the engineering shop will be clustered in their like groups. Thus all forging will be done in one area and all the lathes will be placed in another area. In this layout, several products may share a machine to make its full use. The sequential arrangement of the machine group is generally, but not necessarily made on the basis of labor operations. In this type of layout the process rather than the product has a dominating role. The product is given secondary consideration and is moved for the purpose of operations to the process section with like machines stationed at a particular point. This type of process is more suitable to job order type of production. In such production the operation differs from product to product. So, it is desirable to arrange the machines on the basis of process rather than on the products.

Product layout: In this type of layout, the machines are arranged in the sequence as required by the particular product. All machines as required to balance the particular product the product line layout. In this layout, one product goes through all the machines lined up, in the order required by its manufacture. The best known example of this type of layout is seen in motor car production. To make this layout successful, the work load on the various machines must be balanced. The process of getting even loading at each stage of production is called line balancing.

Fixed Position Layout: This type of layout is the least important for today's manufacturing industries. In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment's are brought to this location. The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment's to work place along with the man power. This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.

Combination Type of Layout: Now days in pure state any one form of layouts discussed above is rarely found. Therefore, generally the layouts used in industries are the compromise of the above mentioned layouts. Every layout has got certain advantages and limitations. Therefore, industries would to like use any type of layout as such. Flexibility is a very important factory, so layout should be such which can be molded according to the requirements of industry, without much investment. If the good features of all types of layouts are connected, a compromise solution can be obtained which will be more economical and flexible.

WORK STUDY

Definition: Work study may be defined as the analysis of a job for the purpose of finding the preferred method of doing it and also determining the standard time to perform it by the preferred (or given) method. Work study, therefore, comprises of two areas of study: method study (motion study) and time study (work measurement).

In order to understand the role of work study, we need to understand the role of method study and that of time study.

Method study (also sometimes called Work Method Design) is mostly used to improve the method of doing work. It is equally applicable to new jobs. When applied to existing jobs and existing jobs, method study aims to find better methods of doing the jobs that are economical and

safe, require less human effort, and need shorter make-ready / put-away time. The better method involves the optimum use of best materials and appropriate manpower so that work is performed in well organized manner leading to increased resource utilization, better quality and lower costs.

It can therefore be stated that through method study we have a systematic way of developing human resource effectiveness, providing high machine and equipment utilization, and making economical use of materials.

Time study, on the other hand, provides the standard time, that is the time needed by worker to complete a job by the standard method. Standard times for different jobs are necessary for proper estimation of

- manpower, machinery and equipment requirements
- daily, weekly or monthly requirement of materials
- production cost per unit as an input to better make or buy decision
- labor budgets
- Worker's efficiency and make incentive wage payments.

Information Recording Techniques:

There are three main types of information recording techniques. These are

• Process Charts

• Diagrams

• Templates

A **Process Chart** is a graphic means of representing the activities that occur during a manufacturing or servicing job.There are several types of process charts. These can be divided into two groups.

Those which are used to record a process sequence (i.e. series of events in the order in which they occur) but do not depict the events to time scale. Charts falling in this group are

• Operation process chart

• Flow process chart – (man / material / equipment type)

• Operator chart (also called Two Handed Process Chart)

Those which record events in the sequence in which they occur on a time scale so that the interaction of related events can be more easily studied. Charts falling in this group are

• Multiple activity charts

- Simo chart

Diagrams: A diagram gives pictorial view of the layout of workplace or floor on which locations of different equipment, machines, etc. are indicated. The movement of subject (man or material) is then indicated on the diagram by a line or a string. The diagrams are valuable in highlighting the movement so that analyst can take steps to simplify or reduce it and thus effect saving in time or reduction in collisions / accidents.

Two types of diagrams are common: Flow diagram and string diagram.

Templates and 3-D models:

Two-dimensional cut outs made from thin card sheet representing machinery, furniture, etc. can be used for developing new layouts and methods. The templates may have pieces of permanent magnet attached to them, so that when used on iron board; they remain glued on the board whenever placed.

A scaled 3-D model of a working area helps easy understanding of lighting, ventilation, maintenance and safety aspects that may be important in a method. Such models are often of great value in demonstrating the advantages of the proposed changes to all concerned. However, their use is limited because of higher cost involved. Some computer software's are available which help in constructing the layout and possibility of visualizing the working of process in a systematic way. Before taking up descriptions of these charts or diagrams, it is necessary to know the various elements of work.

Elements of Work:

There are five basic elements of work: Operation, Inspection, Transportation, Delay, and storage. Table gives the definitions and symbols by which these elements are represented. Also given in the Table are examples of each element. Sometimes, more than one element occur simultaneously. It is shown as combined element with combined symbol. Examples are "Operation in combination will inspection", and "Inspection in combination with Transportation".

Operation Process Chart:

An operation process chart provides the chronological sequence of all operations and inspections that occur in a manufacturing or business process. It also shows materials used and the time taken by operator for different elements of work. Generally a process chart is made for full assembly, that is, it shows all the operations and inspections that occur from the arrival of raw material to the packaging of the finished product.

Flow Process Chart:

A flow process chart is used for recording greater detail than is possible in an operation process chart. It is made for each component of an assembly rather than for the whole assembly. A flow

process chart shows a complete process in terms of all the elements of work. There are two main types of flow charts: product or material type, and the operator type . The product type records the details of the events that occur to a product or material, while the operator flow chart details how a person performs an operational sequence. An important and valuable feature of this chart is its recording of non-productive hidden costs, such as delays, temporary storages, unnecessary inspections, and unnecessary long distances traveled. When the time spent on these non productive activities is highlighted, analyst can take steps to minimize it and thus reduce costs.

Operator Process Chart :

It is also called Left Hand – Right Hand chart and shows the activities of hands of the operator while performing a task. It uses four elements of hand work: Operation, Delay (Wait), Move and Hold. Its main advantage lies in highlighting un-productive elements such as unnecessary delay and hold so that analyst can take measures to eliminate or shorten them.

Multiple Activity Chart:

Worker-Machine process chart and gang process chart fall in the category of multiple activity charts. A worker-machine chart is used for recording and analyzing the working relationship between operator and machine on which he works. It is drawn to time scale. Analysis of the chart can help in better utilization of both worker and machine time. The possibility of one worker attending more than one machine is also sought from the use of this chart. A gang process chart is similar to worker-machine chart, and is used when several workers operate one machine. The chart helps in exploring the possibility of reducing both the operator time and idle machine time.

Simo Chart:

A Simo chart is another Left-Hand Right-Hand chart with the difference that it is drawn to time scale and in terms of basic motions called therbligs. It is used when the work cycle is highly repetitive and of very short duration.

Work Measurement

Work measurement refers to the estimation of standard time for an activity, that is the time allowed for completing one piece of job by using the prescribed method. Standard time can be defined as the time taken by an average experienced worker for the job with provisions for delays beyond the worker's control.

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

Applications:

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

• Estimating material, machinery, and equipment requirements.

• Estimating production cost per unit as an input to

- Preparation of budgets
- Determination of selling price
- Make or buy decision

• Estimating manpower requirements.

• Estimating delivery schedules and planning the work

• Balancing the work of operators working in a group.

• Estimating performance of workers and using that as the basis for incentive payment to those direct and in director labor that show greater productivity.

We will study some of the popular techniques of work measurement.

TIME STUDY: It is the most versatile and the most widely used technique of work measurement.

Definition:

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

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

Time Study Procedure:

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

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

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

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

Step 4: Record information about the standard method, operation, operator, product, equipment, and conditions on the Time Study observation sheet.

Step 5: Divide the operation into reasonably small elements, and record them on the Time Study observation sheet.

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

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

Step 8: Calculate the representative watch time for each element of operation. Multiply it by the rating factor to get normal time.

Normal time = Observed time * rating factor

Calculate the normal time for the whole operation by adding the normal time of its various elements.

Step 9: Determine allowances for fatigue and various delays.

Step 10: Determine standard time of operation.

Standard time = Normal time + allowances.

Work Sampling

Work Sampling (also sometimes called ratio delay study) is a technique of getting facts about utilization of machines or human beings through a large number of instantaneous observations taken at random time intervals. The ratio of observations of a given activity to the total observations approximates the percentage of time that the process is in that state of activity. For example, if 500 instantaneous observations taken at random intervals over a few weeks show that a lathe operator was doing productive work in 365 observations and in the remaining 135 observations he was found 'idle' for miscellaneous reasons, then it can be reliably taken that the operator remains idle (135/500) x 100 = 27 % 0f the time. Obviously, the accuracy of the result depends on the number of observations. However, in most applications there is usually a limit beyond which greater accuracy of data is not economically worthwhile.

Unit 3

Materials management

Materials management plays a very significant role in controlling the costs and reducing the wastage, particularly, in a manufacturing industry. It is, most often, observed that around 60-70 per cent of the price we pay for goods and services is towards the cost of materials. The rest is accounted for wages, salaries, overheads, and profits. This means that the material costs form a significant portion of the total cost. It needs to be closely monitored in terms of assessment of requirements, procurement, and issue of materials. Unless this is ensured, **it** will result in excessive costs of materials, which further leads to increased cost of production.

Materials are a broad term, which includes inventory and stores. Inventory refers to all the idle physical stocks, which have economic value. In other words, inventory covers the items in stores, in addition to the materials .in transit and materials in process. Stores include materials, supplies, and finished goods not required immediately for use or dispatch to customers. .

Inventory:

It defined as a comprehensive list of movable items which are required for manufacturing the products and to maintain the plant facilities in working conditions.

Inventory Control: The systematic location, storage and recording of goods in such a way the desired degree of service can be made to the operating shops at minimum ultimate cost.

Objectives of Inventory Control:

1. To support the production departments with materials of the right quality in the right quantity, at the right time and the right price, and from the right supplier
2. To minimize investments in the materials by ensuring economies of storage and ordering costs
3. To avoid accumulation of work in process
4. To ensure economy of costs by processing economic order quantities
5. To maintain adequate inventories at the required sales outlets to meet the market needs promptly, thus avoiding both excessive stocks and shortages at any given time
6. To contribute directly to the overall profitability of the enterprise

Functions of inventory control:

- To develop policies, plans and standards essential to achieve the objectives.
- To build up a logical and workable plan of organization for doing the job satisfactory.
- To develop procedure and methods that will produce the desired results economically.
- To provide the necessary physical facilities.
- To maintain overall control by checking results and taking corrective actions.

ABC Analysis:

ABC analysis is a technique of controlling inventories based on their value and quantities. It is more remembered as an analysis for ‘Always Better Control’ of inventory. Here all items of the inventory are listed in the order of descending values, showing quantity held and their corresponding value.

Then, the inventory is divided into three categories A, B and C based on their respective values.

A – Refers to high value item

B – Refers to medium value item
C – Refers to low value item
A category comprises of inventory, which is very costly and valuable. Normally 70% of the funds are tied up in such costly stocks, which would be around 10% of the total volume of stocks. Because the stocks in this category are very costly, these require strict monitoring on a day-to-day basis.
B category comprises of inventory, which is less costly. Twenty percent of the funds are tied up in such stocks and these accounts for over 20% of the volume of stocks. These items require monitoring on a weekly or fortnightly basis
C category consists of such stocks, which are of least cost. Volume wise, they form 70% of the total stocks but value-wise, they do not cost more than 10% of the investment in the stocks. This category of stocks can be monitored on a monthly or bi-monthly basis.

VED stands for vital, essential and desirable. This analysis relates to the classification of maintenance spare parts and denotes the essentiality of stocking spares.

The spares are split into three categories in order of importance. From the view-points of functional utility, the effects of non-availability at the time of requirement or the operation, process, production, plant or equipment and the urgency of replacement in case of breakdown.

Some spares are so important that their non-availability renders the equipment or a number of equipment in a process line completely inoperative, or even causes extreme damage to plant, equipment or human life.

On the other hand some spares are non-functional, serving relatively unimportant purposes and their replacement can be postponed or alternative methods of repair found. All these factors will have direct effects on the stocks of spares to be maintained.

Therefore, it is necessary to classify the spares in the following categories:

V:

Vital items which render the equipment or the whole line operation in a process totally and immediately inoperative or unsafe; and if these items go out of stock or are not readily available, there is loss of production for the whole period.

E:

Essential items which reduce the equipment's performance but do not render it inoperative or unsafe; non-availability of these items may result in temporary loss of production or dislocation

of production work; replacement can be delayed without affecting the equipment's performance seriously; temporary repairs are sometimes possible.

D:

Desirable items which are mostly non-functional and do not affect the performance of the equipment.

Types of Inventory Control Systems:

An inventory control system is a system that integrates all aspects of administering a company's inventories including shipping, purchasing, receiving, warehouse storage, turnover, tracking, and re-ordering. These systems often differ based on the type of business being run. From stretch film packaging to warehouses to manufacturing, and even small businesses, inventory control systems are unique tools that help you measure and balance your operations.

Today, there are various types of inventory control systems to help you track and keep your inventory at hand. Here are the two main types of inventory control systems that you could consider using. The main difference between the two is how often inventory data is updated.

Perpetual Inventory System

The perpetual inventory system is by far the most favored method of tracking inventory in stretch film packaging. In this system, inventory data is entered perpetually or continuously. Once an order is placed or received, the data is updated into the system right away. Compared to the periodic inventory system, a perpetual inventory system is superior because it allows real-time tracking of sales in addition to monitoring individual inventory levels for each item.

However, the calculated inventory levels obtained from a perpetual inventory system may steadily deviate from the actual inventory levels due to theft or unrecorded transactions. It is therefore vital to periodically compare the physical inventories to the actual on-hand quantities and adjust accordingly.

Periodic inventory system

In this system, inventory data is not kept consistently up to date. Instead, inventory information is updated after a particular interval of time (usually once a year). Although this method is not as efficient as the perpetual system, it appeals to many people because you do not have to expend as much cash up front to set up the technology and software needed to keep track of data.

One major shortcoming with this system is that for the entire year, you do not have access to inventory data. For stretch film packaging business, this system can prove humongous especially when there is an increase in sales.

Stores Management:

It deals with planning, coordination and control of various activities pertaining or effective efficient and economic storage and store keeping.

Store: Generally, un worked material is known as store Storage: The store room is the place where stores are housed

Storage: Storage is meant holding in custody all kinds of stores and materials semi-processed and fully processed products.

Store Keeping: It may be defined as that aspect of materials control concerned with physical storage of goods.

Functions of stores:

1. To receive raw materials, semi-finished or purchased items from vendors and to check them for identification.

2. To receive parts and components this has been processed in the factory.

3. To make a record of material receipt and current status of material in the store

4. To maintain positioning of materials in the store.

5. To maintain stock safety and in good condition to ensure that they do not suffer from damage

6. Issuing the items/materials to operational personnel

7. Making a record of receipt and issue slips

8. To avoid illegal attics in store areas.

9. To plan for optimum utilization of space.

10. cooperating to full extent which purchasing, manufacturing and production planning and control departments.

Stores Records:

Material requisition note: Whenever the materials are required by a department/section, this form has to be filled in. This note provides information about the job number, description of the items required in terms of number. The head of the department/section should authorize it. Whenever the materials are issued, the receiving person should sign the note. This is to be entered in the materials issued record, which is to be signed by the storekeeper.

Purchase order: The purchasing officer will release the purchase order. The following is the format of a purchase order. Here, we find Vivek enterprises placing a purchase order on Business Solutions Ltd., for the following materials. The terms and conditions of the purchase order such as delivery, payment, and other have to be mentioned clearly.

Invoice: Invoice is a statement sent by the seller to the buyer mentioning the particulars of the goods supplied, net amount payable for the goods, and the terms and conditions governing the sale. It is very important document because it shows the net amount payable by the buyer after all the discounts and the taxes, if any.

Goods received note: The goods received note furnishes the particulars of the suppliers, purchase order number, purchase requisition number, and the job for which the goods are received. These details are to be certified by a competent authority. On this basis, the accounts department initiates the process of payment for the goods received.

Goods returned note: Sometimes, a part or whole of the goods received may not be of acceptable quality, and hence, these have to be returned to the supplier. In this context, the goods received note is prepared. This is also called the 'debit note' because the suppliers or creditors' account has to be debited by the amount mentioned in this debit note for the goods returned.

Stores ledger account: This is maintained to provide the details of the quantity, price and amount of the receipts, issues, and balance of stocks on a day-to-day basis. At any given time, the physical quantity of stocks should match with the balance as per the stores ledger account. A separate account is maintained for each type of the material in the stores. It should necessarily mention the method such as FIFO or LIFO, followed to value the issues of stocks. It is a valuable tool for the costing department in exercising stores control. It facilitates the valuation of stock from time to time.

Bin card: Bin card is the slip or tag attached to the bin where the goods are stocked. Whenever the materials are received or issued, an entry is made on the bin card. The purpose of bin card is to reveal the particulars of the quantities received, issued, and available as on a given date at a glance. Where separate bins are maintained for each item of the store, each bin will have a tag hung to it.

TOTAL QUALITY MANAGEMENT

DEFINITION:

1. TQM is the management approach of an organization, centered on quality, based on me participation of all its members and aiming at long-term success through customer satisfaction and benefits to all members of me organization and to society.- ISO

2. TQM is an integrated organizational approach in delighting customers (both internal and external) by meeting their expectations on a continuous basis through every one involved with the organization working on continuous improvement in all products, services, and processes along with proper problem solving methodology - INDIAN STATISTICAL INSTITUTE (ISI)

3. TQM is a. people - focused management system that aims at continual increase in customer satisfaction at continually lower cost. TQM is a total system approach (not a separate area of program), and an integral part of high level strategy. It works horizontally across functions and departments, involving all employees, top to bottom, and exceeds backwards and forward to include the supply chain and the customer chain – TOTAL QUALITY FORUM OF USA

BASIC CONCEPTS OF TQM:

1. Top management commitment

2. Focus on the customer – Both internal and external

3. Effective involvement and utilization of entire work force

4. Continuous improvement

5. Treating suppliers as partners

6. Establishing performance measures for the processes

PRINCIPLES OF TQM:

1. Customers requirements - (both internal & external) must be met first time & every time

2. Everybody must be involved

3. Regular two way communication must be promoted

4. Identify the training needs and supply it to the employees

5. Top management commitment is must

6. Every job must add value

7. Eliminate waste & reduce total cost

8. Promote creativity

9. Focus on team work

BENEFITS OF TQM

Tangible Benefits

• Improved product quality

• Improved productivity

• Reduced quality costs

• Increased market and customers

• Increased profitability

• Reduced employee grievances

LEADERSHIP

The process of influencing others towards the accomplishment of goals. He triggers tile will to do, shows the direction and guide the group members towards the accomplishment of goals.

CHARACTERISTICS OF QUALITY LEADERS

1. Customers first

2. Value people

3. Build suppler partnership

4. Empower people

5. Strive for excellence

6. Demonstrate involvement / commitment

7. Explain & deploy policy

8. Improve communication

9. Promote teamwork

10. Benchmark continuously

11. Establish system

12. Encourage collaboration

PERFORMANCE MEASURES

Performance measures are required for the managers for managing an organization perfectly. Performance measures are used to achieve the following objectives.

1. To identify the process to be improved

2. To compare actual performance with standard performance

3. To determine the overall performance of the organisation

Performance measurement is an essential element of every total quality management system. Responsibility for implementing a performance measurement program rests with your organization's managers and front-line supervisors, and the first step in the process is educating and training company managers and supervisors. After they are trained, company leadership should take the knowledge gained to enlist your employees in the process of continual improvement.

Bench Marking

Benchmarking is the process of improving performance by continuously identifying, understanding, and adapting outstanding practices and processes found inside and outside an organization (company, public organization, University, College, etc.).

Benchmarking of business processes is usually done with top performing companies in other industry sectors. This is feasible because many business processes are essentially the same from sector to sector. Benchmarking focuses on the improvement of any given business process by exploiting "best practices" rather than merely measuring the best performance. Best practices are the cause of best performance. Companies studying best practices have the greatest opportunity for gaining a strategic, operational, and financial advantage. The systematic discipline of benchmarking is focused on identifying, studying, analyzing, and adapting best practices and implementing the results. To consistently get the most value from the benchmarking process, senior management may discover the need for a significant culture change. That change, however, unleashes bench marking’s full potential to generate large paybacks and strategic

advantage. The benchmarking process involves comparing one's firm performance on a set of measurable parameters of strategic importance against that of firms' known to have achieved best performance on those indicators. Development of benchmarks is an iterative and ongoing process that is likely to involve sharing information with other organizations working with them towards an agreeable metrology.

There are five phases for implementation of benchmarking:

A. PLANNING: During this phase the organization determines which process to benchmark and against what type of organization.

B. ANALYSIS: Following data acquisition, an analysis is performed for the performance gap between the source organization and the recipient organization. An indication of best practice is then evident.

C. INTEGRATION: It involves the preparation of the recipient for implementation of actions.

D. ACTION: This is the phase where the actions are implemented within the recipient organization.

E. MATURITY: This involves continuous monitoring of the process and enables continuous learning and provides input for continuous improvement within the recipient organization.

Benefits of Bench Marking

Benchmarking offers the following benefits to companies and organizations:

- Highlights areas of practice and performance requiring attention and improvement.
- Identifies strengths and weaknesses to other respondents.
- Establishes company's true position versus the rest, making thus easier for the company to raise the organizational energy for change and develop plans for action.
- Helps measure current company performance.
- Prevents reinventing the wheel (Why invest the time and costs when someone else may have done it already -and often better, cheaper, and faster?).
- Accelerates change and restructuring by:

1. using tested and proven practices,
2. convincing skeptics who can see that it works and
3. overcoming inertia and complacency and creating a sense of urgency when gaps are revealed

- Leads to "outside the box" ideas by looking for ways to improve outside of the industry.

- Forces organizations to examine present processes, which often leads to improvement in and of itself.
- Makes implementation more likely because of involvement of process owners.

Benefits of ISO registration:

International Standards mean that consumers can have confidence that their products are safe, reliable and of good quality. ISO's standards on road safety, toy safety and secure medical packaging are just a few of those that help make the world a safer place.

Regulators and governments count on ISO standards to help develop better regulation, knowing they have a sound basis thanks to the involvement of globally-established experts.

ISO 9000 and its benefits:

Quality is something every company strives for and is often times very difficult to achieve. Complications concerning efficiency and quality present themselves everyday in business, whether an important document cannot be found or a consumer finds a product not up to their expectations. How can a company increase the quality of its products and services? The answer is ISO 9000.

As standards go, ISO 9000 is one of the most widely recognized in the world. ISO 9000 is a quality management standard that presents guidelines intended to increase business efficiency and customer satisfaction. The goal of ISO 9000 is to embed a quality management system within an organization, increasing productivity, reducing unnecessary costs, and ensuring quality of processes and products.

ISO 9001 is applicable to businesses and organizations from every sector. The process oriented approach makes the standard applicable to service organizations as well. Its general guidelines allow for the flexibility needed for today’s diverse business world.

ISO 14000

ISO 14000 is a series of environmental management standards developed and published by the International Organization for Standardization (ISO) for organizations. The ISO 14000 standards provide a guideline or framework for organizations that need to systematize and improve their environmental management efforts. The ISO 14000 standards are not designed to aid the enforcement of environmental laws and do not regulate the environmental activities of organizations. Adherence to these standards is voluntary.

The ISO 14001 standard is the most important standard within the ISO 14000 series. ISO 14001 specifies the requirements of an environmental management system (EMS) for small to large

organizations. An EMS is a systemic approach to handling environmental issues within an organization. The ISO 14001 standard is based on the Plan-Check-Do-Review-Improve cycle.

Benefits of an EMS

An Environmental Management System (EMS) is a structured framework for businesses and organisations to manage their environmental impacts. National and international EMS certification schemes emerged in the early 1990s and have since developed closely through to increasingly standardized and complimentary approaches. Environmental Management Systems are now widely adopted offering a number of direct benefits to both public and private sector organisations;

- Helps achieve real cost savings - direct efficiencies in energy, water, waste, purchasing and transport
- Management of environmental risk and ensuring legal compliance
- A valuable engagement process for staff and stakeholders
- Effectively demonstrate commitment and responsibility to key clients, regulators and the public
- Leading schemes have been structured to be compatible and complementary with other mainstream standards (e.g. ISO 9001 Quality Standard)
- Increasingly valuable as a pre-requisite for doing business – EMS accredited certification helping to demonstrate your business's compliance with supply chain requirements

Failure Mode and Effects Analysis (FMEA)

Failure modes and effects analysis (FMEA) is a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service.

"Failure modes" means the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the customer, and can be potential or actual.

"Effects analysis" refers to studying the consequences of those failures.

Failures are prioritized according to how serious their consequences are, how frequently they occur and how easily they can be detected. The purpose of the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones.

Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement. FMEA is used during design to prevent failures. Later it's used for control, before and during ongoing operation of the process. Ideally, FMEA begins during the earliest conceptual stages of design and continues throughout the life of the product or service.

When to Use FMEA

- When a process, product or service is being designed or redesigned, after quality function deployment.
- When an existing process, product or service is being applied in a new way.
- Before developing control plans for a new or modified process.
- When improvement goals are planned for an existing process, product or service.
- When analyzing failures of an existing process, product or service.
- Periodically throughout the life of the process, product or service

Benefits

• Improved product or process functionality

• Verify design integrity

• Provide rationale for change

• Reduced warranty and replacement costs

• Reduction in day-to-day manufacturing problems and costs

• Improved safety of products and processes

Process FMEA

• Assumes the product meets the intent of the design.

• Does not need to include failure modes originating from the design.

• assumes a design FMEA covers these failures

• Usually originates from a flow chart of the process

Total Productive Maintenance

Total Productive Maintenance (TPM) is a maintenance program which involves a newly defined concept for maintaining plants and equipment. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction. TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum.

TPM was introduced to achieve the following objectives.

The important ones are listed below.

·Avoid wastage in a quickly changing economic environment.

·Producing goods without reducing product quality.

·Reduce cost.

·Produce a low batch quantity at the earliest possible time.

·Goods send to the customers must be non defective.

Unit 4

Introduction to CPM / PERT

PERT – Program Evaluation & Review Technique – It is generally used for those projects where time required to complete various activities are not known as a priori. It is probabilistic model & is primarily concerned for evaluation of time. It is event oriented.

CPM – Critical Path Analysis – It is a commonly used for those projects which are repetitive in nature & where one has prior experience of handling similar projects. It is a deterministic model & places emphasis on time & cost for activities of a project.

A project can be defined as a set of large number of activities or jobs (with each activity consuming time & resources) that are performed in a certain sequence determined.

• A network is a graphical representation of a project, depicting the flow as well as the sequence of well defined activities & events.

• An activity (Also known as task & job) is any portion of a project which consumes time or resources and has definable beginning & ending.

• Event (Also known as node & connector) is the beginning & ending points of an activity or a group of activities

Benefits of PERT/CPM

- Useful at many stages of project management
- Mathematically simple
- Give critical path and slack time
- Provide project documentation
- Useful in monitoring costs

Limitations of PERT/CPM

- Clearly defined, independent and stable activities
- Specified precedence relationships
- Over emphasis on critical paths

Applications of CPM / PERT

These methods have been applied to a wide variety of problems in industries and have found acceptance even in government organizations.

These include

- Construction of a dam or a canal system in a region
- Construction of a building or highway
- Maintenance or overhaul of airplanes or oil refinery
- Space flight
- Cost control of a project using PERT / COST
- Designing a prototype of a machine
- Development of supersonic planes

Basic Steps in PERT / CPM

Project scheduling by PERT / CPM consists of four main steps

1. Planning

- The planning phase is started by splitting the total project in to small projects. These smaller projects in turn are divided into activities and are analyzed by the department or section.
- The relationship of each activity with respect to other activities are defined and established and the corresponding responsibilities and the authority are also stated.
- Thus the possibility of overlooking any task necessary for the completion of the project is reduced substantially.

2. Scheduling

- The ultimate objective of the scheduling phase is to prepare a time chart showing the start and finish times for each activity as well as its relationship to other activities of the project.
- Moreover the schedule must pinpoint the critical path activities which require special attention if the project is to be completed in time.
- For non-critical activities, the schedule must show the amount of slack or float times which can be used advantageously when such activities are delayed or when limited resources are to be utilized effectively.

3. Allocation of resources

- Allocation of resources is performed to achieve the desired objective. A resource is a physical variable such as labour, finance, equipment and space which will impose a limitation on time for the project.
- When resources are limited and conflicting, demands are made for the same type of resources a systematic method for allocation of resources become essential.

- Resource allocation usually incurs a compromise and the choice of this compromise depends on the judgment of managers.

4. Controlling

- The final phase in project management is controlling. Critical path methods facilitate the application of the principle of management by expectation to identify areas that are critical to the completion of the project.
- By having progress reports from time to time and updating the network continuously, a better financial as well as technical control over the project is exercised.
- Arrow diagrams and time charts are used for making periodic progress reports. If required, a new course of action is determined for the remaining portion of the project

The Framework for PERT and CPM

Essentially, there are six steps which are common to both the techniques.

The procedure is listed below:

I. Define the Project and all of its significant activities or tasks. The Project (made up of several tasks) should have only a single start activity and a single finish activity.
II. Develop the relationships among the activities. Decide which activities must precede and which must follow others.
III. Draw the "Network" connecting all the activities. Each Activity should have unique event numbers. Dummy arrows are used where required to avoid giving the same numbering to two activities.
IV. Assign time and/or cost estimates to each activity
V. Compute the longest time path through the network. This is called the critical path.
VI. Use the Network to help plan, schedule, and monitor and control the project.

The Key Concept used by CPM/PERT is that a small set of activities, which make up the longest path through the activity network control the entire project. If these "critical" activities could be identified and assigned to responsible persons, management resources could be optimally used by concentrating on the few activities which determine the fate of the entire project. Non-critical activities can be re planned, rescheduled and resources for them can be reallocated flexibly, without affecting the whole project.

Network Diagram Representation

In a network representation of a project certain definitions are used

1. Activity

Any individual operation which utilizes resources and has an end and a beginning is called activity. An arrow is commonly used to represent an activity with its head indicating the direction of progress in the project.

These are classified into four categories

1. Predecessor activity – Activities that must be completed immediately prior to the start of another activity are called predecessor activities
2. Successor activity – Activities that cannot be started until one or more of other activities are completed but immediately succeed them are called successor activities.
3. Concurrent activity – Activities which can be accomplished concurrently are known as concurrent activities. It may be noted that an activity can be a predecessor or a successor to an event or it may be concurrent with one or more of other activities.
4. Dummy activity – An activity which does not consume any kind of resource but merely depicts the technological dependence is called a dummy activity.

The dummy activity is inserted in the network to clarify the activity pattern in the following two situations

To make activities with common starting and finishing points distinguishable

- To identify and maintain the proper precedence relationship between activities

- That is not connected by events.

2. Event

An event represents a point in time signifying the completion of some activities and the beginning of new ones. This is usually represented by a circle in a network which is also called a node or connector. The events are classified in to three categories

1. Merge event – When more than one activity comes and joins an event such an event is known as merge event.
2. Burst event – When more than one activity leaves an event such an event is known as burst event.
3. Merge and Burst event – An activity may be merge and burst event at the same time as with respect to some activities it can be a merge event and with respect to some other activities it may be a burst event.

3. Sequencing

The first prerequisite in the development of network is to maintain the precedence relationships. In order to make a network, the following points should be taken into considerations

What job or jobs precede it.

What job or jobs could run concurrently.

What job or jobs follow it.

What controls the start and finish of a job.

Since all further calculations are based on the network, it is necessary that a network be drawn with full care

Advantages and Disadvantages

PERT/CPM has the following advantages

A PERT/CPM chart explicitly defines and makes visible dependencies(precedence relationships) between the elements,

PERT/CPM facilitates identification of the critical path and makes this visible

PERT/CPM facilitates identification of early start, late start, and slack for each activity

PERT/CPM provides for potentially reduced project duration due to better understanding of dependencies leading to improved overlapping of activities and tasks where feasible.

PERT/CPM has the following disadvantages:

There can be potentially hundreds or thousands of activities and individual dependency relationships,

The network charts tend to be large and unwieldy requiring several pages to print and requiring special size paper.

The lack of a timeframe on most PERT/CPM charts makes it harder to show status although colors can help (e.g., specific color for completed nodes)

When the PERT/CPM charts become unwieldy, they are no longer used to manage the project.

Unit 4

Introduction to CPM / PERT

PERT – Program Evaluation & Review Technique – It is generally used for those projects where time required to complete various activities are not known as a priori. It is probabilistic model & is primarily concerned for evaluation of time. It is event oriented.

CPM – Critical Path Analysis – It is a commonly used for those projects which are repetitive in nature & where one has prior experience of handling similar projects. It is a deterministic model & places emphasis on time & cost for activities of a project.

A project can be defined as a set of large number of activities or jobs (with each activity consuming time & resources) that are performed in a certain sequence determined.

• A network is a graphical representation of a project, depicting the flow as well as the sequence of well defined activities & events.

• An activity (Also known as task & job) is any portion of a project which consumes time or resources and has definable beginning & ending.

• Event (Also known as node & connector) is the beginning & ending points of an activity or a group of activities

Benefits of PERT/CPM

- Useful at many stages of project management
- Mathematically simple
- Give critical path and slack time
- Provide project documentation
- Useful in monitoring costs

Limitations of PERT/CPM

- Clearly defined, independent and stable activities
- Specified precedence relationships
- Over emphasis on critical paths

Applications of CPM / PERT

These methods have been applied to a wide variety of problems in industries and have found acceptance even in government organizations.

These include

- Construction of a dam or a canal system in a region
- Construction of a building or highway
- Maintenance or overhaul of airplanes or oil refinery
- Space flight
- Cost control of a project using PERT / COST
- Designing a prototype of a machine
- Development of supersonic planes

Basic Steps in PERT / CPM

Project scheduling by PERT / CPM consists of four main steps

1. Planning

- The planning phase is started by splitting the total project in to small projects. These smaller projects in turn are divided into activities and are analyzed by the department or section.
- The relationship of each activity with respect to other activities are defined and established and the corresponding responsibilities and the authority are also stated.
- Thus the possibility of overlooking any task necessary for the completion of the project is reduced substantially.

2. Scheduling

- The ultimate objective of the scheduling phase is to prepare a time chart showing the start and finish times for each activity as well as its relationship to other activities of the project.
- Moreover the schedule must pinpoint the critical path activities which require special attention if the project is to be completed in time.
- For non-critical activities, the schedule must show the amount of slack or float times which can be used advantageously when such activities are delayed or when limited resources are to be utilized effectively.

3. Allocation of resources

- Allocation of resources is performed to achieve the desired objective. A resource is a physical variable such as labour, finance, equipment and space which will impose a limitation on time for the project.

- When resources are limited and conflicting, demands are made for the same type of resources a systematic method for allocation of resources become essential.
- Resource allocation usually incurs a compromise and the choice of this compromise depends on the judgment of managers.

4. Controlling

- The final phase in project management is controlling. Critical path methods facilitate the application of the principle of management by expectation to identify areas that are critical to the completion of the project.
- By having progress reports from time to time and updating the network continuously, a better financial as well as technical control over the project is exercised.
- Arrow diagrams and time charts are used for making periodic progress reports. If required, a new course of action is determined for the remaining portion of the project

The Framework for PERT and CPM

Essentially, there are six steps which are common to both the techniques.

The procedure is listed below:

VII. Define the Project and all of its significant activities or tasks. The Project (made up of several tasks) should have only a single start activity and a single finish activity.
VIII. Develop the relationships among the activities. Decide which activities must precede and which must follow others.
IX. Draw the "Network" connecting all the activities. Each Activity should have unique event numbers. Dummy arrows are used where required to avoid giving the same numbering to two activities.
X. Assign time and/or cost estimates to each activity
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When the PERT/CPM charts become unwieldy, they are no longer used to manage the project.

Network representation

Each activity of the project is represented by an arc pointing in the direction of progress in project. For the construction of a network, generally the following rules are followed:

1. Each activity is represented by one and only one arrow.
2. Each activity must be identified by two distinct nodes i.e. Its starting and end node.
3. Nodes are numbered to identify an activity uniquely.

4. Between any pair of nodes, there should be one and only one activity, however more than one activity may emanate from and terminate to a node.
5. Arrows should be kept straight and not curved or bent.
6. The logical sequence between activities must follow the following rules:

An event cannot occur until all the incoming activities into it have been completed.

An activity cannot start unless all the preceding activities on which it depends,have been completed.

Dummy activities should only be introduced if absolutely necessary.

Critical Path(CPM) Computations

The purpose of analysis or computation is to find the critical path, i.e., the sequence of activities with the longest duration, and to find the float associated with each non-critical activity. This helps in checking actual progress against the scheduled duration of the project.

To achieve this objective we carry out special computations that produce the following information:

- Total duration needed for the completion of the project.
- Categorization of the activities of the project as being critical or non-critical.

An activity is said to be critical, if the delay in its start will further delay the project completion time.

A non-critical activity allows some scheduling slack ,so that the start time of the activity may be delayed within limits without affecting the completion time of entire project.

To carry out the special computations, the following terms shall be used in critical path calculations:

- Earliest occurrence time of event ‘i’.
- Latest occurrence time of event 'j'.
- Duration of activity(i,j)

The critical path calculations are done in two ways:

1. Forward pass calculations
2. Backward pass calculations

Critical path: The critical activities of a network that constitute an uninterrupted path which spans the entire network from start to finish is known as critical path.

Float (or Slack) of an activity and event

The float of an activity is the amount of time by which it is possible to delay its completion time without affecting the total project completion time.

1. *Event float* : The float is the difference between its latest time and earliest time.
2. *Activity float*: It is the float in the activity time estimates. There are mainly three types of activity float:

(i)*Total float*: The total float of an activity represents the amount of time by which an activity can be delayed without delay in the project completion date. It is the positive difference between the earliest finish time and the latest finish time. or the positive difference between the earliest start time and the latest start time of an activity depending upon which is defined.

(ii)*Free float*: It is that portion of total float within which an activity can be manipulated without affecting the float of subsequent activities. It is computed for an activity by subtracting the head event slack from its total float.

(iii)*Independent float*: It is that portion of total float within which an activity can be delayed for start without affecting floats of the preceding activities. It is computed by subtracting the tail event slack from the free float of the activity. If the result is negative, it is taken as zero. Which causes a reduction in the float of the successor activities?

(iv)*Interfering float*: Interfering float can be defined as that part of the total float It is the difference between the latest finish time of the activity under consideration and the earliest start time of the following activity, or zero, whichever is larger.

PERT Networks

Under the conditions of uncertainty, the estimated time for each activity for PERT network is represented by a probability distribution. The probability distribution of activity time is based upon three different estimates made for each activity. These are:

1. Optimistic time,' a',is the shortest possible time which occurs when execution goes extremely well.
2. Most likely time, 'm', is the estimate of the normal time an activity would take, which occurs when execution is done under normal conditions.

3. Pessimistic time,' b',is the longest time that an activity could take which occurs when execution goes extremely poorly.

The range (a, b) encloses all possible estimates of the duration of an activity. The estimate m lies somewhere in the range (a, b). Based on the estimates, the average duration

Time, D, and variance, v, are approximated as:

$$D= (a+4m+b) / 6$$

$$v= (b-a / 6)^2$$

Distinction between PERT and CPM

1. CPM is used for repetitive jobs. On the other hand, PERT is used for non-repetitive jobs.
2. PERT is a probabilistic model with uncertainty in activity duration. On the contrary, CPM is a deterministic model with well known activity times based on experience. It therefore doesn't deal with uncertainty in project duration.
3. PERT is said to be event oriented as the results of analysis are expressed in terms of events or distinct points in time indicative of progress. CPM is, on the other hand, activity oriented as the results of calculations are considered in terms of activities of the project.
4. PERT is applied mainly for planning and scheduling research programmers'. On the other hand, CPM is employed in construction and business problems.
5. PERT incorporates statistical analysis and thereby enables determination of probabilities concerning the time by which each activity and the entire project would be completed. On the other hand, CPM doesn't incorporate statistical analysis in determining time estimates because time is precise and known.

UNIT 5

STATISTICAL QUALITY CONTROL

Introduction: Quality is the determining factor the success of any product or service large resource is committed in every organization to ensure quality.

Definition: It is defined as customer satisfaction in general and fitness for use in particular. Both the external consumer who buy the product and services and the internal consumers that is, all divisions or departments of the business organization are equally interested in the quality.

Statistical quality control: The process of applying statistical principles to solve the problem of controlling the quality control of a product or service is called statistical quality control.

Quality elements: a) Quality design b) Quality conformance

a)Quality design: Quality of design refers to product feature such as performance, reliability durability, ease of use, serviceability

b)Quality conformance: Quality conformance means whether the product meets the given quality specification or not .

Inspection: The process of measuring the out put and comparing it to check whether it meets the given specified requirements or not, is called inspection.

Inspection Methods: The following are the methods of inspection based on merits

1) Incoming inspection: In this method, the quality of the goods and services arriving into the organization is inspected. This ensures that the material cannot suppliers enter adhere into to the production given specifications process. This focuses this defective on the vendor materials quality and ability to supply acceptable raw materials.

2) Critical point inspection: Inspecting at the critical points of a product manufacture gives valuable insight into the completely functional process. At the points of manufacture that involve high costs or which offer no possibility for repair or rework, inspection is crucial further operation depend on these results critical point inspection helps to drop the defective production, and thereby, facilitate avoiding unnecessary further expenditure on them.

3) Process inspection: This is also called patrolling inspection or floor inspection or roving inspection. Here the inspector goes around the manufacturing points in the shop floor to inspect the goods produced on random sample basis from time to time.

4) Fixed inspection: It provides for a centralized and independent where work is brought for inspection from time to time. This method is followed where the inspection equipment cannot be moved to the points of productions.

5) Final inspection: This is centralized inspection making use of special equipment. This certifies the quality of the goods before they are shipped.

Elements of statistical Quality Control:
The technique under SQC can be divided in to two parts a) Process control b) Acceptance sampling

- **a)** Process control: Process control is a technique of ensuring the quality of the products during the manufacturing process itself. If a process consistently produces items with acceptable or tolerable range of specification. It is said to be statically under control. Process control is achieved through control charts. Process control aims to control and maintain the quality of the products in the manufacturing process.
- **b)** Statistical control charts: A control chart compares graphically the process performance data to computed statistical control limits. These control limits act as limit lines on the chart control chats are the tools to determine whether the process is under control or not.

The quality of the production process may be affected by chance cause or assignable cause.

Chance cause: such causes, which may or may not affect the manufacturing process are called chance cause, chance cause cannot even be identified. It is not possible to always maintain the given specification.

Assignable Cause: Assignable causes affect the quality of the production process. These causes can be identified and specified. Causes such as change in the labour shift, power fluctuations, or excessive tool wear are said to be assignable causes as they affect the quality of manufacturing process in different ways.

Process capability: Process capability refers to the ability to achieve measurable results from a combination of machines, tools, methods, materials and people engaged in production

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 ($\bar{\bar{X}}$ is equal

to the average of all the sample ranges R) are found and from these we can calculate the control limits for the $\overline{X}$ and R charts.

For $\overline{X}$ charts :

Upper Control Limit, $UCL_{\overline{X}} = \overline{\overline{X}} + A_2 \overline{R}$

Lower Control Limit, $LCL_{\overline{X}} = \overline{\overline{X}} - A_2 \overline{R}$

$\overline{\overline{X}}$ and $\overline{R}$ are also called centre line values.

For R chart : $UCL_R = D_4 \overline{R}$

$LCL_R = D_3 \overline{R}$

Here the factors A_2, D_4 and D_3 depend on the number of units per sample. Larger the number, the close the limits. The value of the factors A_2, D_4 and D_3 can be obtained from Statistical Quality Control tables. However for ready reference these are given below in tabular form.

As long as X and it values for each sample are within the control limits, the process is said to be in statistical control. where d_2 is a factor, whose value depends on number of units in a sample.

Summary of Formula used in $\overline{X}$ and R Chart

Chart	*Centre line*	*3 Sigma Control limits*
$\overline{X}$, Average	$\overline{\overline{X}}$	$\overline{\overline{X}} + A_2 \overline{R}$
R, Range	$\overline{R}$	$D_3 \overline{R}$ and $D_4 \overline{R}$
Estimated spread of individual measurement	$= \overline{\overline{X}} \pm \frac{3\overline{R}}{d_2}$	

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.

The various reasons for the process being out of control may be:

(i) Faulty tools,

(ii) Sudden significant change in properties of new materials in a new consignment,

(iii) Breakdown of lubrication system,

(iv) Faults in timing of speed mechanisms etc.

Control Charts for Attributes:

The $\bar{X}$ and R control charts are applicable for quality characteristics which are measured directly, i.e., for variables. There are instances in industrial practice where direct measurements are not required or possible.

Under such circumstances, the inspection results are based on the classification of products as being defective or not defective, acceptable as good or bad accordingly as that product confirms or fails to confirm the specified specification.

In manufacturing, sometime it is required to control burns, cracks, voids, dents, scratches, missing and wrong components, rust etc. Here, we inspect products only as good or bad but not how much good or how much bad. Furthermore, there are many quality characteristics that come under the category of measurable variables but direct measurement is not taken for reasons of economy.

These products are inspected with GO and NOT GO gauges. Again under this type also, our aim is to tell that whether product confirms or does not confirm to the specified values. Quality characteristics expressed in this way are known as attributes.

The various control charts for attributes are explained as under:

1. Attribute Charts for Defective Items: (P-Chart):

This is the control chart for percent defectives or for fraction defectives. This is used whenever the quality characteristics are expressed as the number of units confirming or not confirming to the specified specifications either by visual inspection or by 'GO' and 'NOT GO' gauges.

The Centre Line Value:

It is denoted by $\bar{P}$ (P bar) and may be defined as the ratio between the total number of defective (non-conforming) products observed in all the samples combined and the total number of products inspected. For example, 15 products are found to be defective in a sample of 200, then 15/200 is the value of $\bar{P}$.

Fraction and Percent Defectives:

The fraction defective value is represented in a decimal as proportion of defectives out of one product, while percent defective is the fraction defective value expressed as percentage. As in the above example, fraction defective of 15/200 = 0.075, and percent defective will be 0.075 x 100 = 7.5%.

Standard Deviation:

The standard deviation for fraction defective denoted by σ P is calculated by the formula.

$$\sigma P = \sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$$

where n = sample size and $\bar{P}$ = fraction defective.

Trial Control Limits:

Just as the control limits for the X and R-charts are obtained as + 3σ values above the average. The two control limits, upper and lower for this chart are also calculated by simply adding or subtracting 3σ values from centre line value. These trial limits are computed to determine whether a process is in statistical control or not.

So $$UCL_P = \bar{P} + 3\sigma P\ . = \bar{P} + 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$$

Similarly, $$LCL_P = \bar{P} - 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$$

Mostly the control limits are obtained on the basis of about 20-25 samples to pick up the problem and standard deviation from the samples is calculated for further production control.

Tracing of these causes is sometimes simple and straight forward but when the process is subject to the combined effect of several external causes, then it may be lengthy and complicated business.

2. Attribute Charts for Number of Defects per Unit: (C-Chart):

This is a method of plotting attribute characteristics. In this case, the sample taken is a single unit, such as length, breadth and area or a fixed time etc. In some cases it is required to find the number of defects per unit rather than the percent defective.

For example take a case in which a large number of small components form a large unit, say a car or transistor. The transistor set may have defect at various points. In this case, it seems natural to count the number of defects per set, rather than to determine all points at which the unit is defective.

This attempt to use P-charts to locate all the points at which transistor is defective seems to be wrong, impossible to some extent and impracticable approach to the problems. Such a condition warrants the necessity for the use of a C-chart.

Examples of C-Chart:
The distribution of the variables in C-chart very closely follows the Poisson's distribution.

The examples given below show some of representative types of defects, following Poisson's distribution where C-chart technique can be effectively applied:
(i) Number of blemishes per 100 square metres.

(ii) Typing mistakes on the part of a typist.

(iii) Number of spots on a distempered wall.

(iv) Air gap between two meshing parts of a joint.

(v) Welding defects in a truss.

(vi) Unweave points on a piece of a textile cloth.

(vii) Leakage in water tight joints of radiator.

(i) The Average Number of Defects:
It is denoted by $\bar{C}$ (C bar) and is the ratio between the total number of defects found in all samples and the total number of samples inspected.

(ii) Standard Deviation:
The sigma of standard deviation for number of defects per unit production is calculated from the formula $\sigma c = \sqrt{\bar{C}}$
Trial Control Limits:
The control limits can be calculated as $\pm 3\sigma c$ from the central line value C.

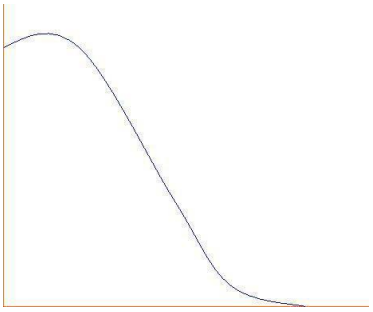
i.e., $UCL_c = \bar{C} + 3\sqrt{\bar{C}}$
$LCL_c = \bar{C} - 3\sqrt{\bar{C}}$

Acceptance Sampling:
Acceptance sampling is a technique of deciding whether to accept the whole lot or not based on the number of defectives from a random drawn sample.

It is widely use in buying food products, such as rice, wheat etc. Before buying the random samples drawn from the bags of say rice are tested. If the quality of sample drawn looks good or free from defects then according to the requirement the entire bag or part of it can be brought.

The process of acceptance sampling through operating characteristic curve (OCC)

Operating characteristic curve (OCC): The graphical relationship between percentage defective in the lots being submitted for inspection and the probability acceptance is termed as operating characteristic of a particular sampling plan



It gives a clear picture about the probability of acceptance of lot for various values of percent defectives in the lot. The probability of acceptance of a lot is high for low values of actual percentage decrease and it is low for high values of actual percentage defectives.

Construction of OC curve:
To develop a sampling plan for acceptance sampling, an appropriate O.C curve must be selected to construct an OC curve an agreement has to be reached between the producer and the consumer on the following four points.

1) Acceptable quality level (AQL): This is the maximum proportion of defectives that will make the lot definitely acceptable.
2) Lot tolerance percentage defective (LTPD): This is the maximum proportion of defectives that will make the lot definitely unacceptable.
3) This is the risk, the producer is willing to take that lots of the qua ity level AQL will be rejected, even though, they are

TOTAL QUALITY MANAGEMENT

DEFINITION:

1. TQM is the management approach of an organization, centered on quality, based on me participation of all its members and aiming at long-term success through

customer satisfaction and benefits to all members of me organization and to society.- ISO

2. TQM is an integrated organizational approach in delighting customers (both internal and external) by meeting their expectations on a continuous basis through every one involved with the organization working on continuous improvement in all products, services, and processes along with proper problem solving methodology - INDIAN STATISTICAL INSTITUTE (ISI)

3. TQM is a. people - focused management system that aims at continual increase in customer satisfaction at continually lower cost. TQM is a total system approach (not a separate area of program), and an integral part of high level strategy. It works horizontally across functions and departments, involving all employees, top to bottom, and exceeds backwards and forward to include the supply chain and the customer chain – TOTAL QUALITY FORUM OF USA

BASIC CONCEPTS OF TQM:

1. Top management commitment

2. Focus on the customer – Both internal and external

3. Effective involvement and utilization of entire work force

4. Continuous improvement

5. Treating suppliers as partners

6. Establishing performance measures for the processes

PRINCIPLES OF TQM:

1. Customers requirements - (both internal & external) must be met first time & every time

2. Everybody must be involved

3. Regular two way communication must be promoted

4. Identify the training needs and supply it to the employees

5. Top management commitment is must

6. Every job must add value

7. Eliminate waste & reduce total cost

8. Promote creativity

9. Focus on team work

BENEFITS OF TQM

Tangible Benefits

• Improved product quality

• Improved productivity

• Reduced quality costs

• Increased market and customers

• Increased profitability

• Reduced employee grievances

Benefits of ISO registration:

International Standards mean that consumers can have confidence that their products are safe, reliable and of good quality. ISO's standards on road safety, toy safety and secure medical packaging are just a few of those that help make the world a safer place.

Regulators and governments count on ISO standards to help develop better regulation, knowing they have a sound basis thanks to the involvement of globally-established experts.

ISO 9000 and its benefits:

Quality is something every company strives for and is often times very difficult to achieve. Complications concerning efficiency and quality present themselves everyday in business, whether an important document cannot be found or a consumer finds a product not up to their expectations. How can a company increase the quality of its products and services? The answer is ISO 9000.

As standards go, ISO 9000 is one of the most widely recognized in the world. ISO 9000 is a quality management standard that presents guidelines intended to increase business efficiency and customer satisfaction. The goal of ISO 9000 is to embed a quality management system within an organization, increasing productivity, reducing unnecessary costs, and ensuring quality of processes and products.

ISO 9001 is applicable to businesses and organizations from every sector. The process oriented approach makes the standard applicable to service organizations as well. Its general guidelines allow for the flexibility needed for today's diverse

business world

HUMAN RESOURCE MANGEMENT

Human Resource Management: Human resource management is the process of managing the human resources of an organization in tune with the vision of the top management.
Personnel Management: Defines personnel management as the planning, organizing, and controlling of the procurement, development, compensation, integration and maintenance of people for the purpose of contributing to the organizational goals.

Personal management versus Human resource management:

1. Personnel management function is often viewed as a function of the specialized staff. Human resource management function is the responsibility of all the line managers in the organization.
2. Personnel management goal is employee orientation
Human resource management goal is organization orientation
3. Personnel management managerial function Human resource management operative function
4. Personnel management cooperative level manager concern Human resource management top level manager concern.
Definition of HRM: According to Flippo HRM is planning, organizing , directing and controlling of the procurement development, Compensation, integration, maintenance and suppuration of human resources to the objectives.

FUNCTION OF HRM:

Most experts agree that managing involves 5 functions

- Planning
- Organizing
- Staffing
- Leading
- Controlling

Planning: Establishing goals and standards, developing rules and procedures, developing plans and forecasting.

Organising: Giving each sub ordinate a specific staff establishing departments delegating authority, Communication and co-coordinating work.

Staffing: Manning the position. Determining the required people, selecting training, developing, Evaluating and compensating.

Leading: Getting others to get the job done, maintain moral, motivating sub-

ordinates.

Controlling: Setting standards such as sales quota, quality standards production levels, checking Actual performance and comparing with standards, taking necessary action.

JOB ANALYSIS

Harry L.Wylie: Job analysis deals with the anatomy of the job. This is the complete study of the job embodying every known and determinable factor. Including the duties and responsibilities involved in its performance. The conditions under which performance is carried on, the nature of the task; the qualifications required in the worker, and the conditions of employment such as pay, hours, opportunities and privileges.

Objectives of Job analysis:

1. Job Description:
Job description is a job profile which describes the contents environment and condition of jobs. It is prepared on the basis of data collected through job analysis. It provides information relating to activities and duties to be performed in a job. It differentiates one job from another by introducing unique characteristics of each job.

2. Job Specification:
Job specification is another notable objective of job analysis. It includes the information relating to the requirements of skills and abilities to perform a specific task. It states the minimum acceptable qualifications that an incumbent must possess to perform the assigned duty successfully. The job specification statement identifies he knowledge, skills, abilities needed to perform that task effectively.

3. Job evaluation:
Job analysis also provides required information which is necessary for evaluating the worthiness of jobs. After the preparation of job description and job specification statements. It assists for the evaluation of actual performance against the predetermined standard. Then the deviation is found out that has taken place during the course of action. Moreover, it helps to establish the value of different jobs in a hierarchical order which allows comparing jobs one from another.

Steps involved in Job Analysis or Job Analysis Process:
1. Information collection

2. Review background information

3. Selection of representative position to be analyzed

4. Analysis of job by collecting data

5. Develop job description

6. Develop job specification

JOB DESCRIPTION:

Job description is an important document which is basically descriptive in nature and contains a statement of job analysis. It serves to identify a job for consideration by other job analysis. It tells us what should be done, why it should be done and where it should be done.
A job description is an organized, factual statement of duties and responsibilities of a specific job . It tells what is to be done, how it is done and why?

Contents of Job Description:
Job title
Location of the job
Supervision given and receive
Materials, tools, machinery
Designation of superior/sub-ordinates
Salary particulars
List of duties
Conditions of work
Training and development facilities

JOB SPECIFICATIONS:

Job specification is a written statement of qualifications, traits and mental characteristics that all individual must possess to perform the job duties and discharge responsibilities effectively.
A job specification is a statement of minimum acceptable human qualities necessary to perform a job properly. In contrast to the job description it is a standard of personnel and designates the qualities required for acceptable performance.
Departmental human resource management plans are used to link together the overall policies of the Civil Service Branch, the mission, objectives and values of the department, and any specific Human Resource Management activities being undertaken at line management level. The plans thereby provide clear policies and guidelines for staff and managers.

Methods of Merit Rating: Traditional and Modern Methods

The two methods of techniques of merit rating are as follows: 1. Traditional Methods 2. Modern Methods

A. Traditional Methods:

The various traditional methods used are mentioned below:

1. Ranking Methods:

It is the simplest, oldest and most conventional method of merit rating. Every employee is judged as a whole without distinguishing the rates from his performance. In this method a list is then prepared for ranking the workers in order of their performance on the job so that an excellent employee is at the top and the worst at the bottom. It permits comparison of all employees in any single rating group regardless of the type of work.

The difficulty of this method is that it is very difficult to compare persons on the whole when they differ in qualities, attitudes, etc. This method only gives the idea about the standing of various people and not the actual difference among them. This method however does not indicate specific strengths and weaknesses between two or more workers. This technique is used in those enterprises where there are few workers

2. Paired Comparison Method:

In this method every person is compared trait wise, with other persons one at a time, the number of times one person is compared with others is recorded on a piece of paper. These numbers help in yielding rank of employees. For example, if there are five persons to be compared.

As performance is first compared with that B to determine who has better performance, then A's compared with C,D and E in turn and performance is recorded. Later B is compared to C,D and E since he has already been compared with A. Afterwards C is compared with D and E and so on. The results of these comparisons are tabled and a rank is assigned to each employee. The number of comparisons can be worked out with the formula.

Number of Comparisons = N(N- 1) / 2

Where N is total number of employees to be evaluated. This method gives more reliable rating than straight raking. But it will be suitable only when the number of persons is small.

3. Grading system:

Under this system certain features like analytical ability, cooperativeness, dependability, job knowledge, etc. are selected for evaluation. The employees are given grades according to the judgment of the rater.

The grades may be such as:

A-outstanding, B-very good: C-satisfactory, D- average, etc. The actual performance of every employee is rated with various grades in the mind of the rater.

4. Forced distribution method:

Some evaluators suffer from a constant error i.e. either they rate all workers as good, average or poor. They do not evaluate the employees properly. This system minimizes rater's bias so that all employees are not equally rated. This system is based on the presumption that all employees can be divided into five categories.

Outstanding, above average, average below average and poor. The main aim in this system is to spread ratings in a number of grades. This method will be useful only when the group of employees is large, it is also easy to understand and simple to apply.

5. Check list method:

In this technique the supervisors are provided with printed forms containing descriptive questions about the performance of workers. The supervisor has to answer in yes or no. After putting answers to these questions the forms are sent to Personnel Department where final rating is done. Various questions in the form may be weighted equally or certain questions may be given more weight age than others.

The check list may contain such questions:

1. Is the employee hard working? (Yes/No)

2. Is he regular on the work? (Yes/No)

3. Does he co-operate with his superiors? (Yes/No)

4. Does he maintain his equipment/machines well? (Yes/No)

5. Does he obey instructions well? (Yes/No)

The supervisor's bias is the main characteristic of this method because he can distinguish between positive and negative question. It is also difficult to put all possible questions in the check list because it will make the check list lengthily.

6. Critical incident method:

This method measures worker's performance in terms of certain events or incidents that occur in the course of work. The assumption in this method is that the performance of an employee/ worker on the happening of critical incidents determines his failure or success. The supervisor keeps a record of critical incidents occurring at different times and then rates him on this basis.

Examples of critical incidents are:

(i) Refused to follow instructions without a detailed discussion with superiors.

(ii) Refused to follow instructions even when these were made clear.

(iii) Increased his efficiency despite resentment from other worker/ employees.

(iv) Showed presence of mind in saving a worker when sudden fire broke out.

(v) Performed a difficult task even though it was outside has regular duties.

(vi) Displayed a courteous behavior to a supplier.

(vii) He helped fellow employees in solving their problems.

The only difficulty in this method is that outstanding incidents may not regularly occur. Moreover negative incidents may be more noticeable than the positive ones.

The supervisor may not record an incident immediately and forget it later on. It may be difficult for the supervisors to decide whether an incident is critical or not.

7. Free essay method:

In the free essay method the supervisor writes a report about the worker which is based on his assessment about performance of workers. The supervisor continuously watches the workers or subordinates and writes his assessment in the report. The covered factors are the behavior with employees, job knowledge, employee traits, development requirements for future, etc.

In this method the supervisor will be able to provide a detailed account of the employee's performance. The system may suffer from human bias because of likings or disliking of the supervisor for specific workers. The other limitation of this technique is that an appraiser may not be able to express his judgment in appropriate words and it will limit the utility of appraisal reports.

B. Modern Methods:

The modern methods used in merit rating are as follows:

1. Management by objectives:

The management by objective or management by results was developed by Peter Drucker who emphasized that performance of each job should be directed towards the achievement of whole business objectives. According to Georg S. Ordisure, "The system of management by objectives can be described as a process whereby the superior and subordinate managers of an organization jointly identify its common goals, define each individual's major areas of responsibility in terms of results expected of him and use these measures as guides for members". Petrer Drucker pointed out that objectives are required in every area where performance and results directly and vitally affect the survival and chances of success of the business.

In the MBO system of merit rating the superior and subordinate sit together and set the goals to be achieved by the later in a particular period of time. The work to be performed becomes a goal for performance evaluation. The employees periodically

meet their supervisor to evaluate the progress of important features of this system.

MBO, as a technique of evaluation, may not provide good results if the goal setting is hasty and over ambitious. Lack of proper feedback between the superior and subordinate may also adversely affect the application of this technique.

2. Assessment centre method:

The assessment centre method was first used in German army and later in British Army. The purpose was to assess people in particular situations. The evaluators record their assessment regarding various people when they perform in an actual situation. This method is utilized, generally, to determine the suitability of persons for first supervisory levels. It also helps in determining training and development requirements or employees.

The distinguishing characteristics training and development requirements of employees. The distinguishing characteristics normally assessed are organizing and planning ability, getting along with other, quality thinking, resistance to stress, orientation to work etc. The assessment centre ratings are said to be influenced by the participant's interpersonal skills.

The employees who generally perform well in a normal situation may become conscious under stimulated situations. The supervisors who nominate employees to assessment centres normally do not favour people who are aggressive, intelligent, and independent even though these qualities are essential for higher level positions.

Wage Incentive

Wage incentive refers to performance linked compensation paid to improve motivation and productivity. It is the monetary inducements offered to employees to make them perform beyond the acceptance standards.

According to the National Commission of Labour "wage incentives are extra financial motivation. They are designed to stimulate human effort by rewarding the person over and above the time rated remuneration, for improvements in the present or targeted results".

Types of Wage Incentive Plans:

Following are the types of wage incentive plans.

They can be diagrammatically represented as below:

1. Straight Piece Rate Plan:

Under the straight piece rate plan workers are paid based on their output. For example, if the piece rate is Rs. 4 per piece of the product, then a worker who turns out 40 pieces/day earns Rs. 160 (Rs. 4 x 40) as his wage for that day. Whereas another employee who produces 32 pieces/ day earns Rs. 128 (Rs. 4 x 32 pieces). Hence a fast worker earns more compared to the slow worker.

Advantages:

i. Motivates the workers to increase their output.

ii. Simple and easy to understand.

iii. improve productivity.

Disadvantages:

i. No guaranteed minimum wage. This makes workers insecure.

ii. Great disparity of earning between slow and fast workers.

iii. Wastage might increase.

iv. Quality of production may suffer as the workers concentrate on quantity.

v. Interpersonal relationship suffers due to jealousy and competition to earn more.

vi. Enforced idleness like electricity failure or machine breakdown, adversely affect earning of workers.

2. Standard Piece Rate with Guaranteed Minimum Wage:

Here the minimum guaranteed wage is fixed on hourly basis. A worker gets the minimum fixed wage/day plus the incentive for the number of pieces produced. To illustrate this, assume that there is 8 hour's shift the piece rate is Rs 4 and a minimum fixed wage of Rs 16/ hours (Rs 16 x 8 hours = Rs. 128 per day). The

standard time/piece is 15 min.

Now, there are two workers A and B. (If worker A produces 25 prices/day then he earns: Rs. 128 (min. guaranteed wage) + Rs. 100 (Rs. 4 x 25 pcs) = Rs. 228/ day

If worker B produces 40 pieces / day then he earns Rs. 128 (min. guaranteed wage) + Rs. 160 (40 pieces x Rs. 4) = Rs. 228/ day)

Advantages:
i. Min. guarantee improves sense of security.

ii. Disparity between slow and faster workers is reduced.

Disadvantages:
i. Demotivate faster worker.

ii. Slow workers get higher piece rate viz Rs. 5.12 (128/ 25).

Differential Piece Rates:
The shortcoming of the above mentioned incentive plans have given way Differential piece rates. The differential piece rates are classified under two heads viz. Individual incentive plans and Group incentive plans

Marketing

Marketing is the study and management of exchange relationships.[1][2] Marketing is used to create, keep and satisfy the customer. With the customer as the focus of its activities, it can be concluded that Marketing is one of the premier components of Business Management - the other being Innovation

Marketing vs. Selling

Marketing plays a major role in creating new channels or clients and maintaining the existing channels, which contributes to more sales. Selling involves making sales so as to increase the company's revenues. Despite their differences, the two

functions are dependent on each other.

Marketing and selling are both activities aimed at increasing revenue. They are so closely entwined that people often don't realize the difference between the two. This is particularly true in the case of small businesses, which often equates marketing with selling deliberately due to organizational and resource limitations. However, the fact is that they are two very different business activities.

Marketing Mix

Definition: The marketing mix refers to the set of actions, or tactics, that a company uses to promote its brand or product in the market. The 4Ps make up a typical marketing mix - Price, Product, Promotion and Place. However, nowadays, the marketing mix increasingly includes several other Ps like Packaging, Positioning, People and even Politics as vital mix elements.

Description: What are the 4Ps of marketing?

Price: refers to the value that is put for a product. It depends on costs of production, segment targeted, ability of the market to pay, supply - demand and a host of other direct and indirect factors. There can be several types of pricing strategies, each tied in with an overall business plan. Pricing can also be used a demarcation, to differentiate and enhance the image of a product.

Product: refers to the item actually being sold. The product must deliver a minimum level of performance; otherwise even the best work on the other elements of the marketing mix won't do any good.

Place: refers to the point of sale. In every industry, catching the eye of the consumer and making it easy for her to buy it is the main aim of a good distribution or 'place' strategy. Retailers pay a premium for the right location. In fact, the mantra of a successful retail business is 'location, location, location'.

Promotion: this refers to all the activities undertaken to make the product or service known to the user and trade. This can include advertising, word of mouth, press reports, incentives, commissions and awards to the trade. It can also include consumer schemes, direct marketing, contests and prizes.

What is the importance of the marketing mix?

All the elements of the marketing mix influence each other. They make up the business plan for a company and handled right, can give it great success. But

handled wrong and the business could take years to recover. The marketing mix needs a lot of understanding, market research and consultation with several people, from users to trade to manufacturing and several others.

Product Life Cycle

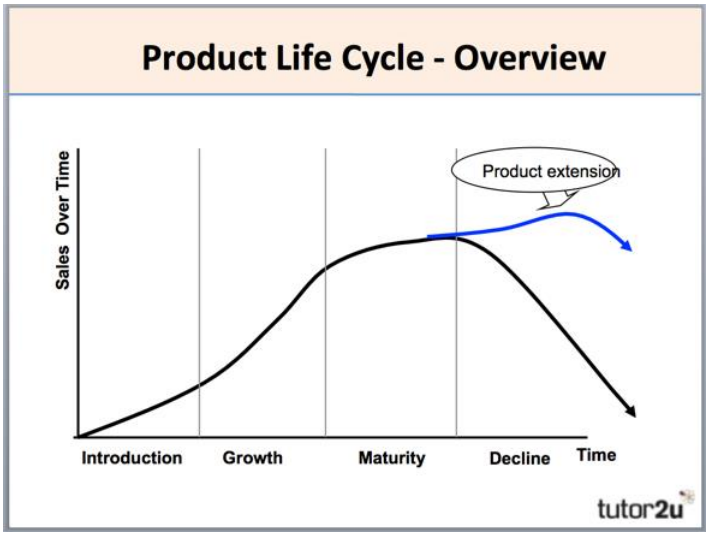
The product life cycle is an important concept in marketing. It describes the stages a product goes through from when it was first thought of until it finally is removed from the market. Not all products reach this final stage. Some continue to grow and others rise and fall.

What are the main stages of the product life cycle?

The main stages of the product life cycle are:

1. Introduction – researching, developing and then launching the product
2. Growth – when sales are increasing at their fastest rate
3. Maturity – sales are near their highest, but the rate of growth is slowing down, e.g. new competitors in market or saturation
4. Decline – final stage of the cycle, when sales begin to fall

This can be illustrated by looking at the sales during the time period of the product



Extending the Product Life Cycle

What can businesses do to extend the product life cycle?

1. Extension strategies extend the life of the product before it goes into decline. Again businesses use marketing techniques to improve sales. Examples of the techniques are:
2. Advertising – try to gain a new audience or remind the current audience
3. Price reduction – more attractive to customers
4. Adding value – add new features to the current product, e.g. improving the specifications on a smart phone
5. Explore new markets – selling the product into new geographical areas or creating a version targeted at different segments
6. New packaging – brightening up old packaging or subtle changes