Motivation:

Introduction – Definitions:

The term motivation is derived from the word 'motive' and is as defined by Berelson and Steiner – "an inner state that energises, activates and that directs or channels behaviour towards goals".

Motivation is a general term applying to the entire class of drives, desires, needs, wishes and such similar forces or factors. When we say that, a manager motivates his subordinate employees, it means that he does those things which, he hopes, will satisfy these factors (drives and desires) and thereby induce subordinates to act in the desired manner.

Scot defines motivation as, "a process of stimulating people to action, to accomplish desired goals".

The level of motivatiomn directly related to the level of incentives and disincentives, i.e.,

Motivation = Incentives – Disincentives.

The level of motivation does not only affect employees psychologically, but also their performance level; i.e.,

Performance = Ability x Motivation.

To have an effective technical organization we need to understand the nature of motivation, especially as it applies to technical professionals **Berelson** and **Steiner** have defined motive as "an inner state that energizes, activates, or moves (hence 'motivation'), and that directs or channels behaviour toward goals".

Robbins defines motivation in an organizational sense as "the willingness to exert high levels of effort to reach organizational goals, conditioned by the effort's ability to satisfy some individual need".

Campbell et al. define motivation in terms of three measures of the resulting behaviour:

1. The *direction* of an individual's behaviour (measure by the choice made when several alternatives are available)
2. The *strength* of that behaviour once a choice is made.
3. The persistence of that behaviour.

Shannon concludes that "there is only one way to get people to do what you would like them to do, and that is by making them *want* to do it. Motivation flows from within the individual". Therefore, we need to learn why people want to do things, and how they can be persuaded (or motivated) to do those things that will enhance organizational goals.

The Carrot and The Stick Theory:

The metaphor 'the Carrot and the Stick' related to the use of rewards and penalties respectively in order to induce the desired behaviour of the employees. It comes from the old story that to make a donkey move, one must put a carrot in front of him or jab him with a stick from behind.

Despite all the research on motivation techniques, the reward and punishment are still considered as the strong motivators. The Carrot – in the form of reward – represents

money, promotion, appreciation and other benefits and the Stick – in the form of punishment – represents loss of job, loss of income, reduction of bonus, demotion or some other forms of penalty. Using the carrot and stick approach, there are basically two ways; behaviour is changed by force or by choice through the use of incentives.

The 'stick' or fear is a good motivator and when used at the correct times can be very helpful. In that context, fear has always been the 'convenient' choice of Malaysian managers and organizations. When all else fails, the stick approach is somehow most attractive as it usually produces instantaneous compliance and hence immediate results. Fear is also attractive as in the short term, an employee's performance may be improved without any need for incentives or financial remuneration.

Fear however has its weaknesses in that an organization motivated by fear is prone to mutiny. It can also be stressful for employees. It is extrinsic, which means that the motivation only works while the motivator is present. When the motivator goes, the motivation also usually goes. Fear is also only useful on a short-term basis, as it needs to be applied in ever-increasing doses. In a worst case scenario, fear motivation can backfire and could even lead to cases of sabotage.

On the other hand, people contribute or become more productive because they are offered incentives i.e. the carrot approach. The major advantage with this is that it can work very well as long as the incentive is attractive enough. A good illustration of this concept is by using the well-known analogy of a donkey with a carrot dangling in front, and with a cart behind. In this instance the carrot serves as the incentive. However, the carrot will serve as an incentive to motivate only if there a combination of:

a) the donkey is hungry enough,
b) the carrot is sweet enough; and
c) the load is light enough.

If any of the above is not satisfied, then the carrot will not serve as an incentive. On the assumption that the conditions are satisfied, there is still the question of letting the donkey take a bite of the carrot from time to time, otherwise it is going to get discouraged. A new scenario will then develop in that if the donkey gets to eat the whole carrot and is now not hungry anymore; putting another carrot in front of it will not serve as an incentive, until it gets hungry again. This is very often seen in organizations where salesmen on meeting their quota, stop working as their motivation is only limited to meeting that target.

Once the donkey has eaten the carrot, the next carrot may not be as attractive an incentive as the first. On the other hand changing the incentive to another vegetable may not necessarily motivate unless the donkey perceives it as a better incentive than the carrot. This is another very important element in motivation and that is the reward must be perceived as attractive enough. Otherwise it will not serve its purpose effectively, and may in fact backfire.

Here is the question to evaluate critically – "***Is Money the best Carrot***"?

Maslow's Need Hierarchy Theory of Motivation:

Maslow's 'need hierarchy theory' is probably one of the earliest and most popular and infulenccial content theory of motivation. **Abraham.H.Maslow**, a famous psychologist and social scientist, suggested that people have a complex set of exceptionally strong needs and the behaviour of the individuals at a given moment is usually determined by their strongest needs.

Maslow's theory is based upon two assumptions, namely:

1. the human beings have many needs that are different in nature ranging from the biological needs at the lower level which is the level of survival to psychological needs at the upper extreme which is the level of growth; and
2. the needs occur in an order of hierarchy so that lower needs must be satisfied before the higher level needs arise or become motivators. **Mahatma Gandhi**, therefore, once remarked – "even God cannot talk to a hungry man except in terms of food".

Maslow saw human needs in the form of hierarchy and is arranged in a hierarchy of five successive orders, ascending from the lowest to the highest needs. The physiological needs are the lowest level followed by the security (safety), social, esteem (egoistic), and self-actualisation needs; and he concluded that when one set of needs was satisfied, this kind of need ceased to be the motivators. Maslow's need hierarchy may be depicted as below:

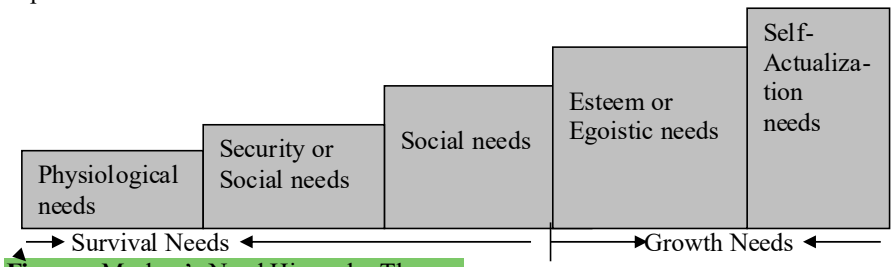


Figure: Maslow's Need Hierarchy Theory.

The first three level needs are known as "***deficiency needs or survival needs***", because they must be satisfied inorder to ensure the individual's very existence and security (safety) and make him fundamentally comfortable. The two higher level needs are classified as "***growth needs***", since they are concerned with personal growth , development, and full realisation of one's potential.

1. **Physiological Needs** – These needs arise out of the basid physiology of life and the basic needs for sustaining human life itself; such as food, water, warmth, shelter, sleep, rest, etc., and are must be atleast partially satisfied for continued survival as necessaries of life.
2. **Security or Safety Needs** – Once the physiological needs are satisfied reasonably, other level needs become important. According to P.F.Drucker , "one's attitude towards security is an important consideration in choosing a job". It includes feeling free from physical danger, deprivations, economic threats and protection from arbritrary lay-off, dismissal, disaster, etc., and also stability and the like. Organisation can influence these security needs through pension plan, insurance plan, provident fund facilities, etc.
3. **Social Needs** – Since man is a social being, he has needed to belong and to be accepted by others and the people want to love and be loved. It includes the need of belongingness, association, affiliation, etc.
4. **Esteem (Egoistic) Needs** – The esteem needs are concerned wih self-respect, self-confidence, a feeling of personal worth, feeling of being unique and recognition, power, prestige, status, control, etc.
5. **Self-actualisation Needs** – This term coined for the first time by Kurt Goldstein and he stated it as "the tendency to become actualised in one's own potentiality". A man with high intensity of achievement needs will be restless unless he can find fulfilment in doing what he is fitted to do. As Maslow states, "this need might be phrased as the desire to become more and more of what one is, to become everything that one is capable of becoming". Status and role are not material to the drive for self-satisfaction.

Maslow suggests that the various levels of needs are interdependent and overlaping, where higher level needs emerge before the lower level needs are fully satisfied. When a need is fully satisfied, that need ceases to be the primary motivator and the next level need then begins to dominate. Maslow's need hierarchy theory made management aware that people are motivated by a wide variety of needs and that management must provide an opportunity for the employees to satisfy these needs through creating a physical and conceptual work environment so that they will be motivated to do their best to achieve organisational goals.

Motivation – Hygiene Theory (Herzberg's Two Factor Theory) of Motivation:

In 1950s Fredrick Herzberg, a well known management theorist with his associates conducted intensive study of experiences, feelings, and need satisfaction of 200 engineers and accountants employed in the firms in and around Pittsburg, USA. The purpose of the study was to find out – what people want and what motivates them. He asked the people to explain the situations in which they found their jobs – 'exceptionally good', therefore motivating and 'exceptionally bad'. Herzberg concluded, that there were two categories of needs essentoially indepe de t of each other affecting behaviour in different ways; they are :

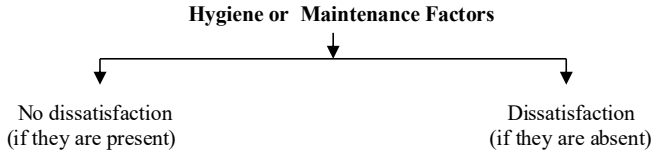
1. **The Hygiene or Maintenance Factors:**

These include the need-factors wh;i;ch operate primarily to dissatisfy employees when they are absent and are not effective enough to bring strong motivation when they are present. These factors are **TEN** in numbers:

- Company policy and administration
- Technical supervision
- Interpersonal relations with superior
- Interpersonal relations with peer
- Interpersonal relations withsubordinates
- Salary
- Job security

- Personal life
- Work conditions; and
- The status.

Then, these factors operate as shown below:



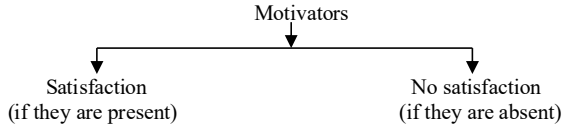
These are ***extrinsic*** to the job, but they are related to conditions under which a job is performed. These maintenance factors are necessary to maintain a reasonable level of satisfaction in employees and they prevent only losses in workers performance, but produce no growth in productivity.

2. **Motivational Factors:**

Motivational factors or satisfiers are directly related to job content itself, the individual performance or it, its responsibilities and the growth and recognition obtained fronm it; i,e., motivators are ***intrinsic*** to the job. Herzberg included **six** factors under this category such as:

- Achievement
- Recognition
- Advancement through creative and challenging work
- The work itself
- The possibilities of personal growth; and
- The responsibility.

These are the job-conditions, if present build high levels of motivation and job-satisfaction. However, if these conditions are not present, they do not cause dissatisfaction, and then they operate as below:



Thus, the employees of an organisation are classified into 'motivation seekers'(those who work for hygine or maintenance factors) and 'maintenance seekers'(those who work for the motivators)

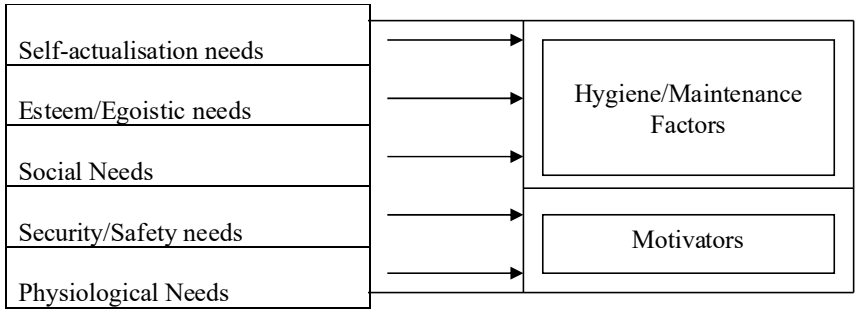
A composite of the factors that are involved in causing job satisfaction and job dissatisfaction, (was) drawn from samples of 1,685 employees……..The results indicate that motivators were the primary cause of satisfaction, and hygiene factors the primary cause of unhappiness on the job. The employees, studied in 12 *different investigations, included lower-level supervisors, professional women, agricultural administrators, men*

about to retire from management positions, hospital maintenance personnel, manufacturing supervisors, nurses, food handlers, military officers, engineers, scientists, housekeepers, teachers, technicians, female assemblers, accountants, finish foremen, and hungarian engineers.

They were asked what job events has occurred in their work that had led to extreme satisfaction or extreme dissatisfaction on their part …….of all the factors contributing to job satisfaction, 81% were motivators. And of all the factors contributing to the employees' dissatisfaction over their work, 69% involved hygiene elements.

Maslow's Theory and Herzberg's Theory – A Comparison:

Herzberg's hygiene factors correspond well to the lower three of Maslow's needs (physiological, security/safety, and social), and his motivators with the upper two (esteem/egoistic and self-actualisation/self-fulfillment). Herzberg considered salary as primarily a hygiene factor, and certainly it leads a person to be dissatisfied when their salary is less than think is merited, or when they are given a smaller raise than the employee at the next desk. However, salary is "a way of keeping score", and a healthy raise can be clear recognition for one's work and in that sense motivating. Bonuses and profit sharing can be motivating as well.



Maslow's Need Hierarchy **Herzberg's Two-Factor Theory**

Relevance (Implications) of the Herzberg Theory:

Herzberg developed the methodology of *job enrichment* to increase the content of motivators in a job. Examples of job enrichment actions include reducing the number and frequency of controls, making the worker responsible for checking his or her own work, establishing a direct relationship between the worker and the customer or user of that work (whether internal or external), and in other ways increasing authority and autonmy.

Job enrichment and the underlying two-factor theroy have attracted many disciples, who have applied it in a wide variety of enviorments. In an extended study at **Texas Instruments**, Myers found that engineers, manufacturing supervisors, hourly male technicians, and especially scientists tended to be motivation seekers, whereas female assemblers tended to be maintenance seekers.

Based on analysis of job-enrichment efforts and attitude surveys involving primarily blue-collar workers, **Fein** reported that essentially all job-enrichment efforts are initiated by management, not by a desire of workers or their unions to make jobs more meaningful, and concluded:

For the most part (blue-collar) workers satisfied with the nature of their work. What they find most discomforting is their pay, their job security, and many of the work rules with which they must cope.

In the 1980s many American companies, especially the automobile industry, tried to reduce the number of categories of production workers by asking workers to learn several jobs,so that they could be used more flexibly and labour cost could be reduced. In essence, this amounted to job enrichment for the benefit of corporate profit and, ultimately, the survival of the plants against foreign competition. American union workers fought this attempt bitterly.

McClelland's Trio of Needs:

David McClelland and others have proposed that there are three major motives or needs in work situations. Shortly after World War II, a group of psychologists led by David C McClelland of Harvard University began to experiment with TAT (Thematic Apperception Test) to see if it were sensitive enough to detect changes in motivation that were caused by simple attempts to sway the individual's attitudes. In order to simplify their task, the group decided to select one particular motive for intensive analysis. For, it was not long before the implications of the achievement motive were recognized that it became the subject of intensive investigation in its own right.

McClelland had identified three types of basic motivating needs. He classified these needs as:

1. **Need for Achievement (*n/ACH*)** – this is also called as Achievement Motive. Over the years, behavioural scientists have observed that some people have an intensive desire to achieve. It is the drive or desire to excel, to accomplish something better than has been done in the past. People with a high need for achievement tend to be entrepreneurs, setting moderately difficult goals, taking moderate risks to achieve them, and taking personal responsibility for getting things done. McClelland's research has led him to believe that the need for achievement is a distinct human motive that can be distinguished from other needs. It can also be isolated and assessed in any group. He identified four basic characteristics of high achievers:
    a. Ability to accept *Moderate Risks*.
    b. Immediate and precise *feedback* about how he is progressing toward goal.
    c. *Accomplishment* of the task.
    d. *Preoccupation with the tasks* until it is successfully completed.
2. **Need for Power (*n/PWR*)** – The ability induce or influence behaviour is power and is also called as Power Motive. It is the desire to control one's environment, including resources and people. Persons with high need for power are more likely to be promoted to managerial positions and are likely to be successful managers if they master self-control and use their power for the good of the organization rather than solely for personal ends. McClelland and his associates have found that people with high power motive are generally seeking positions of leadership; they involve in conversations; they are forceful, outspoken, hard headed, and demanding.
3. **Need for Affiliation (*n/AFF*)** – Since people are social animals, most individuals like to interact and be with others in situations where they feel they belong and are accepted. These are the needs of a human for companionship and acceptance. Sometimes, affiliation is equated with social motives or needs. People with a strong need for affiliation want reassurance and approval, are concerned about other people, and perform well as coordinators, integrators, counselors, and in sales positions. McClelland has suggested that people with high need for affiliation usually derive pleasure from being loved and tend to avoid the paid of being rejected. They are concerned with maintaining pleasant social relationships, enjoying a sense of intimacy and understanding, and enjoy consoling and helping others in trouble.

Implications of the Theory: The need for affiliation might be compared with Maslow's third level needs – the social needs, the need for power with his fourth level needs – Esteem or Egoistic needs, and the need for achievement with the fifth level needs – Self actualization needs. However, McClelland's point is that different people have different needs, not just the same need in a clear hierarchy of importance. For example, an engineer with a high need for achievement may achieve success in technical assignments in the process of satisfying this need, and he or she might be promoted into a management position as a result. If this need for achievement is combined with a low need for power, the engineer will often peak earlier in his or her career and at a lower level, since the need for achievement can be satisfied by the work itself rather than (as with need for power) requiring continuing promotions. Again, engineering jobs that put a premium on coordination and cooperation, such as today's team management organization or the matrix organizations common in project management, certainly require a blend of need for achievement and for affiliation.

Self Motivation:

The Managers or the Managements are responsible for providing an environment conducive to performance. But, individuals themselves are responsible for self motivation. Some of the steps to self motivation:

a) Set a goal for yourself and do not lose sight of it.
b) Supplement your long – term objectives with short – term goals and specific actions.
c) Learn a challenging new task each year.
d) Make your job a different one. Set improvement objectives for your position.
e) Develop an area of expertise. Build on your strengths or develop your weaknesses into strengths.
f) Give yourself feedback and reward yourself. Setting verifiable goals provides you with a standard against which you can measure your performance.

General Motivational Techniques (Motivation in Practice):

There exist no correact answers to the motivation problem to deal with it effectively. Many engineers and managers who have a very rationalistic approach to work seem to have difficulty with this. There are no universal solutions. What motivates one person will not motivate another, therefore the engineer who manages has to be prepared to compromise and develop strategies that form the best overall solution for a number of people, including themselves.

Therefore, managers have to try to develop an idea about what their subordinates are really like and expect and also establish what it is that drives them. Since, the motivation is a complex issue, affected and influenced by many factors, it is difficult to evaluate what motivates workers. Yet, managers or leaders need to possess and collect such information; using their knowledge of motivation theories of Maslow's Need Hierarchy theory, Two Factor Theory or Motivation and Hygiene Theory of Herzberg, and 'goals' as motivators as explained by Hunt and others – which will help the managers to understand the psychology of the employees.

Inorder to improve the motivation and providing opportunity for improvement it is essential to understand the factors which motivate the subordinate employees of a manager. Job-descriptions and appraisal interviews of employees can both help in improving motivation as they cn be used to set goals, clarify what is expected by the employees of doing a particular job. Moreover, various general and common motivational factors are identified to promote better work conditions and improve productivity both in quality and quantity.

The techniques of motivation refers to the job redesign and structuring tasks high level of motivation. It involves alteration of specific aspects of job in a manner, that would increase both the quality of the employees' work experience as well as his productivity. It involves:

- Altering the basic relationship between employees and their jobs.
- Developing a direct relationship between the job and employee behaviour; so as to make the worker to experience more rewarding work; through wich developing favourable attitudes.
- It opens opportunities to initiate changes in other areas such as development of supervisory skills and management development programmes.
- It makes an organisation people-oriented rather than machine-oriented. The work activities become more challenging and as a result the workers experience feeling of worth, personal growth and development and aspire for higher needs such as self-esteem and self-actualisation.

The practice of motivation and the techniques (motivators) used to motivate the employees in any organisation generally involves:

- Monetay and economic rewards,
- Job-enlargement – which seeks to motivate the employees by enlarging the scope of the job,
- Job-enrichment – it implies deliberate upgrading of responsibility, scope and challenge in work,

- Job-rotation – the employees may be shifted from one job to anotherinorder to provide some variety so as to minimise the monotomy and boredom of doing the same routine job,
- Participation of workers – by using participation of workers in decision-making, greater acceptance to change is accomplished,
- Creation of highly work accomplishment environment,
- Effective Criticism – it helps in improving an employees behaviour and performance; and
- Praise – the praise and credit for work done is a good and effective method of motivation and it satisfies ego and esteem needs of employees.

Leadership:

Nature of Leadership:

Leadership is the process of getting the cooperation of other in accomplishing a desired goal. The modern day leaders all over the world have taken their places in guiding the thoughts and effforts of people to the achievement of the common goals. Coming to the business organisations, people working there need leaders; who could be instrumental in guiding the efforts of group of workers to the achievement of goals and objectives both of the individuals and the organisation. Leadership is intrinsically linked with motivation.

Ordway Tead in his "The Art of Leadership" has defined leadership as "*the activity of influencing people to cooperate towards some goal which they come to find desirable*". In the context of business situation, leadership is one of the means of direction and represent that part of the manager's activities by which he guides and influences the behaviour of his subordinates and the group towards some specified goals by personally working with them and by understanding their feelings and problems as they engage themselves in doing certain jobs assigned to them. Thus, leadership is defined as, "***the ability to influence people or subordinate toward the accomplishment of goals***".

Harry Truman explained: "You know what makes leadership? It is the ability to get men to do what they don't want to do and like it". In a more subtle vein, **Barney Frank** said: "The great leader is the one who can show people that their self-interest is different from that which they perceived".

People become leaders by appointment are called as *Formal or titular* leaders. *Emergent or informal* leaders evolve based on their expertise or referent powers as it is expressed in the process of group activity.

Leadership Traits: Early researchers into the nature of leadership tried to identify the *personal characteristics or traits* that are made for effective leaders. For example, Peterson and Plowman list the following 18 attributes as being desirable in a leader.

1. **Physical qualities** – health, vitality, and endurance.

2. **Personal attributes** – personal magnetism, cooperativeness, enthusiasm, ability to inspire, persuasiveness, forcefulness, and tactfulness.
3. **Character attributes** – integrity, humanism, self-discipline, stability, and industriousness; and
4. **Intellectual qualities** – mental capacity, ability to teach others, and a scientific approach to problems.

Styles of Leadership:

The styles of leadership adopted by a leader differs and are relative to the attitude and traits of the leader, behaviour of the followers, and expectations of the management and so on. The major styles of leadership described with the following terms:

1. Autocratic (Dictator) leadership - Autocratic leadership is an extreme form of transactional leadership, where leaders have absolute power over their workers or team. Staff and team members have little opportunity to make suggestions, even if these would be in the team's or the organization's best interest.

Most people tend to resent being treated like this. Therefore, autocratic leadership often leads to high levels of absenteeism and staff turnover. However, for some routine and unskilled jobs, the style can remain effective because the advantages of control may outweigh the disadvantages.

2. Bureaucratic leadership - Bureaucratic leaders work "by the book." They follow rules rigorously, and ensure that their staff follows procedures precisely. This is a very appropriate style for work involving serious safety risks (such as working with machinery, with toxic substances, or at dangerous heights) or where large sums of money are involved (such as handling cash).

3. Charismatic leadership - A charismatic leadership style can seem similar to transformational leadership, because these leaders inspire lots of enthusiasm in their teams and are very energetic in driving others forward. However, charismatic leaders can tend to believe more in themselves than in their teams, and this creates a risk that a project, or even an entire organization, might collapse if the leader leaves. In the eyes of the followers, success is directly connected to the presence of the charismatic leader. As such, charismatic leadership carries great responsibility, and it needs a long-term commitment from the leader.

4. Democratic leadership or participative leadership – Although democratic leaders make the final decisions, they invite other members of the team to contribute to the decision-making process. This not only increases job satisfaction by involving team members, but it also helps to develop people's skills. Team members feel in control of their own destiny, so they're motivated to work hard by more than just a financial reward.

Because participation takes time, this approach can take longer, but often the end result is better. The approach can be most suitable when working as a team is essential, and when quality is more important than speed to market, or productivity.

5. Laissez-faire (Free–rein) leadership - This French phrase means "leave it be," and it's used to describe leaders who leave their team members to work on their own. It can be effective if the leader monitors what's being achieved and communicates this back to the team regularly. Most often, laissez-faire leadership is effective when individual team members are very experienced and skilled self-starters. Unfortunately, this type of leadership can also occur when managers don't apply sufficient control.

6. People-oriented leadership or relations-oriented leadership - This is the opposite of task-oriented leadership. With people-oriented leadership, leaders are totally focused on organizing, supporting, and developing the people in their teams. It's a participative style, and it tends to encourage good teamwork and creative collaboration. In practice, most leaders use both task-oriented and people-oriented styles of leadership.

7. Servant leadership - This term, created by Robert Greenleaf in the 1970s, describes a leader who is often not formally recognized as such. When someone, at any level within an organization, leads simply by meeting the needs of the team, he or she is described as a "servant leader."

In many ways, servant leadership is a form of democratic leadership, because the whole team tends to be involved in decision making.

Supporters of the servant leadership model suggest that it's an important way to move ahead in a world where values are increasingly important, and where servant leaders achieve power on the basis of their values and ideals. Others believe that in competitive leadership situations, people who practice servant leadership can find themselves left behind by leaders using other leadership styles.

8. Task-Oriented leadership - Highly task-oriented leaders focus only on getting the job done, and they can be quite autocratic. They actively define the work and the roles required, put structures in place, plan, organize, and monitor. However, because task-oriented leaders don't tend to think much about the well-being of their teams, this approach can suffer many of the flaws of autocratic leadership, with difficulties in motivating and retaining staff.

9. Transactional leadership - This style of leadership starts with the idea that team members agree to obey their leader totally when they accept a job. The "transaction" is usually the organization paying the team members in return for their effort and compliance. The leader has a right to "punish" team members if their work doesn't meet the pre-determined standard.

Team members can do little to improve their job satisfaction under transactional leadership. The leader could give team members some control of their income/reward by

using incentives that encourage even higher standards or greater productivity. Alternatively, a transactional leader could practice "management by exception" – rather than rewarding better work, the leader could take corrective action if the required standards are not met.

Transactional leadership is really a type of management, not a true leadership style, because the focus is on short-term tasks. It has serious limitations for knowledge-based or creative work, however it can be effective in other situations.

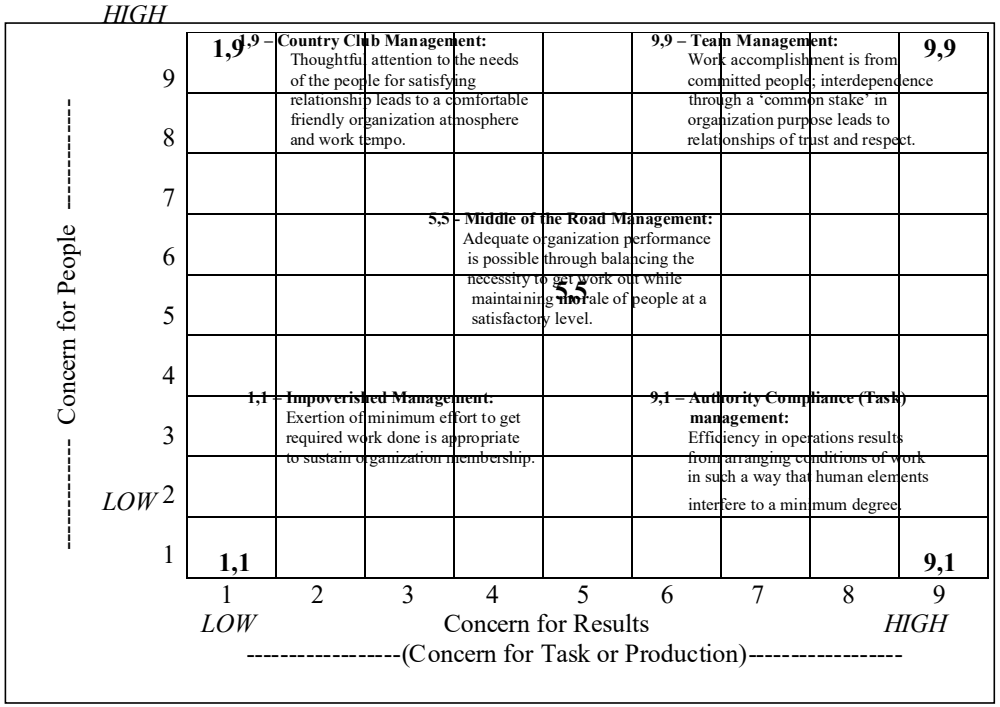
10. Transformational leadership - As we discussed earlier, people with this leadership style are true leaders who inspire their teams constantly with a shared vision of the future. While this leader's enthusiasm is often passed onto the team, he or she can need to be supported by "detail people." That's why, in many organizations, both transactional and transformational leadership are needed. The transactional leaders (or managers) ensure that routine work is done reliably, while the transformational leaders look after initiatives that add new value.

The Leadership Grid:

One of the widely known and popular approaches to identify leadership styles of practicing managers is the '***Leadership Grid***' or the '***Managerial Grid***' by Robert Blake and Jane Mouton, which shows that good leadership depends on skillful management of the task and the relationship between group members. The word 'Grid' means "an iron grating, a framework of parallel bars". It is graphical portrayal of two dimensional view of the grid – 'concern for the people' along with vertical axis and 'concern for task or production' along with horizontal axis, as depicted in the chart.

Robert.R.Blake and ***Jane.S.Mouton*** emphasize that leadership style consists of factors both the 'task oriented' and 'relation oriented' behaviour in varying degrees. The 'concern for' phrase has been used to convey how managers are concerned for people or production, rather than 'how much' production getting out of group. '***Concern for production or task***' means the attitudes of superiors (leaders) towards a variety of things, such as – quality of policy decisions, procedures and processes, creativeness of research, quality of staff-services, work-efficiency, and volume of output. '***Concern for People***' includes degree of personal commitment, trust, and satisfying interpersonal relations, etc.

Blake and Mouton identified **FIVE** basic leadership styles of practicing managers in the grid representing various combinations of the aforesaid two dimensions – 'concern for people' and 'concern for task or production'. It is, however, important to point out these basic styles are a matter of convenience rather than a fact. The figure given represents "managerial grid" or "leadership grid" in a nine-by-nine (9 x 9) matrix outlining eighty one (81) different leadership styles; and Blake and Mouton have described the five basic styles identified in the grid, which represents varying combination of 'concern for people' and 'concern for task'. The chart given represents the 'leadership grid' of Blake and Mouton, representing different styles of leadership followed by the practicing managers or leaders.



The five major basic styles of leadership followed by the practicing managers are discussed as below:

The 1,1 - Managerial Style (Impoverished Management):

It relates to the exertion of minimum effort to get required work done is appropriate to sustain organizational morale and membership. A manager or leader with this orientation exerts minimum influence on the contact with group members. He exposes little concern for the people and production or task. In this style the subordinates and members of the group are left to find for themselves the ways of doing the job.

The 1,9 - Managerial Style (Country Club Management):

It relates to "thoughtful attention to needs of people for satisfying relationships leads to a comfortable friendly organization atmosphere and work-groups and work-tempo". Here the boss is more of a big brother than an autocratic leader. The group, not the individual, is the key in the organization. The aim is to achieve friendliness and harmony among the members of the organization.

The 9,1 - Managerial Style (Task or Authority Compliance Management):

It relates to "the efficiency results in operation from arranging conditions of work in such a way that human elements interfere to a minimum degree; and have little effect". People or members of the group are regarded as the instruments of production under the 9,1 managerial style. It is an autocratic style of leadership; and it places heavy emphasis

on task and job requirement. Human relationships and interactions are minimized. Subordinates or the members are expected to carry out orders with an unquestioning obedience; merely as 'means for doing the tasks assigned to them.

The 5,5 – Managerial Style (Middle of the Road Management):

It relates to "adequate organization performance is possible through balancing the necessity to carry out work with maintaining morale of people at satisfying/satisfactory level". In this style, the 'people-dimension' is as important as the 'production or task dimension' at work. This style seeks to maintain a balance between the two. A basic assumption of this style is that people will work willingly and they are told the reasons for doing so are explained to them. In this style meetings are held to listen to their suggestions and to create a sense of participation in decision-making.

The 9,9 – Managerial Style (Team Management):

It relates "to work-accomplishment from committed people with interdependence through a common stake in organization purpose, which leads to relationships of trust and respect". A major difference between 9,9 style and other managerial style is in goal setting and its use as a basic management approach to a large variety of problems. The capability of people to be involved in organizational objective through commitment to objectives is fundamental. In other words, 9,9 –style aims at integrating the 'people and production' dimensions of work under conditions of high concern for growth. The key is the involvement and participation of these responsible for planning and execution of work. This brings about a kind of team-spirit that leads to high organizational accomplishment.

The 'leadership-grid' of Blake and Mouton is widely used as a technique of managerial training and for identifying various combinations of leadership styles. It helps the leaders and the managers to understand why they get the reactions from the subordinates or members. It also suggests some alternative styles available to the leaders with in the

Motivating and Leading Technical Professionals:

In the light of the knowledge of the study of general theories of motivation and leadership, let us make an attempt to apply them to the technical professionals. In this attempt we discuss something of the nature of the professional, what motivates scientists and engineers, and finally consider the significance of these factors in the effective leadership of technical professionals.

Project Planning and Acquisition:

Characteristics of a Project:

A project represents "a collection of tasks aimed toward a single set of objectives, culminating in a definable end point and having a finite life span". A project is a one-of-a-kind activity, aimed at producing some product or outcome that has never existed before.

Responsibility for a project is normally assigned to a single individual, assisted by a close-knit project team. The term 'programme' is sometimes used interchangeably with 'project', but more often a program is a more comprehensive undertaking, which may in turn consist of a number of projects.

Project management methods should be considered:
1) where close interaction of a variety of technologies, divisions, or separate organizations is required;
2) when completion within a tight schedule and budget is necessary; and
3) for activities involving significant technical and/or economic risk to the organization.

The **three essential considerations in project management** ("three-legged stool" of successful project management) are:

1) ***Time*** (project schedule),
2) ***Cost*** (monetary and other resources); and
3) ***Performance*** (the extent to which objectives are achieved).

Since, achieving maximum performance is often possible only at the expense of cost and schedule, difficult trade-off decisions involving compromises are often necessary.

The Project Proposal Process:

Every type of project should be preceded by a detailed description of what is to be accomplished, together with a proposal or estimate of the time and cost required. The various steps or components of the proposal process are:

Proposal Effort:

A successful organization generally begins the work long before a request for proposal (RFP) is received from a potential customer. The successful project-driven organization is continuously identifying new business opportunities- areas of technology or types of activity where attractive projects are likely to be funded. The firm estimates the resources and capabilities that will be needed to meet the expected future needs of potential customers, compare them with the resources they have on hand, and then proceeds to develop the needed technical skills and acquire other needed resources or at least identify sources for them in advance.

Proposal Preparation:

By the time the request for proposal (RFP) arrives, management often has appointed a proposal manager, who has prepared a budget for the proposal process and a letter ready for release calling on functional managers to provide members of the

proposal team. The RFP is quickly examined to be sure it holds no surprise, and the tentative decision to prepare a bid is reconfirmed.

A well prepared "kickoff" meeting for the proposal team launches the proposal process. A representative of senior management may give a short pep talk on the importance of the project to the company and introduce the proposal manager, who will do much or all of the following duties in proposal preparation:

a) Give an overview of what the RFP (request for proposal) asks for.
b) Provide the best estimate from company intelligence as to what the customer really wants and the factors the customer will use in determining the contract winner.
c) Identify the organization, schedule, and labour-hour allocations for the proposal effort.
d) Provide handouts giving, in as much as preparation time has permitted, management's concept of how the project might be carried out, and instructions to the project proposal team.

Proposal personnel are usually all experienced people, and so they can work rapidly with minimum guidance.

Proposal Contents:

The RFP (request for proposal) often specify separate management, technical, and cost proposals and their expected contents. It involves:

a) Management Proposal - The management proposal typically discussed the company, its organizations, its relevant experience, its management methods and control systems, and describes the personnel proposed to lead the project.
b) The Technical Proposal - The technical proposal outlines the design concept proposed to meet the client's needs, with special emphasis on the approach planned to resolve the most difficult technical challenges posed by the project.
c) The Cost Proposal - The cost not only includes a detailed price breakdown, but often also discusses aspects of inflation, contingencies, and contract change procedures.

The proposal package is critically reviewed by company senior management not involved in creation of the proposal, revised, printed, and delivered to the customer.

Project Planning Tools:

The project is a set of activities and planning is very extensive and critical to carryout these activities in project. The major planning tools available are:

1. The Statement of Work,
2. The Milestone Schedule,
3. The Work Breakdown structure,
4. The Gantt (Bar) Charts,
5. The Network Scheduling Systems (PERT, CPM , etc.); and
6. Resource Allocation Methods.

1. The Statement of Work:

The project award will generally be accompanied by a statement of work (SOW) describing exactly what is to be provided in the project. The SOW will normally begin with the general scope of the work, and then itemize the tasks to be performed, the contract end items (products) to be delivered, and the data and reports to be supplied. Sometimes the SOW is that proposed by the contractor in the proposal bid package, and sometimes it has been created or modified by the customer. In any event, it is essential that customer and contractor come to a common understanding of exactly what each paragraph of the SOW means before work has progressed very far.

2. Milestone Schedule:

Milestones are the key dates for major project phases or activities. A typical milestone schedule of an aerospace project is given below:

	2005												2006											
Milestone	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Project go-ahead			▲																					
Complete project plan				▲																				
Preliminary design review									▲															
90% design release															▲									
Prototype complete																		▲						
System Test Complete																				▲				
Final Design Review																						▲		
Production Release																								▲

Such a schedule is essential for detailed planning, since reaching a major milestone point typically requires the coordinated effort of a great many people. For example, a major design review may require completion to a specified level of component or subsystem design by dozens of design groups, analyses of reliability, maintainability, producibility, safety, and other aspects of the design, and plans for testing, training operators, production tooling, and logistic support. The milestone schedule is an essential and useful tool in accomplishing these aspects of a project proposal and design and a guideline to meet the major and crucial milestones in a project.

3. Work Breakdown Structure (WBS):

A Work Breakdown Structure (WBS) is a product-oriented "family tree" of work effort that provides a level-by-level subdivision of the work to be performed in a contract. The WBS provides a common framework or outline that can be used to:

a) Describe the total programme or project effort,
b) Plan and schedule effort,
c) Estimate costs and budgets,
d) Support network schedule construction,
e) Assign responsibilities and authorize work; and
f) Track time, cost, and performance.

Every project activity that consumes resources is included in some work package, permitting progress on a particular end item of the work breakdown structure to be evaluated.

4. Gantt (Bar) Chart:

Henry L Gantt, one of the pioneers of the scientific management movement, is generally credited with initiating the concept of a class of charts in which the progress of some set or sequence of activities or resources in the vertical dimension is plotted against time in the horizontal dimension. Gantt chart has many managerial applications such as in the job-shop or batch production environment, it is used to schedule the use of production machines, and elsewhere for the planning and control of work crews. In project management, it is tasks or activities that must be charted against time. Three things must be established in the project planning process before Gantt charts can be created:

a) The tasks or activities needed o complete the project.
b) The precedence relationships of the tasks (which tasks must be completed before other specified tasks can begin).
c) The expected duration of each task.

[**Note:** ***Give a numerical example and chart using example worked out in the class using the class notes on ETM***]

5. Network Scheduling System:

About 1958 two similar systems for network-based project scheduling were devised – the ***Programme Evaluation and Review Technique*** (**PERT**) was created by Booz, Allen and Hamilton (management consultants) and Lockheed Aircraft Corporation for the use in development of Polaris ballistic missiles , and the ***Critical Path Method*** (**CPM**) was developed by DuPont Company for chemical plant construction. In the subsequent years the features of each have been added to the other, but the terminology "PERT" is still used in aerospace and related industry, and "CPM" is preferred in the construction industry.

The network can be portrayed using either of the two graphical techniques:

a) The Activity-On-Node (AON) network diagram; and
b) The Arrow (Activity-On-Arrow) Network diagram.

PERT Treatment of Uncertainty:

A special feature developed with PERT is treatment of activity duration (and therefore total project duration) as variables rather than constants. To use this feature, estimators are asked to provide ***three estimates*** of the duration of any activity that might vary:

a) An *optimistic time* (t_a) that would only be improved upon once in 100 attempts,
b) A *most likely time* (t_m) that would occur most often if the activity were repeated many times (statistically, the mode); and
c) A *pessimistic time* (t_b) that would only be exceeded once in 100 attempts.

Then, the *expected time* (t_e) or mean value in the beta distribution can be approximated by

$$t_e = \frac{t_a + 4t_m + t_b}{6}$$

and, the *expected length of Critical Path* (T_e) for the entire project is obtained simply by adding the expected times (t_e) for only those activities lying on the critical path. Moreover, the *standard deviation* σT of the total project duration becomes the *root mean square* of the standard deviations of activities lying along the critical path:

$$\sigma T = \sqrt{\sum \sigma^2}$$

PERT calculations normally consider only the longest (critical) path. If there is a second near-critical path with a duration close to the critical one, ignoring it may lead to an overly optimistic estimate of the probability of completion.

[**Note***: **For the graphical, diagrammatic and numerical examples to write in your theory answers, please refer to your class notes on ETM***]

Distinction between PERT and CPM Network Analysis:

Although these techniques (PERT and CPM) use the same principles and are based on network analysis yet they are different from each other in the following respects:

a) PERT is appropriate where time estimate is uncertain in the duration of activities as measured by optimistic time, most likely time and pessimistic time, whereas CPM is good when time estimates are found with certainty. CPM assumes that the duration of every activity is constant and therefore every activity is critical or not.
b) PERT is concerned with events, which are the beginning or ending points of operation, while CPM is concerned with activities.
c) PERT is suitable for non-repetitive projects, while CPM is designed for repetitive projects.
d) PERT can be analyzed statistically, whereas CPM cannot.
e) PERT is not concerned with the relationship between time and cost, whereas CPM establishes a relationship between time and cost which is proportionate to time.

The most important difference is that originally the time estimates for the activities were assumed to be deterministic in CPM and probabilistic in PERT. Today, PERT and CPM actually comprise one technique and the differences if any are only historical. Therefore, these techniques are referred to as 'Project Scheduling' techniques.

Managerial Uses of PERT and CPM:

PERT and CPM as Project Scheduling techniques has a wide array of applications in managerial practice.

a) The PERT and CPM techniques help the management in properly planning the complicated projects, controlling working plan, and also keeping g the plan upto-date. These are also helpful in searching the potential spots and in taking corrective measures.

b) The network techniques provide a number of checks and safeguards against going astray in developing the plan for the project. Thus there are little chances of over-sight of certain activities and events.
c) These techniques help the management in reaching the goal with minimum time and least cost and also in forecasting the probable project duration and the associated cost.
d) The networks clearly designate the responsibilities of different supervisors. The supervisor of an activity himself knows the time schedule precisely and also the supervisors of other activities with whom he has to co-operate.
e) The flexibility of the network permits the management to make the necessary alterations and improvements as and when they are needed. These allocations can be made during the deployment of the resources and reviewing.
f) Application of network techniques has resulted in better managerial control, better utilization of resources, improved communication and progress reporting, and better decision making.
g) Application of PERT and CPM techniques resulted in saving of time which directly results in saving the cost. Also, saving in time or early completion of the project results in earlier returns of revenue and introduction of the product or process ahead of the competitors, resulting in increased profits.

Though the list containing the areas of application of PERT and CPM is very large, these techniques are very widely used in the areas of

- building construction,
- in administration for streamlining the paperwork, making major administrative changes, for making long range plans, etc.,
- in manufacturing areas like design development, testing, plant layout plans, installation activities, etc.,
- maintenance planning,
- research and development,
- marketing and inventory management and planning, etc.

Depreciation:

No articles remain ever new and immortal. Most of the productive instruments and articles such as building, plant, machinery, equipments and so on become obsolete (outdated) in course of time, losing their economic value and productive efficiency; and such fall in the economic value of assets is referred to as 'depreciation'.

The theory of depreciation contends that the capital sunk on an asset will become valueless after some period of time. This period of time id considered to be the life – time of the asset. The major aspects to be taken into consideration in depreciation calculation are:

a) The first cost or initial cost of the asset.
b) The period of time of depreciation assessment since the time of purchase.
c) The action of the enterprise resulting in depreciation; and
d) Any possible external changes of normal and predictable limits, etc.

Types (Kinds) and Causes of Depreciation:
A common classification of the types of depreciation includes:

1. Physical Depreciation; and
2. Functional Depreciation.

1. Physical Depreciation – The depreciation resulting in physical impairment of asset is known as 'physical depreciation'. Physical depreciation manifests itself in such tangible ways as the wearing of particles of an asset. The major causes of physical depreciation are:

- Physical decay or deterioration – There are certain items in a factory such as insulation materials, furniture, electric cables, buildings, chemicals, and vessels, etc., which get decay because of climate and atmospheric effect, with the result value of these articles goes on reducing with lapse of time.
- Wear and Tear – Continuous use of machines causes the machine and articles to wear-away and tear-out with time. The machines gradually tend to go out of adjustment not only as a result of use, and also because of temperature changes, vibration impact, etc.
- Ageing – Articles exposed to the atmosphere and weather conditions decay in the operating capacities or in their usefulness. This also contributes to the reduction in the economic value of the articles.
- Accident Depreciation – The newly installed machines without careful maintenance; the unexpected accidents result in loss of physical work-efficiency due to heavy damages and also loss if its economic value and such depreciation is called as 'accidental depreciation'.
- Deferred (Bad) Maintenance and Negligence – If the machines and articles are not maintained according to the instruction issued; such as lubricating, decarbonising, etc., and also negligence on the part of user of the machine may also result in lessening work-efficiency and depreciation of machines and assets. It also results in reduction of expected life time of the asset and loss of economic value.

2. Functional Depreciation – This is the result of failure of the machine or plant to function properly; caused by the factors like:

- Inadequacy – It means the capacity of a machine becoming less than what is required. Where the equipments are becoming inadequate for handling the load of new products and increased demands. Then these machines need to be either scrapped or replaced. Sometimes, even the healthy machines need to be dismantled and sold for a lesser price than what is really worth expected of it.
- Obsolescence or Outdatedness – It is loss of value of machine due to new inventions and new products replacing the old ones altogether. In other words, the existing machines become outdated and inadaptable to the new changes in production techniques, use and to produce the new products introduced into the product-line of the company.
- Lack of adaptability – the failure of the existing machines to adapt to the new method of production and use.

Methods of Computing Depreciation:

There are different depreciation methods applicable on the basis of the type and nature of the industry, pattern of profit earning, growth rate of the enterprise and out put, etc. Major methods of computing the depreciation of assets are:

1. Straight Line Method:

This method assumes that the loss of value of machine is directly proportional to its age. In this method the book-value of the asset decreases linearly (a straight line law) with time; because same amount of depreciation charge is made each year. It means one should deduct the scrap or salvage value (S) from the original value and divide the remaining value by the number of years of useful life (n). Then,

$$D=\frac{(C-S)}{n}$$

Where C – original cost
S - salvage or Scrap value or residual value
n – the serviceable life or economic life i.e., the number of years of useful life of the asset.
D – depreciation amount per year

Thus,
the depreciation in any year 't' is:

$$D_t=\frac{(C-S)}{n}$$

depreciation – fund (total amount of depreciation accumulated) at the end of year 't' is:

$$D_{ft}= t\left[\frac{C-S}{n}\right]$$

and ; the Book-Value (the value left with the machine) at the end of the year 't' is:

$$D_{vt}=C- t\left[\frac{C-S}{n}\right]$$

2. Reducing Balance Method:

This method is also called as 'Diminishing or Declining Balance Method' or 'Percentage on Book-Value Method'. In this method, depreciation takes place at a fixed rate on the basis of 'negative compound interest law'. Obviously, the depreciation charge is the largest in the first year and decreases in each succeeding years. Hence, under this method, the book-value of the machine goes on diminishing as its existence continues.

Then;
the fixed percentage rate of depreciation on Book – Value:

$$P=1-\left(\frac{S}{C}\right)^{\frac{1}{n}}$$

and; depreciation for any year 't' is:

$$D_t=C\times P(1-P)^{t-1}$$

the depreciation fund at the end of year 't' is:

$$D_{ft}=C\left[1-(1-P)^t\right]$$

the book-value for the year 't' is:

$$B_{vt}=C-C\left[1-(1-P)^t\right] = C(1-P)^t$$

There are two cases to be considered while calculating depreciation by reducing or diminishing balance method:

a) Considering not any interest on depreciation fund accumulated; i.e., depreciation fund is not invested on securities or deposited to earn interest. The formulae used are as given above and the calculations are direct.

b) Considering the interest earned on depreciation fund. The formula used here to calculate depreciation fund for the year 't' is:

$$D_{ft}=\frac{P\times C}{P+i}\left[(1+i)^t-(1-P)^t\right]$$

where; P – fixed percentage rate, i.e., $P=1-\left(\frac{S}{C}\right)^{\frac{1}{n}}$

i - interest charged on depreciation fund.

3. Sinking Fund Method:

This method is also known as the 'Interest Law Method', or 'Annuity or Compound Interest Method'. In this method, an identical sum is charged every year as depreciation. The rate of depreciation will be constant throughout the life of the machine. At the end of the useful life of the machine or asset, the total amount in depreciation plus compound interest should become equal to the original cost of the fixed assets.

The formulae to calculate depreciation under this method:

Depreciation for any year 't' is:

$$D_t=\left[(C-S)\left(A/F,\%,n\right)\right]\left(F/P,\%,t-1\right)$$

$$=\frac{i(C-S)}{(1+i)^n-1}$$

Depreciation fund at the end of year 't' is:

$$D_t=\left[(C-S)\left(A/F,\%,n\right)\right]\left(F/A,\%,t\right)$$

and the Book Value at the year end 't' is:

$$B_{vt}=C-D_{ft}$$

i.e., = C - $\left[(C-S)(A/F,\%,n)\right](F/A,\%,t)$

4. Sum of the Years' Digits Method:

This method is often called as 'Fixed Base Diminishing Rate Method'. In this method, the depreciation will be greater initially and it will go on decreasing gradually in subsequent years of usefully life of the asset. Therefore, while calculating the depreciation, the net amount (i.e., the total depreciation fund accumulated during the life time is equal to the total first cost minus scrap or salvage value) is spread over the whole life of the asset in a decreasing proportion. The credit of developing and elaborating this method goes to W.M.Cole in similarity with Diminishing Balance Method.

By following this method, if 'n' is the estimated life of the asset, the rate of depreciation is calculated for each period as a 'fraction' in which denominator is always the sum of the series 1, 2, 3, 4, ……t,……..n-1, n and the digits representing all the years from the first year of life to the last year of the life (eg., if a proposal has a life of 4 years , i.e., n = 4 years, then the sum of the years' digits is 1+ 2 + 3 + 4 = 10); and the numerator of the fraction is the digit giving the number of the years expressed in the reverse order, starting from the last year to the first year(eg., when n = 4; it begins from the year 4, 3, 2, 1). Let us say,

C = First cost of the asset,

S = Scrap or Salvage value of the asset,

N = useful life (economic life) of the asset.

Then,

Total Depreciation = $(C-S)$

Where, the denominator of the fraction is:

$$1+2+3+4+.....(n-1)+n=\frac{n(n+1)}{2}$$

and the numerator of the fraction for depreciation at the end of a particular year 't' is:

$$n+1-t$$

hence, Depreciation for a particular year 't' is:

$$D_t=\left[\frac{n+1-t}{\frac{n(n+1)}{2}}\right](C-S)$$

and the Depreciation fund accumulated after the year 't' is:

$$D_{ft}=\left[\frac{t\left(n-\frac{t}{2}+\cdot 5\right)}{\frac{n(n+1)}{2}}\right](C-S)$$

and the Book Value at the en of the year 't' is:

$$B_{vt}=C-D_{ft}$$

Depletion:

The calculation of depreciation of an asset that has a value (i.e., depreciation fund) that can be recovered by a replacement. Depletion is similar to depreciation; however, the depletion is very much applicable in calculations related to natural resources, which cannot be repurchased or replaced with new one like machines, plant, building, etc. Thus, the depletion method is applicable to natural deposits removed from mines, wells, quarries, forests, and so on. There are two methods of depletion:

a) Factor or Cost or Unit Depletion; and

b) Percentage Depletion.

Factor Depletion is based on the level of activity or usage, not time, as in the case of depreciation. The depletion factor, therefore, for the year 't' is:

Depletion (D_t) = Initial Investment ÷ Resource Capacity

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9. "Operation Research – An Introduction", - Hamdy A Taha; Pearson Prentice Hall.
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UNIT IV

Controlling – Meaning, Controlling Process, Three Perspectives on the Timing of Control, Types of Control, Characteristics of Effective Control System.

Controlling:

Meaning and Steps in the Control Process:

The simplest definition of controlling, attributed to B.E. Goetz, is "compelling events to conform to plans". As stated by Robert E Shannon, "control techniques and actions are intended to insure, as far as possible, that the organization does what management wants it to do". Control is a ***process*** that pervades not only management, but technology and our everyday lives. Effective control must begin in planning; as shown in figure below, the planning and control are inseparable.

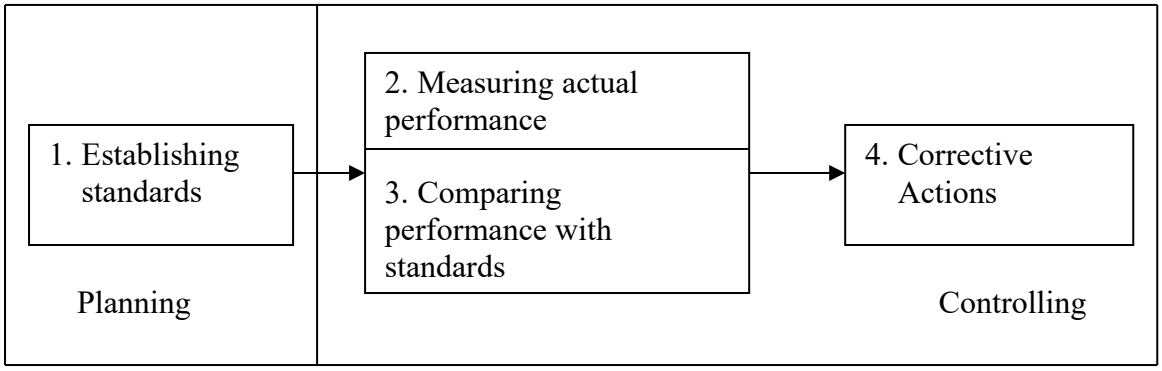

Figure: The Control process.

The steps in the Control Process are:

1. Establishing standards of performance – also an essential part of effective planning. Standards should be measurable, verifiable, and tangible to the extent possible.
2. Measurement of the actual level of performance achieved.
3. Comparison of the two – the established target or standard and actual performance, and measurement of the variance (deviation between the two) and communicating this deviation promptly to the entity responsible for control of this performance.
4. The final step is taking Corrective Action as required to "compel events t conform to plans".

Closed-Loop versus Open-Loop Control:

Closed-loop control, also known as ***automatic or cybernetic control***, monitors and manages a process by means of a self-regulating system. The essential feature of this type of control is the strong feedback system. A common home thermostat is a simple example of an automatic control system.

Open-loop or noncybernatic control requires an external monitoring system and an external agent to complete the control loop. Frequently, when an automatic device identifies and measures the deviation with warning signals, then the human judgement is required to identify the reason for the variance and to determine corrective action. Even systems that are automated (cybernetic) in the short run are ultimately open loop, because they permit an external agent to adjust the standard. In engineering management the last step in the control process, corrective action, usually requires human judgement.

Three Perspectives on the Timing of Control:

1. **Feedback Control** – Engineers are usually comfortable with idea of feedback systems, in which the output of a system can be measured and the variance between measured and desired output used to adjust the system.
2. **Screening or Concurrent Control** – Controls may also be applied concurrently with the effort being controlled. In this method corrective actions are sought at regular interval of production process. However, concurrent control can be expensive, stifling of initiative, and lead to inactivity while awaiting the next inspection.

3. **Feed-forward (Preliminary or Steering) Control** – the essence of this system of control is that it can predict the impact of current actions or events on future outcome, so that current decisions can be adjusted to assure that future goals will be met. Engineers and managers have many applications where controls must be applied in the early phases of a project or program. The PERT (Programme Evaluation and Review Technique) and CPM (Critical Path Method) are the examples of the feed-forward control tools used by the managers in controlling function.

Characteristics of Effective Control System:

An effective control system should satisfy most of the following criteria:

1. **Effective** – Control system should measure what needs to be measured and controlled.
2. **Efficient** – Control systems should be economical and worth their cost.
3. **Timely** – Control systems should provide the manager with information in time to take corrective action.
4. **Flexible** – Control systems should be tools, not straitjackets, and should be adjustable to changing conditions and requirements.
5. **Understandable** – Control systems should be easy to understand and use, and they should provides information in the format desired by the users.
6. **Tailored** – Where possible, control system should deliver to each level of manager the information they need for decisions, at the level of detain appropriate for the level.
7. **Highlight deviations** – Good control systems will "flag" parameters that deviate from planed values by more than a specified percentage or amount for special management attention.
8. **Lead to corrective action** – Control systems should either incorporate automatic corrective action or communicate effectively to an agent that will provide effective action; this is why the control system exists.

Types of Controls:

The major types of controls are grouped into Financial Controls and Non-financial controls.

Financial Controls

- Financial Statements
- Ratio Analysis
- Budgets – Budgeting process
- Cost Accounting
- Audits of Financial Data

Non-financial Controls

- Human Resource Controls
  - Management audits
  - Human resource accounting
  - Social controls - includes the corporate culture, values, obligations, norms, procedures, policies, etc..
- Other non-financial controls like – inventory control, quality control, project management controls, and so on.