

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING
TELANGANA :: HYDERABAD**

From
Er. A. Pullaiah,
M.I.E., M.I.S.T.E., F.I.E.,
Secretary
State Board of Technical Education & Training
Sankethika Vidya Bhavan, Masab Tank,
Hyderabad-500028.

To
The Principals of Government
and Private Un-Aided
Polytechnics in the state of
Telangana.

Sir,

Sub: SBTET- Academics - ME-501- Permit to allow the students to bring the Xerox copy of handout from OP Khanna Text Book which was watermarked under Open Book System - Regarding.

Ref:- 1. File No. SBTET-AAC/OTH/30/2020-ACA, dated 2-12-2021.
2. Mail received from the Principal, GPT, Jogipet, Dt: 26-08-2023.

In the reference 1st cited, the Principals of All Polytechnics have been informed that, the following are the open books identified under Open Book System in V semester, ME 501 of C-21 Curriculum, with a condition that only two books are allowed from the reference books during the examination.

SL NO .	Se m	Subjec t_ Code	Subject_ Name	Common to branches	Reference Books
1	V	ME-501	Industrial Managem ent and Entrepren eurship	ME/AU/CH/ CS/EE/EC/ LF/LG/PT/ TT/ES/CCB/ AI/CPS/EV/ EI	1. Industrial engineering and management by O.P Khanna. 2. Production management by Buffa 3. Industrial Engineering & Management Science by TR Banga 4. Engineering Economics and management science by Banga & Sharma 5. Personnel management by Flippo

In the reference 2nd cited, the Principal has stated that, the reference books suggested by the SBTET, are too costly and students are unable to purchase the books as they costs around Rs. 1500/- to Rs.2000/- and requested to give the handouts from the text book for ensuing examinations.

In view of the above, the Principals of the Polytechnics are informed to allow the handout (Watermarked the pages from the Text Book) ME-501 enclosed herewith.

(This has the approval of Chairman, SBTET)

Encl: IME Chapter-1 & 2 with watermark.

Yours faithfully,

Signed by Akuti Pullaiah

Date: 29-08-2023 15:35:39

SECRETARY

Copy to Joint Secretary (COE) in the SBTET.

Organisation

3.1. CONCEPT OF ORGANISATION

- Almost any business manager will affirm that sound organization is highly important to business success.
- Many will characterize organisation as the foundation upon which the whole structure of management is built.
- Organisation is a *mechanism* or *structure* that enables living things to work effectively together.
- Organisation may be defined as the process of (i) *identifying and grouping* the work to be performed, (ii) *defining and delegating responsibility and authority* and (iii) *establishing relationships* for the purpose of enabling people to work most effectively together in accomplishing objectives.
- Organisation is the pattern of ways in which a large number of people engaged in a complexity of tasks, relate themselves to each other in systematic establishment and accomplishment of mutually agreed purposes.

Organisation :

- (i) establishes the pattern of relationship by giving duties and responsibility to an individual or group;
- (ii) demarcates the authority, responsibility and duties of each individual or group;
- (iii) provides adequate communication; and
- (iv) coordinates or integrates and controls the activities of individuals or groups to achieve common objectives or objectives of the business enterprise.

For more details refer article 15.3.

3.2. IMPORTANCE OF ORGANISATION

- Sound organization can contribute greatly to the continuity and success of the enterprise.
- The importance of organization can be judged from the following words of *A. Carnegie*, an American Industrialist:
 "Take away our factories, take away our trade, our avenues of transportation and our money. Leave nothing but our organisation, and in four years we shall have re-established ourselves".
- *Facilitates Administration*: A properly designed and balanced organisation facilitates both management and operation of the enterprise; inadequate organisation may not only discourage but actually preclude effective administration.
- *Facilitates growth and diversification*: Sound organisation permits organizational elaboration.
- The organization structure can profoundly affect the people of the enterprise. Proper organisation facilitates the effective use of the manpower.

- Organisation theory helps managers in exploring, analysing and explaining what is happening in the organisations.
- In a very real sense, organisation theory can make a manager more competent and more influential. Understanding how and why organisations act, lets managers know how to react.

Different Organisation Theories

Various organisation theories have been and are being evolved. These theories may be grouped into three broad categories namely :-

- (A) Classical Organisation Theory
- (B) Neo-classical Organisation Theory
- (C) Modern Classical Theory.

3.6.1. CLASSICAL ORGANISATION THEORY

Concept

- The classical writers have viewed organisation as a *machine* and persons as different *components* of that machine.
- The classical theory has its origin in the writings of Taylor. However the main ideas of this Theory have been developed by Mooney, Brech, Allan and Urwick.
- As per Classical Theory, where organisation is treated as machine, the efficiency of the organisation can be increased by making each individual efficient in it. For instance, Taylor emphasised on division of labour, fixing every day's work etc.
- The emphasis is more on specialisation of performance and coordination of various activities.
- Classical theory completely ignores the *human aspects* of organisation and deals exclusively with the formal structure that should be in an organisation.

Key Pillars (or Characteristics) of Theory

(i) Division of Labour

- It refers to the division of the organisation task into subtask and then allot these subtasks to individuals in such a way that each individual would have the narrowest task so that he can specialise himself in that task with a view to improve the efficiency of the organisation.

(ii) Scalar and Functional Processes

- Scalar and functional processes deal with the *vertical* and *horizontal* growth of the organisation respectively.
- The *scalar process* deals with the *vertical* elaboration of organisation. The scalar process refers to the growth of the chain of command, the delegation of authority and the unity of command from the top (chief executive) to the bottom (first line supervisor); and obligation and reporting from the bottom to the top. Whenever there are two persons in an organisation existing in a superior subordinate relationship, there is a *scalar* relationship.
- The *functional process* focuses on the *horizontal* elaboration of the organisation. The functional process refers to the division of organisation into specialised parts and the regrouping of the parts into compatible units. Two experts such as a Legal Adviser and a Manager Industrial Engineering working in the same organisation have *functional* relationship.

(iii) Structure

- Structure is the framework of the formal relationship among various persons (tasks and activities) in the organisation.
- Proper structure, by introducing logical and consistent relationship among various functions, determines how effectively and efficiently an organisation will perform. The basic structural element in the classical theory is the position. These positions are grouped together in various ways – either horizontally, vertically or both *line* and *staff* relationships.
- People and departments that are authorized to determine the basic objectives of the organisation and assess the achievements constitute the line function, for example, a production manager. The *staff function* is that part of the organisation which assists and advises the line function on specialized matters. For example, an Industrial Engineer or a Personnel Manager is a staff function.

(iv) The Span of Control

- In order to achieve the objectives of the organisation, a manager has to look after the works of several subordinates in a large organisation. However, a manager cannot effectively supervise unlimited number of subordinates because he has a limited time and energy.
- The span of control refers to the number of subordinates a manager can supervise effectively.
- Classical theory puts a limit on the span of control. According to Urwick, no superior can supervise directly the work of more than five or six subordinates.

Criticisms of Classical Theory*(i) Criticisms of principles*

- The classical principles are mainly based on experience and not tested by researches.
- Lack of universality.
- The classical theory is based upon the hierarchical structure that establishes the authority (superior-subordinate) relationships between individuals in an organisation. Today, not this concept, but the technological specialisation with authority is gaining importance.
- Classical theory suggests unity of command i.e., each person has only one superior. Today, due to introduction of specialized staff functions, work is carried out under *multiple command*.

(ii) Unrealistic assumptions

- The Classical Theory assumes the organisation – a closed system – a house that, once created will work smoothly.
- Static view of organisation. That the organisation is not dynamic and it does not adopt any change whatsoever.
- Unrealistic assumptions about human behaviour. The theory assumes human beings as inert machines.
- That people at work can be motivated solely through economic rewards.

(iii) Excessive reliance on the strength of key pillars

- Division of labour causes depersonalisation of work at the operative level which results in loss

(iii) What are the processes which link various parts of the system and facilitate their adjustment to each other?

(iv) What are the goals of the system.

(i) **Parts of the System**

— Organisation being a system has the following five parts :-

(1) *Individual*

- An organisation is nothing but collection of individuals who have united to achieve its goals.
- Individuals enter the organisation with varied backgrounds, attitudes, motives and sentiments. They interact and influence each other and the things in the environment and are also influenced by them.

(2) *Formal Organisation*

- Formal organisation structure is the vehicle for uniting the individuals and their efforts to achieve organisational goals.
- Formal organisation has certain laid down principles, rules, regulations, procedures and norms of conduct for its proper functioning.
- A well defined structure of the organisation provides the guidance, consistency and control essential to achieve a productive unified effort.

(3) *Informal organisation*

- It comes into existence automatically alongwith the formal organisation because, while at work, individuals interact and develop certain relations and sentiments – positive, negative or indifferent.
- The informal organisation has its own goals, objectives and authority patterns and these factors may or may not coincide with those of the formal structure.
- Informal organisation is the primary source for the information and furtherance of *social ties*.
- Informal groups satisfy many of the social needs, remained uncared for by the formal organisation.

(4) *Status and Roles*

- Every organisation has a prescribed pattern of roles the individuals play. The roles differentiate one position from another.
- Role may be defined as a pattern of actions expected of an employee in the organisation.
- According to the roles, the individuals perform, their status or rank is determined.

(5) *Physical setting/environment*

- Physical setting implies the physical conditions (say shop floor conditions) under which a person has to do the work.
- Physical environment or working conditions affect efficiency level.

(ii) Nature of interdependency

- The above explained five parts of the system, work unitedly, cooperatively and in collaboration with each other. They interact within and between themselves. Such interactions are of two types :
- (1) *Interpart interactions* in which each part of the organisation interacts with all other parts. An individual may mould the group according to his point of view and then the group may put their viewpoint before the organisation.
- (2) *Intrapart interactions* in which an individual performs a minute part of the total job and even for that limited task he is to seek assistance from others, such as a lathe operator needs the services of maintenance-man. The individual's job may be a part of the series of processes involved.

(iii) Linking Processes

No part of the system works in isolation. They are interdependent and interlinked. The *linking* is achieved by three linking processes namely :-

(1) Communication

Through communication process, various parts are able to get, store, retrieve and feed information. The communication may be formal-informal, vertical-horizontal and line-staff.

(2) Decision-making

- All parts of the system make decisions and most of the decisions, especially the important ones are the result of joint efforts of various parts. Thus, the decision-making process links the various parts.
- Two classes of decisions are important viz. *decisions to produce* and *decisions to participate*. Interaction between employees and demands of organization results in decisions to produce. Decision to participate depends on the demands and rewards of organization.

(3) Balance

Balance refers to an equilibrating mechanism whereby the various parts of the system are maintained in a harmoniously structured relationship to one another.

(iv) Goals

- Every system including the organisational system has certain goals.
- Almost all organizations have at least three major goals namely *growth, stability and adaptability*.
- *Interaction* is essential ingredient so that all the subsystems in combination produce the output.

Appraisal of Modern Organization Theory

(A) The validity of the modern theory is appreciated on the following grounds :-

- (1) Modern theory considers organizational unit as *open system*. It essentially consists of five basic elements - input, transformation process, output, feedback and environment.
 - Being open system, it continually interacts with the external environment ; the basic purpose of interaction is *survival*.
 - Unlike closed system, the open system operates even in the event of dynamic and ever changing environment.

- Since every action involves an element of risk in decision, the best course of action would be that a decision should be arrived at from the pooling of judgement of all those (e.g., chief executive and a team of staff specialists) who share in authority and responsibility for the situation in question.
- Everybody in the organisation structure must understand the limits of his authority and responsibility, i.e., he should know where his responsibility and authority start and stop.

(4) Span of Control

(i) *Span of control or span of management* refers to the number of subordinates that report to an executive or the number of subordinates that an executive can supervise directly.

(ii) An executive should not have more subordinates looking to him for guidance than he can reasonably be expected to serve; because

- (a) the executive has limited time available for his activities, and
- (b) he has limited available energy.

(iii) Depending upon the conditions of the business enterprise, the span of control may be any number varying from 2 to 20.

Some writers have concluded that ideal span is between four and eight; but it is fairly common to see as many as twelve or more workers reporting to a foreman.

(iv) If the span is small, an executive may tend to oversupervise and may do even spoon feeding to his subordinates. On the other hand if the span is large, the executive may not be able to supervise his subordinates efficiently and they may start thinking that they are too remote from the point of control and may become careless or they may feel that they are impersonal and unimportant part of the organisation machinery.

(v) The *span of control varies with and depends upon the following considerations:*

1. Trained and experienced subordinates need less directions and hence a large number of them can work under one executive.
2. Span of control can be large for workers, all doing specialised and same work at one table or very close to each other. For example, wider spans are suitable for assembly line work or routine clerical jobs.
3. For maintenance and R & D departments and other departments which require many policy decisions and coordination with the work of others, a small span of control is the ideal.
4. A small span of control is also ideal when a number of employees are working in isolated areas, doing different type of works and require close supervision and control.
5. Complex nature of work demands a small span of control.
6. Span of control even for the same nature of job varies from executive to executive and depends upon his capacity to guide and work.
7. Wider span of control can be employed if the organisation and its control system are efficient and communication is good.
8. Span of control can be widened by providing personal assistant to an executive; because a good P.A. can offset a good amount of routine work-load associated with a wide span of control.
9. Span of control is decidedly small for an executive who goes to the extent of checking each and every action of his subordinates.
10. A wider span of control can be employed in an organisation which has clear and definite objectives, policies and plans with no confusion in the minds of employees; and if each employee knows about his job (work), duties, responsibility and authority.

11. Besides certain weaknesses of a wider span and control [refer (iv) above], it has an advantage also (but not always); since the executive personally is unable to supervise the actions of all his subordinates, he will have to delegate authority to his subordinates who in turn will be forced to learn their jobs better and hence acquire a sense of accomplishment, responsibility and high morale.

(5) Dividing and Grouping Work (including coordination)

(a) **Dividing.** Divisionalisation provides a broader perspective, a greater sense of responsibility on the part of the personnel and more clear-cut control over profits. Head of each division has a considerable freedom to act and adopt to local needs.

(b) **Grouping.** Departmentation i.e., the process of grouping is essential for specialisation and coordination.

(c) **Specialisation.** Specialisation may be in terms of product, process, labour etc. Specialisation is essential for attaining familiarity and proficiency within a particular area of activity. A specialised person understands his job thoroughly and is in a better position to do and further improve the work or product etc.

(d) Coordination

- Coordination means weaving together the segments of an organisation into a coherent whole in such a way that all parts operate at the most efficient level and produce maximum profit.

- Coordination is necessary to hold the specialised parts together and to have one suitably big team than a lot of little ones.

- Coordination unifies the purposes and efforts of the employees working in a concern.

- Coordination can be achieved through:

1. Cooperation of both executives and subordinates.

2. Good human relations.

3. Understanding of the goals or objectives of the organisation (common to everybody in the organisation).

4. Communication, i.e., effective means of communication among the people working for the organisation.

- An organisation makes use of the following tools for achieving coordination:

(i) Organisation chart

- An organisation chart helps understanding organisational relationships.

- An organisation chart shows the groupings of major activities into departments and the main lines of authority and responsibility among these departments.

(ii) Organisation Manual

- Whereas an organisation chart shows only job titles and their relationship to each other, organisation manual outlines in detail all the duties and responsibilities for different positions the chart shows.

- Organisation Manual

- (i) makes everybody clear as what he is to do and what is his authority;

- (ii) eliminates overlapping of duties and responsibility, and

The *horizontal* dimension defines the basic *departmentation*. Departmentation is the process of division of the enterprise into different parts i.e., smaller, flexible administrative units.

The *vertical* aspects of the structure relate to the creation of a hierarchy of superiors and subordinates, leading to the establishment of a managerial structure.

Taken together, horizontal and vertical aspects set the formal structure of the organisation (Fig. 3.1)

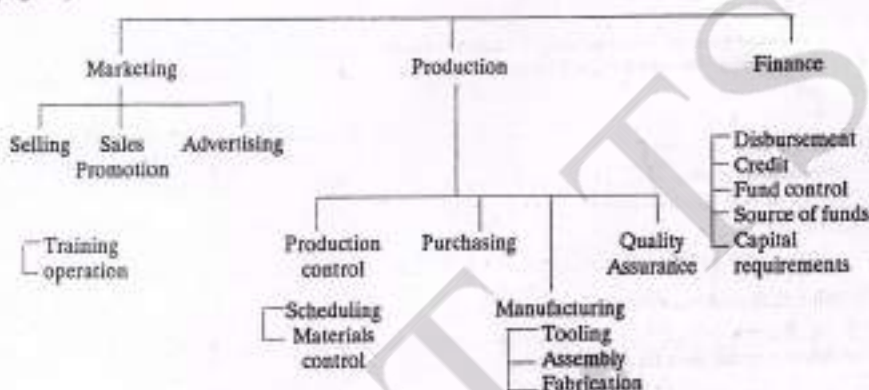


Fig. 3.1. Organisation structure of a manufacturing concern.

- Organisation has *informal structure* too which arises spontaneously out of the activities and interactions of people.

Need for

1. The organisation structure is designed by the management to achieve *specific goals*.
2. The organisation structure facilitates in fixing the *responsibility* departmentwise, sectionwise or on individual basis. It is necessary for timely completion of work.
3. It is necessary for the establishment of *authority*. It also clarifies one's authority.
4. It helps in achieving the desired level of *coordination*.
5. It promotes *division of work* and leads to specialisation.
6. Since organisation structure clearly defines the authority and responsibility, it avoids confusion, duplication, wastage and inefficiencies.
7. Organisation structure facilitates the flow of information and decision-making from one level to another.
8. Organisation structure defines the positions and units within the organisation.

3.9. DESIGN OF ORGANISATION STRUCTURE

Introduction

- In designing the structure of an organisation, there are two main *considerations*:

 1. *Differentiation*
 2. *Integration*

- *Differentiation* means differences in cognitive and emotional orientations among managers in different departments and the differences in the formal structure of these departments.
- *Integration* refers to the quality of the state of collaboration that is required to achieve unity of effort. Various departments are integral part of the whole system.
- Design structure of one department may be different from that of the other, because each department is interacting with the environment in a different way. Environments are of two types:
 - (i) *Internal environment* : Everything within the organisation, including its workers, managers, working conditions and culture.
 - (ii) *External environment* : The environment outside the organisation, for example suppliers of raw material and energy, customers, competitors, government agencies etc.
- The overall objective of organisational designing should be integration of activities and authority roles and relationships existing in different departments.

Steps involved in Organisation Design

The procedural steps involved are:

- (i) Understand and formulate the objectives and goals of the organisation and the nature of business to be carried out.
- (ii) Determine the functions necessary to achieve the objectives of the organisation.
- (iii) Related functions e.g., Inventory Control, Production Control and Quality Control, can be grouped together.
- (iv) Examine all the functions and outline the various positions to be filled to take up those functions.
- (v) Prepare job descriptions, duties and responsibilities of each position.
- (vi) Fill up all the positions by recruiting suitable persons either from outside or from within by upgrading the existing personnel after giving them extensive appropriate training.

3.10. ORGANISATION CHART

Concept

- Organisation chart is the result of organisation design.
- Organisation chart portrays graphically the structural relationship among the different functions (departments) and the positions (persons) in the enterprise who are responsible for those functions.
- Organisation chart shows — how the dynamic activities of a concern are coordinated into a working unit.
- Organisation chart which is also known as organisation tree is nothing but a map or drawing of the organisation. Fig. 3.2 shows an organisation chart.

3.10. ORGANIZATIONAL MANUAL

Introduction

- *Organization charts* are sometimes supplemented in large organizations by *organization manuals*.
- *Organization manuals* may simply be in the form of brief notes, accompanying the departmental charts to explain the functions of each department and its relationships with other departments.
- At the opposite extreme, organization manuals may consist of volumes which detail the responsibilities and authority of different posts and the procedures to be adopted in carrying out different tasks. Clearly this is only appropriate where a high degree of control is both desirable and practicable. This is true of some governmental departments.
- In brief, organization manual sets down in the form of a booklet all the details of the organization, its objectives and policies, authorities, functions, duties and responsibilities of each unit and all information relating thereto.
- Copies of organization manual should be available with top managers and also be available for inspection within each department and division.

Contents of Manual

- It is particularly important to include all pertinent material related directly to the company organization in the manual, so that managers at all levels can use it as a convenient source of reference. The manual should contain the following data:

1. *Statement of Company objectives and policies.* Organisation objectives and policies, in particular, should be spelled out. These state, the Company organization aims and specify those management decisions related to organization which are binding on all managers in the Company.

The Company organization objectives may be as follows:

- (a) To arrange functions so that personnel can perform their job most effectively.
- (b) To create an organization which will offer the greatest opportunity for individual development.
- (c) To organize each unit so that the corporation may take full advantage of growth and expansion opportunities.

2. *Glossary of terms.* To establish a common nomenclature for administrative terms used in the manual, it is advisable to establish a glossary of management terms such as Accountability, Executive, Supervise, Work etc.

3. Organization procedures

- What standard methods will the Company require of all managers in organization matters?
- What organization work must be done the same in all units so that it will fit the pattern of overall company organization activity?

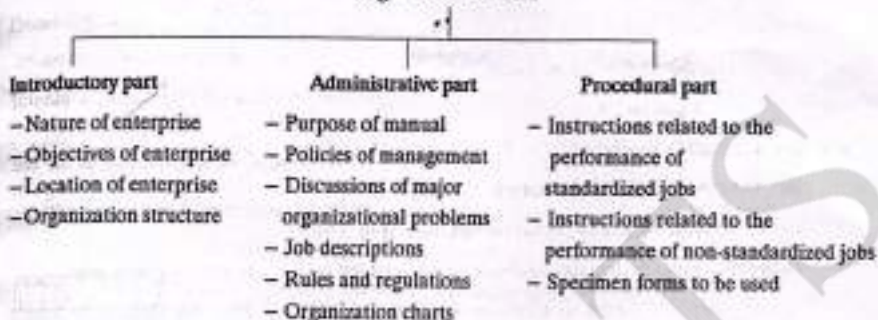
Organization procedures prescribe such uniformity. They may be prepared to include such matters as reporting organization changes and similar matters.

Reporting Organization Changes

If effective organization control is to be maintained, there should be clear channels for reporting organization changes.

In most cases, changes should be approved by the accountable manager but cleared through the organization planning specialized staff.

Organization Manual



Types of Organization Manuals

- (i) *Policy manual* states the policies of the enterprise. It describes the overall limitations within which activities are to take place.
- (ii) *Operations manual* informs employees of established methods, procedures and standards of doing work.
- (iii) *Organisation manual* explains the duties and responsibilities of various departments and their respective sub-divisions, responsibilities and authorities of different employees, etc.
- (iv) *Rules and regulations manual* informs about the operating rules and employment regulations such as hours of work, procedure for taking leave etc.
- (v) *Departmental practice manual* deals in detail with the internal policies, organization and procedures of a particular department.

Advantages of organization manual

- (i) Since it contains rules, regulations and various instructions, it enables the employees to learn the various procedures and practices in short time.
- (ii) Since instructions and policies are clearly stated, it is easy and quick to take decisions.

Drawbacks of Organization Manual

- (i) Manual preparation is costly and time-consuming.
- (ii) Since rules, regulations etc., are all predecided, it leaves little scope for individual's initiative and discretion.

3.11. TYPES OF ORGANISATION (FORMAL)

Concept

- The structure of one industrial organization differs from that of another organisation and it (i.e., structure of an organisation) depends upon:
 - (i) Size of the organisation.
 - (ii) Nature of the product being manufactured.
 - (iii) Complexity of the problems being faced.

1. Route clerk or order of work and route clerk was in charge of issuing work orders and routing the jobs.
2. Instruction clerk would issue specifications and instructions related to jobs to the workers.
3. Time and cost clerk keeps records pertaining to the time (the workers have spent in doing work) and cost (i.e., worker's wages etc.)
4. Disciplinarian keeps personal records of the workers and handles cases of insubordination.
5. Gang boss has the charge of the preparation of all work up to the time that the work piece is set in the machine.
6. Speed boss ensures that proper cutting tools are being used, cut is started at right place in the workpiece, and the optimum speeds, feeds and depths of cut are being employed.
7. Repair boss is responsible for adequate repairs and maintenance of equipment and machinery.
8. Inspector or inspection boss looks after and is responsible for the quality of the product.

Advantages of Functional Organisation

1. Since a foreman is responsible for one function, he can perform his duties in a better manner.
2. Functional organisation makes use of specialists to give expert advice to workers.
3. It relieves line executives of routine, specialised decisions.
4. Expert guidance reduces the number of accidents and wastage of materials, man and machine hours.
5. It relieves pressure of need to search a large number of all-round executives.
6. Quality of work is improved.

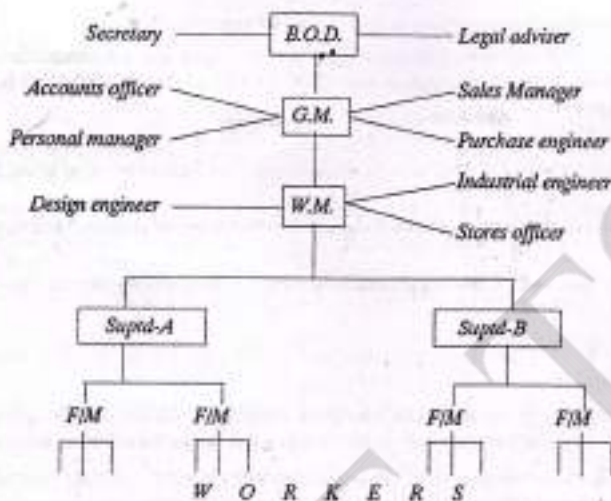
Disadvantages

1. Coordination of the efforts of various functional foremen is difficult.
2. It is difficult to maintain discipline as each worker is responsible to eight foremen.
3. It is very difficult to fix up the responsibility to any one foreman in case something goes wrong.
4. Workers always remain confused about the authority and activity of each foreman.
5. It makes industrial relationships more complex.
6. Workers are not given opportunity to make use of their ingenuity, initiative and drive.
7. All-round executives cannot be developed.

Applications. For these reasons (disadvantages), the functional organisation as such is obsolete; however in the modified form, employing the principles explained above, it is frequently used in some most modern and advanced concerns.

3.11.3. Line and Staff Organisation

- The line organisation gradually developed to shape as the line and staff organisation; Taylor's functional organisation hastened its development.
- As the industry grew in size and complexity, the line executives could not perform properly all other functions (besides looking after production) such as R & D, planning, distribution, legal, public relations, etc. This necessitated the employing of special executives to assist line executives and they were known as *staff* as they were recruited to perform staff or specialist functions.
- The line executives retain supervisory authority and control over the work of their subordinates whereas the staff executives relieve line executives of certain specialised work and advise them on matters referred to them.



B.O.D. : Board of Directors

G.M. : General Manager

W.M. : Works Manager

Suptd. : Superintendent

F/M : Foreman

Fig. 3.7. Line and staff organisation.

- The final decision whether to accept and implement the recommendations of the staff executive remain in the hands of the line executive.
- Fig. 3.7 shows a line and staff organisation. The line executives are marked vertically whereas staff executives are placed horizontally.
- A variation of line and staff organisation is **Line and Functional Organisation** in which the staff or specialist executive has full authority (i.e., a higher degree of authority than in a line and staff organisation) over his particular function which may be inspection, work study, purchasing, employment, etc.

Advantages of Line and Staff Organisation

1. Expert advice from specialist staff executives can be made use of.
2. Line executives are relieved of some of their loads and are thus able to devote more attention towards production.
3. Less wastage of material, man and machine hours.
4. Quality of product is improved.
5. There is no confusion as exists in functional organisation.
6. Line and staff organisation possesses practically all the advantages of both the line and functional organisations.

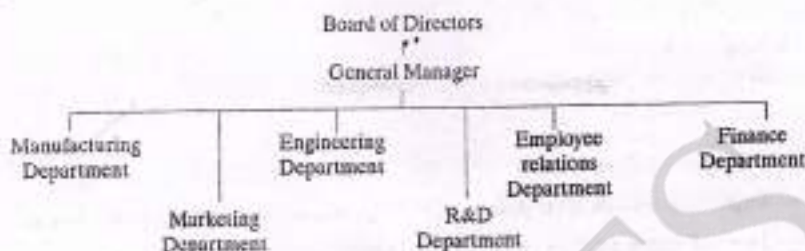


Fig. 3.11. Departmentalization by Function.

- This arrangement has the advantage of the specialization and concentration of similar activities within a departmental unit. It is the most prevalent form of departmentalization and is seen not only in business enterprises but in hospitals, government agencies and many other kinds of organizations.
- The major problem associated with this form is the coordination of the specialized activities.

(b) By Product

- Product departmentalization has become increasingly important, especially for large, complex organizations.
- Under this category, large organizations, have major product divisions with substantial autonomy.
- In departmentalization by product, product lines are segregated and each product line has its own manager, its own manufacturing, selling etc.
- An automobile industry, for example, may departmentalise its activities as follows :-

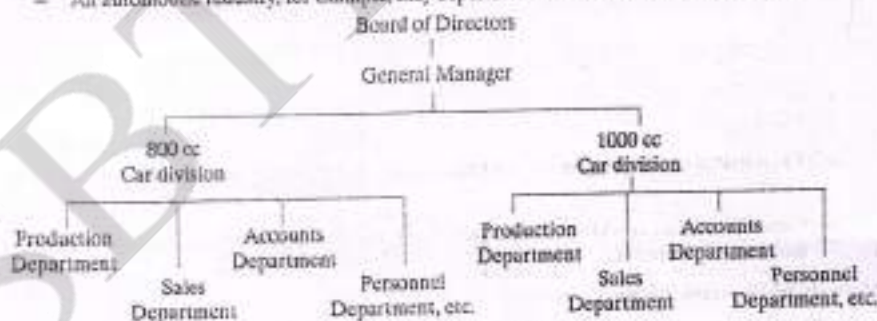


Fig. 3.12. Departmentalization by product.

Advantages of departmentalization by product

- Each product division could be considered as a viable profit centre for accountability purposes. It is easier to evaluate the performance of each product line. Unprofitable product lines may be dropped. Moreover, proper attention can be given to each product.
- The problem of coordination as present in departmentalization by function is removed here.
- Classification by product permits to make a maximum use of specialization in technical skill, managerial knowledge and capital equipments.

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Defects of departmentalization by product

It increases management cost; duplicate service functions are required both at the top and operating levels of management. High cost of operation prevents the small and medium-sized concerns from adopting this basis of classification, particularly for creating major units.

(c) Departmentalization by Customers or Markets

- Sales is the exclusive field of its application.
- To give individual attention to the diverse groups of buyers in the market, sales activities are often split into several parts.
- When the products are offered to an extensive market through numerous channels and outlets, it has the special merit of supplying goods according to the peculiar needs of customers.

(d) Departmentalization by Territory

- Market area is broken up into sales territories and a responsible executive is put in charge of each territory.
- The salesmen of each territory report to their regional or territorial manager who in turn is in communication with the sales manager.

(e) Departmentalization by Process

- The manufacturing activities may be sub-divided on the basis of their process of production. Similar machines such as all lathes, all drilling machines, all shapers etc., are grouped into separate sections, each kept at one place and used for a distinct operation on the job.
- This arrangement works alright for job order work and is unsuitable for mass production.

In actual practice, no single method of grouping activities is applied throughout the organisation structure with all its levels. In reality, a single organization may employ one or all of the bases of departmentalization at the same or various hierarchical levels.

3.18. MATCHING PEOPLE TO JOBS

Introduction

- The basic tasks of describing jobs and seeking the right people to do them can be considered as two different activities, perhaps requiring different skills, but the manager must appreciate that success of the organisation will only follow after a careful matching operation.
- On the one hand, the manager must be clear about the job requirements, on the other, he must be equally clear about the sort of person he is looking for.
- The sources of manpower supply and chosen method of attack in finding the person, will be of little value unless the matching problem is understood and allowed for.
- At times, even after offering high salaries, and involving expensive recruiting and selecting campaigns, managers find themselves asking why they were not able to get their man. The choosing opportunity is not that of the manager's alone, it is very much a two-way business, and it is quite likely that the manager (or job offer) be turned down by the person the manager wants. The reason for this lies in the matching aspect of the situation and failure to recognize

(F) Why people work and

- The word *mission* provides general term to describe the company's over-all reason for existence. The mission expresses the objective of the entire enterprise and is based on top management's knowledge of broad economic needs and the competitive resources of the firm. *Mission* refers to the broad purpose that society expects the organization to serve.
- *An example of mission is*
'To protect and promote the health and welfare of the citizens of the commonwealth'.
- *An example of goal is*
'The eradication of tuberculosis as a health hazard by the end of 1995'.
- *An example of objective is*
'To reduce the incidence of tuberculosis from 6 per 10,000 to 4 per 10,000 by the end of current year'.
- The development of a coherent set of missions, goals and objectives defines the scope and direction of the organisation's activities.

15.12. EVOLUTION AND DEVELOPMENT OF MANAGEMENT THOUGHT

(a) General

- Management in one or the other form has existed in every nook and corner of the world since the dawn of civilization.
- The origin of management can be traced back to the days when man started living in groups.
- History reveals that strong men organised the masses into groups (according to their intelligence, physical and mental capabilities) and became their leaders.
- Management took the form of leadership which was essential to coordinate the efforts of group members in order to arrange the necessities of life.
- Evidence of the use of *principles of management* is to be found in the organizations of public life in ancient Greece, the organisations of the *Roman* catholic church and the organisation of *military forces*. They were not much used in the business world so long as the structure of organisation was simple.
- With the onset of Industrial Revolution (Around 1750) the position underwent a radical change. The structure of industry became extremely complex and new problems generated for industrialists. At this stage, the development of a formal theory of management—both of work and the workers—became absolutely necessary. It was against this background that the foundations of *modern management* were laid.

(b) Management in antiquity

(1) Egypt

- The Egyptian skill in planning and organising the construction of public edifices, is evident in their pyramids.
- The Babylonian empire developing along the Tigris and Euphrates also gives us many examples of early managerial practices.

(2) China

- Some fifteen hundred and more years ago there flourished in China a diverse and complex civilization in which business and enterprise and the art of government had been developed to a high degree.
- The need for methodological means of employee selection and staffing was also recognized by ancient Chinese philosophers.

(b) The Contingency Approach School of Management

- The major contributors to this school of thought are Joan Woodward, Fiedler, Lorsch and Lawrence.
- Theorists of the process school, quantitative, behavioural and systems schools often assume that their concepts and techniques have *universal applicability*, which is not so. These concepts may work in some situations and not in others.
- The *Contingency Approach* to management is based upon the fact that there is no one best way to handle any of the management problems. The applications of management principles and practices should be *contingent* upon the existing circumstances. Process, behavioural, quantitative and systems tools of management should be applied *situationally*.
- There are three major parts of the overall conceptual framework for contingency management:
 - (i) Environment
 - (ii) Management concepts, principles and techniques.
 - (iii) Contingent relationship between (i) & (ii) above.

The environmental variables are *independent*.

Management variables (process, quantitative, behavioural and systems tools) are *dependent*.

Every manager has to apply the various schools of thought (approaches) to management according to the demands of the situation.

- It is the basic function of managers to analyse and understand the *environments* in which they function, before adopting any techniques, processes and practices. The choice of approaches and also their effectiveness is contingent on the behaviour and dynamics of situational variables. There is no universally valid one best way of doing things.
- Contingency thinking helps managers in several ways in performing their functions of planning, organising, direction and control. It widens their horizons beyond the theory of management, its concepts, principles, techniques and methods. It leads them to be sensitive, alert and adaptive to situation-behavioural variables, while tailoring their approaches and styles.
- Contingency thinking enlarges the area of freedom of operation of managers. They are not handicapped by having to apply the same approach to diverse situations. They can even think of a blend of known approaches as demanded by the existing situations.
- The contingency approach seems to hold a great deal of promise for the future development of management theory and practice.

15.22. PRINCIPLES OF MANAGEMENT

- 'Principles of Management' implies a list of current management practices.
- Though F.W. Taylor developed principles of management, credit goes to Henri Fayol, a French management theorist for advocating and publicizing certain principles (or laws) for the soundness and good working of the management.
- Henri Fayol warned that the principles of management should be,
 - (i) Flexible and not absolute—must be usable regardless of changing conditions,
 - (ii) Used with intelligence and with a sense of proportion, etc.
- Henri Fayol listed 14 principles, that grew out of his experience; they are briefed as under.

1. Division of Work (or Labour)

- Division of work means dividing the work on the principle that different workers (and different places) are best fitted for different jobs (or things) depending upon influences arising from geography, natural conditions, personal aptitude and skills.

- Division of work leads to specialization.
- Concept of division of labour can be applied to all kinds of work, managerial as well as technical.

Advantages of Division of labour. Since the same worker does the same work repeatedly.

- (i) he gains proficiency and skill on the jobs,
- (ii) rate of production increases,
- (iii) product quality improves,
- (iv) he is in a position to suggest changes in products, processing or methods of doing that work.

Disadvantages of Division of Labour

- (i) Division of labour gives rise to loss of craftsmanship; workers become machine-minders and no more.
- (ii) With the passage of time, the same job becomes dull and monotonous.
- (iii) Workers do not remain all-round and one cannot work in place of another if he is absent.

2. Authority and Responsibility

- Authority and responsibility should go together, hand-in-hand and must be related.
- An executive can do justice with his responsibility only when he has the proper authority.
- Responsibility without Authority or vice versa is meaningless.

[For details refer Chapter 3].

3. Discipline

- Discipline is absolutely necessary for efficient functioning of all enterprises.
- Discipline may be described as - respect for agreements that are directed at achieving obedience, application, and the outward marks of respect.

[For details refer Chapter 20].

4. Unity of Command

- Unity of command means, employees should receive orders and instructions from one boss (or supervisor) only. In other words a worker should not be under the control of more than one supervisors.
- Unity of command avoids confusion, mistakes and delays in getting the work done.

5. Unity of Direction

- It is a broader concept than the unity of command.
- Unlike unity of command which concerns itself with the personnel, unity of direction deals with the functioning of the body corporate.
- Unity of direction implies that there should be one plan and one head for each group of activities having the same objective.

In other words, there should be one common plan for an enterprise as a whole.

6. Subordination of Individual to General Interest

- The interests of an individual person should not be permitted to supersede or prevail upon the general interests of the enterprise.
- This is necessary to maintain unity and to avoid friction among the employees.

7. Remuneration

- Remuneration is the price paid to the employees for the services rendered by them for the enterprise.

- i. Lay down the company objectives/ targets.
- ii. Collect and classify the information relating to company objectives.
- iii. Develop alternative course of action to do the things.
- iv. Compare the alternatives in terms of objectives, feasibility and consequences.
- v. Select the optimum course of action yielding maximum benefit/gain.
- vi. Establish policies, procedures, methods, schedules, programmes, systems, standards and budgets for the optimum course of action selected.

2. Organising

- After determining the course and make-up of action, the next step, in order to accomplish the task, is to distribute the necessary work among the working groups.
- *The process of organising involves:-*
 - i. Divide the work into Component activities.
 - ii. Assign people to task (component activities).
 - iii. Define responsibilities.
 - iv. Delegate authority.
 - v. Establish structural relationship (i.e., organisation structure) to secure coordination.

3. Actuating (move to action)

- Actuating means carrying out physically the activities resulting from planning and organising.
- *The process of actuating involves:-*
 - i. Provide effective leadership.
 - ii. Integrate people and tasks and convince them to assist in the achievement of the overall objectives.
 - iii. Ensure effective communication.
 - iv. Provide climate for subordinates' development.

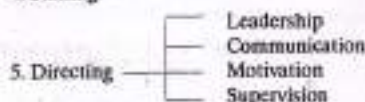
4. Controlling

- Controlling means checking up (or follow up) to ensure that the planned work is progressing as per schedule and if not, then to apply corrective action to achieve the pre-determined objectives.
- *The Process of controlling involves:-*
 - i. Observe continuously and study the periodic results of performance.
 - ii. Compare this performance with the present standards.
 - iii. Pinpoint deviations if any.
 - iv. Ascertain the exact causes of deviations.
 - v. Initiate and implement the corrective action.

15.25. FUNCTIONS OF MANAGEMENT

- One way to look at the process of management is to identify the (basic) functions which together make up the process.
- Since some functions are basic to managerial activities at all levels from the foreman to the manager, they are applicable to all business enterprises.
- Though Fayol, Urwick, Davis, Koontz and O'Donnel have specified different number of management functions, the author feels that the following eight functions may be used to describe the job of management.

1. Forecasting.
2. Planning.
3. Organising.
4. Staffing.



6. Coordinating.
7. Controlling.
8. Decision making.

- The above list of the functions of management is a useful analytical device for stressing the basic elements inherent in the job of management.

1. Forecasting

- Forecasting is a necessary preliminary to planning.
- Forecasting estimates the future work or what should be done in future; may be as regards Sales or Production or any other aspect of business activities.
- Forecasting begins with the sales forecast and is followed by production forecast and forecasts for costs, finance, purchase, profit or loss, etc.

2. Planning

- Planning all aspects of production, selling, etc., are essential in order to minimise intangibles.
- Planning is a process by which a manager anticipates the future and discovers alternative courses of action open to him.
- Planning is a rational, economic, systematic way of making decisions today which will affect the future e.g., what will be done in future, who will do it and where it will be done.
- In fact, every managerial act, whether it be mental or physical, is inexorably intertwined with planning.
- Without proper planning, the activities of an enterprise may become confused, haphazard and ineffective; for example if a refrigerator making concern does not plan in advance - how many refrigerators and of what capacities are to be made before the summer starts and thus it does not procure necessary material, tools, supplies and personnel in time, it cannot reach the production targets and hence may not run profitably.
- Prior planning is very essential for utilizing the available facilities (men, materials, machines etc.) to the best of advantage.

3. Organising

- Organising is the process by which the structure and allocation of jobs is determined.
- Organising involves determining activities required to achieve the established company objectives, grouping these activities in a logical basis for handling by subordinate (persons), managers, and finally, assigning persons to the job designed. In carrying out the above, the manager will delegate necessary authority to his subordinates (persons) and they, in turn, will take the necessary responsibility.
- Organising means, organising people, materials, jobs, time etc., and establishing a framework in which responsibilities are defined and authorities are laid down.

- (b) Managing Directors.
- (c) Chief Executives.
- (d) General Managers.
- (e) Owners.
- (f) Share-holders/Financiers.
- *Top Management Functions are*
 - (a) Setting basic goals and objectives.
 - (b) Expanding or contracting activities.
 - (c) Establishing policies.
 - (d) Monitoring performance.
 - (e) Designing/Redesigning organization system.
 - (f) Shouldering financial responsibilities, etc.

2. Upper Middle Management

- *Upper Middle Management includes*
 - (a) Sales executive (Manager).
 - (b) Production executive.
 - (c) Finance executive.
 - (d) Accounts executive.
 - (e) R & D executive.
- *Upper Middle Management Functions are*
 - (a) Establishment of the organization.
 - (b) Selection of staff for lower levels of management.
 - (c) Installing different departments.
 - (d) Designing operating policies and routines.
 - (e) Assigning duties to their subordinates, etc.

3. Middle Management

- *Middle Management includes*
 - (a) Superintendents.
 - (b) Branch Managers.
 - (c) General Foremen, etc.
- *Middle Management Functions are*
 - (a) To cooperate to run organization smoothly.
 - (b) To understand interlocking of departments in major policies.
 - (c) To achieve coordination between different parts of the organization.
 - (d) To conduct training for employee development.
 - (e) To build an efficient company team spirit.

4. Lower Management

- *Lower Management includes*
 - (a) Foremen.

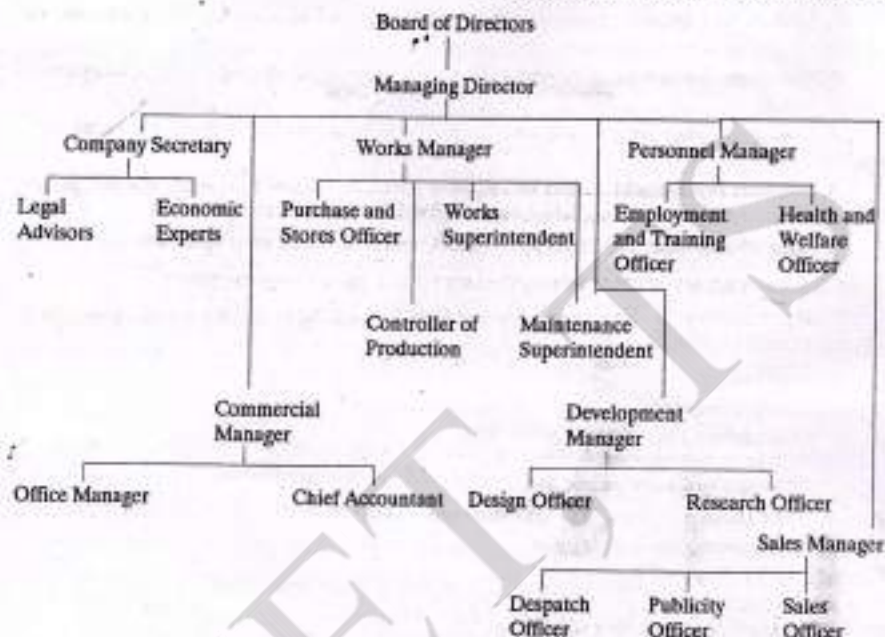


Fig. 15.2. Management Structure (Chart).

15.30. NEED AND USEFULNESS OF MANAGEMENT THEORY

- Theory is a systematic grouping of interrelated principles. Its task is to tie together significant knowledge, to give it a framework.
- Theory of management involves a systematic synthesis of the concepts and principles of management.
- The need for a clear concept of management and for a framework of related theory and principles was recognised many years ago by such early practical scholars of management as Henri Fayol, Chester Barnard, and Alvin Brown. This need has been increasingly recognised by intelligent managers as time has gone on.
- When management theory, principles and techniques can be developed, proved and used, managerial efficiency will inevitably improve. Then the conscientious manager can become more effective by using established guidelines to help solve problems, without engaging in original laborious research or the risky practice of trial and error.
- Lack of understanding of the theory and principles of management makes it difficult to analyze the managerial job and to train managers.
- Development of management theory would unquestionably have a revolutionary impact on the cultural level of society.

15.31. MANAGEMENT DEVELOPMENT

Concept

Management development is a planned and organised process and programme of training and growth whereby an individual manager or executive (at each level of management hierarchy) gains knowl-

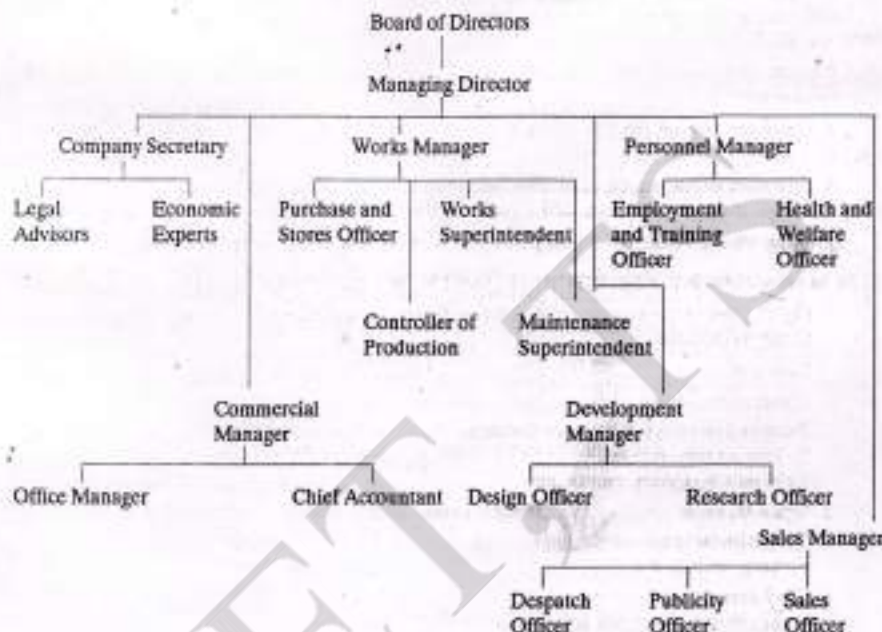


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debts associated with the business.

Advantages

1. Easy to establish as it does not require to complete any legal formality.
2. Simplicity of organization.
3. The expenses in starting the business are minimal.
4. Owner is free to make all decisions.
5. This type of ownership is simple, easy to operate and extremely flexible.
6. The owner enjoys all the profits, thus,
7. There is a great deal of personal motivation and incentive to succeed.
8. Minimum legal restrictions are associated with this form of ownership.
9. Owner can keep secrecy as regards the raw materials used, method of manufacture, etc.
10. Single ownership associates with it the great ease with which the business can be discontinued.

Disadvantages

1. The owner is liable for all obligations and debts of the business.
2. The business may not be successful if the owner has limited money, lacks ability and necessary experience to run the business.
3. Because of relatively unstable nature of the business, it is difficult to raise capital for expanding the business.
4. If the business fails, creditors can take the personal property as well as the business property of the (single) owner to settle their claims. This means single ownership involves unlimited liability for debts and losses.
5. There is limited opportunity for employees as regards monetary rewards (e.g. profit sharing, bonuses, etc.) and promotions.
6. Generally, single ownership firm has limited life, i.e. the firm may cease to exist with the death of the proprietor. This is the cause of unstable nature of the firm (refer 3 above).

Applications. Single ownership is suitable

1. For retail trades, service concerns and small engineering firms which require relatively small capital to start with and to run.
2. For those businesses which do not involve high risks of failure.
3. When the business can be taken care by one person.

16.4. PARTNERSHIP

Concept

- A single owner becomes inadequate as the size of the business enterprise grows. He may not be in a position to do away with all the duties and responsibilities of the grown business.
- At this stage, the individual owner may wish to associate with him more persons who have either capital to invest, or possess special skill and knowledge to make the existing business still more profitable.
- Such a combination of individual traders is called *Partnership*.
- *Partnership* may be defined as the relation between persons who have agreed to share the profits of a business carried on by all or any of them acting for all.

Individuals with common purposes join as partners and they put together their property, ability, skill, knowledge, etc., for the purpose of making profits.

- In brief, partnership is an association of two or more (up to 20) persons to carry on as co-owners of a business for profit.

- Partnerships are based upon a partnership agreement which is generally reduced to writing.

It should cover all areas of disagreement among the partners. It should define the authority, rights and duties of each partner.

- It should specify—how profits and losses will be divided among the partners, etc.

Kinds of Partners

(i) *Active Partners* who take active part in the management of the business enterprise.

(ii) *Sleeping Partners* who do not take any active part in the conduct of the business.

Both Active and Sleeping partners are responsible for the debts of the Partnership.

General Duties of Partners

Partners should

(i) Be just and faithful to one another.

(ii) Render true accounts and full information about every thing that affects any partner.

(iii) Cooperate and accommodate each other.

(iv) Have confidence in each other and better mutual understanding.

(v) Respect the views of one-another.

Types of Partnership

(i) General Partnership.

(ii) Limited Partnership.

(i) General Partnership

Whatever has been discussed above so far pertains to General Partnership; besides that

- In a general partnership, each partner has full agency powers and may bind the partnership by any act, i.e. each partner may act as though he were an individual proprietor. General partnership differs from single ownership in that the actions of any partner not only affect himself but they affect other partners also.
- As the partnership grows or personnel changes occur, additional partners can be had with the consent of all old partners.

Advantages

- (i) Large capital is available to the firm.
- (ii) The firm possesses much better talents, judgement and skills.
- (iii) General partnership is easy to form and is relatively inexpensive in terms of organization cost.
- (iv) Incentive for success is high.
- (v) There is a definite legal status of the firm.
- (vi) Partners have full control of the business and possess full rights to all profits.
- (vii) Partnership associates tax advantages with it.
- (viii) Partnership firms can borrow money quite easily from the banks.
- (ix) For all losses, there are more than one person to share them.

association and articles of association.

- (iv) A public company has to issue a prospectus to the public.
- (v) It has to allot shares within 180 days from the date of prospectus.
- (vi) It can start only after receiving the certificate to commence business.
- (vii) It has to hold a Statutory Meeting and to issue a Statutory Report to all members and also to the Registrar within a certain period.
- (viii) There is no restriction on the transfer of shares.
- (ix) Directors of the company are subject to rotation.
- (x) The public company must get its account audited every year by registered auditors.
- (xi) It has to send financial statements to all members and to the Registrar.
- (xii) It has to hold a general meeting every year.
- (xiii) The Managing Agent gets a fixed percentage of net profit as remuneration.

Advantages of Joint Stock Companies

- (i) A huge sum of money can be raised.
- (ii) It associates limited liability with it.
- (iii) Shares are transferable.
- (iv) Company's life is not affected by the life (death) of shareholders.
- (v) Services of specialists can be obtained.
- (vi) Risk of loss is divided among many shareholders.
- (vii) The company associates with it stability, efficiency and flexibility of management.

Disadvantages of Joint Stock Companies

- (i) A good deal of legal formalities is required for the formation of a joint stock company.
- (ii) Company is managed by big shareholders only.
- (iii) High paid officials manage the whole shows; they cannot have as high interests in the company as the proprietors can have.
- (iv) People can commit frauds with the company.
- (v) Board of directors and managers who remain familiar with the financial position of the company may sell or purchase shares for their personal profits.
- (vi) It is difficult to maintain secrecy as in partnership.
- (vii) The team spirit with which partnership works, is lacking in a joint stock company.
- (viii) Divided responsibility.

Applications of Joint Stock Companies

- (i) Steel mills,
- (ii) Fertiliser factories, and
- (iii) Engineering concerns, etc.

16.6. COOPERATIVE ORGANISATION (OR SOCIETIES)

Concept

- It is a form of private ownership which contains features of large partnership as well as some features of the corporation.

Demerits

- (i) There is exploitation motive, the workers and the consumers may not receive fair deal.
- (ii) There is dearth of capital to expand the business.
- (iii) Private enterprise leads to concentration of wealth in the hands of a few.
- (iv) Private enterprises lead to unbalanced growth of industries.

- The main aim of the cooperative is to eliminate profit and provide goods and services to the members of the cooperative at cost.
- Members pay fees or buy shares of the cooperative, and profits are periodically redistributed to them.
- Since each member has only one vote (unlike in joint stock companies), this avoids the concentration of control in a few hands.
- In a cooperative, there are shareholders, a board of directors and the elected officers similar to the corporation.
- There are periodic meetings of shareholders, also.
- Special laws deal with the formation and taxation of cooperatives.
- Cooperative organisation is a kind of voluntary, democratic ownership formed by some motivated individuals for obtaining necessities of everyday life at rates less than those of the market. The principle behind the cooperative is that of cooperation and self-help.

Forms of Cooperative Enterprises

- (i) *Consumer's Cooperatives*, in retail trade and services.
- (ii) *Producer Cooperatives*, for group buying and selling such items as dairy products, grain, fruit, etc.
- (iii) *Cooperative farming* for more and good quality yield from the farms.
- (iv) *Cooperative housing* for constructing and providing houses to the members of the association at relatively lesser rates.
- (v) *Cooperative credit society*, to provide loans to the needy individuals.

Advantages

- (i) Daily necessities of life can be made available at lower rates.
- (ii) It is the democratic form of ownership.
- (iii) Overheads are reduced as members of the cooperative may render honorary services.
- (iv) It promotes cooperation, mutual assistance and the idea of self-help.
- (v) The chances of large stock-holding (hoarding) and black marketing are eliminated.
- (vi) No one person can make huge profits.
- (vii) Common man is benefited by cooperatives.
- (viii) Monetary help can be secured from government.
- (ix) Goods required can be purchased directly from the manufacturers and therefore can be sold at less rates.

Disadvantages

- (i) Since the members of the cooperative manage the whole show, they may not be competent enough to make it a good success.
- (ii) Finance being limited, specialist's services cannot be taken.
- (iii) Conflict may arise among the members on the issue of sharing responsibility and enjoying authorities.
- (iv) Members who are in position may try to take personal advantages.
- (v) Members being in services may not be able to devote necessary attention and adequate time for supervising the works of the cooperative enterprise.

- To check the work as regards quantity and quality.
- + To keep abreast with the modern developments in his own field of work.

17.3. QUALIFICATIONS OF A FOREMAN

(i) Suitable engineering qualification to understand the technical aspects of the job, production processes, equipments, etc.

(ii) Skill to meet the demands of the job.

(iii) Mechanical ability.

(iv) Skill in imparting instructions to the workers.

(v) Familiarity with

Production control
Quality control
Safety practices
Machine management
Record keeping
Merit rating
Costing and Estimating, etc.

(vi) Ability to train workers,

(vii) Ability to handle (i.e. supervise and control) workers properly.

(viii) Elementary knowledge of labour psychology.

(ix) Familiarity with modern developments in the field, etc.

17.4. QUALITIES OF A FOREMAN

(i) Democratic leadership.

(ii) Result consciousness

(iii) Judgement and decision making in an existing situation.

(iv) Full knowledge of men, materials and machines

(v) Versatility and ingenuity.

(vi) A cooperative sympathetic and helpful attitude towards others.

(vii) Just, fair and impartial attitude towards all his subordinates.

(viii) Self-control and firmness.

(ix) Ability to develop an organisation.

(x) Ability to plan and control work.

(xi) Willful acceptance of responsibility.

(xii) Constructive and independent thinking, etc.

17.5. LEADERSHIP

Definition and concept

- Leadership is the knack of getting other people to follow you and to do willingly the things you want them to do.
- Leadership means to inspire confidence and trust so that there is maximum cooperation from the employees within the control of a manager.
- Leadership is the ability to persuade others to seek defined objectives enthusiastically. It is the

human factor which binds a group together and motivates it toward goals.

- Leadership may also be defined as the process of influencing a group in a particular situation at a given point of time and in a specific set of circumstances that stimulate people to strive willingly to attain company objectives.

Styles (Types) of Leadership

The three relatively distinct leadership styles are

1. Authoritarian,
2. Democratic, and
3. Laissez-Faire.

1. Authoritarian Leadership

- It is felt that this technique is old-fashioned, but it works well in many cases.
- The leader makes all the decisions (no matter it is right or not) and demands obedience from the people he supervises.
- All policies are determined by the leader without consulting the subordinates.
- The leader dictates to the subordinates, the techniques and activity steps, he tells them what to do next, he does not inform them about future plans and thus future steps always remain uncertain to a large degree.
- The leader decides the particular work task for a person and the work companion of each person (worker).
- The leader tends to be personal in his praise and criticism of the work of each member (worker).
- The leader remains aloof from active group participation except when demonstrating.
- Authoritarian leadership is negative because the subordinates remain uninformed, they feel insecure and remain afraid of the leader.
- In authoritarian leadership, there is a tighter control and supervision over the persons (i.e. subordinates).
- Authoritarian leadership succeeds where
 - (i) Subordinates shirk work but want security.
 - (ii) Subordinates do not want to take initiative.
- The advantages of Authoritarian leadership is that
 - (i) Decisions can be taken quickly.
 - (ii) Some people who simply work for fear of punishment remain disciplined and devoted towards the tasks given to them.

2. Democratic Leadership

- Democratic leadership is most popular today.
- The leader discusses and consults his subordinates. He draws ideas from them, supervises and lets them help set policy.

Industrial Psychology

19.1. DEFINITION AND CONCEPT OF INDUSTRIAL PSYCHOLOGY

- Industrial psychology is the study of men at work as individuals and in groups and of the relationship between individuals and groups.
- Industrial psychology is concerned with the study of human behaviour in different aspects of industry and business, e.g., production, distribution and use of the goods and services of the civilization.
- Industrial psychology studies human behaviour in order to obtain information that can be applied to the very practical objectives of helping to resolve industrial problems.

19.2. INDUSTRIAL PSYCHOLOGY VERSUS PERSONNEL MANAGEMENT

- Both, Industrial psychology and Personnel management cover the entire process of management's dealing with men at work.
- However, industrial psychology differs from personnel management in the sense that it emphasizes the scientific and research aspects of men at work and omits many of the routine administrative details.

19.3. AIMS AND OBJECTIVES OF INDUSTRIAL PSYCHOLOGY

1. To improve the situation on the job.
2. To affect high morale and enthusiasm at work.
3. To restore the mental health of upset and confused individuals.
4. To remove risks to healths or threats to safety.
5. To increase efficiency of people at work.
6. To increase productivity and hence the profits.

19.4. SCOPE OF INDUSTRIAL PSYCHOLOGY

In industry, psychology is applied :

1. To understand the culture-pattern of a working group or the commonly accepted attitudes and standards to which the individual must conform if he is to be accepted as a member.
2. In connection with human problems associated with aspects of human work, including
 - Employee selection and placement.
 - Employee training and development.
 - Attitude, Morale and Motivation.
 - Supervision and evaluation.
 - Measurement of various kinds of human ability.

4. *Temperament*

- By temperament is meant excitability of response—the degree to which an individual responds with emotion.

5. *Character*

- Character implies honesty-resistance to stealing, to lying and to cheating where money is involved.

6. *Aptitude*7. *Personality characteristics*8. *Education*9. *Experience*10. *Age*11. *Sex*

- Besides individual variables, there are some *Situational Variables* also which influence the performance (behaviour) of an employee on a given job. Situational variables are :

(a) *Physical and job variables*

1. Physical environment.
2. Work space and layout.
3. Design and condition of work equipment.
4. Methods of work.

(b) *Organizational and social variables*

1. Character of organization.
2. Kind of training and supervision.
3. Types of incentives.
4. Social environment.

19.7. GROUP DYNAMICS—HUMAN BEHAVIOUR UNDER GROUP INFLUENCE—GROUP BEHAVIOUR

- Many jobs in industries, e.g., riveting, forging, maintenance work, etc., require a collective effort on the part of employees to achieve the goals of the organisation. This leads to the formation of *Formal Groups* in the industry and such groups are set up by the organisation itself.
- Besides formal groups, individuals because of their social needs, common interests, security and some psychological factors tend to collect themselves in what are known as *Informal Groups*.
- *Characteristics of Group Behaviour*
 - (i) It has been observed that an employee behaves differently, when acting as an individual, than when as a member of a group.
 - (ii) Group influences and changes the attitude and behaviour of an individual towards work and towards the organisation.
 - (iii) Every group has its characteristics culture-pattern to which the individual must conform if he is to remain a member.
 - (iv) Groups differ in their degree of cohesiveness. Some are loosely bound, they slowly

disintegrate and vanish whereas other groups are strong, effective and possess active support of most members.

- (v) In case of difference in opinion in a group, the extremists face pressure to change or modify their opinions.

This pressure is more effective in *high-cohesive* groups.

The extremists either modify their views or leave the group.

- (vi) In a group, the persons who try hardest to influence others, are generally most willing to accept the opinions of others.

The understanding of *group characteristics* as explained above and otherwise is very essential for the management to maintain good human relations.

- Group behaviour may be beneficial as well as detrimental for the organisation and management.

Group may influence the behaviour of those in the group as regards absenteeism, restriction of work output, etc., such restrictions being invisible, unwritten and informal.

The possibility of group influence being contrary to the interests of management has tended to cause the managements of some enterprises to view dimly the development of strong, integrated groups within the organisation.

Group Dynamics

- Group dynamics is an expression that describes the situation in which persons working together in a group accomplish certain things, either positively or negatively, in a way that cannot be explained adequately in terms of the individual acting separately.
- Group dynamics describes the interaction between members within a work group and the concurrent changes of their attitudes, behaviour and relationships; similarly, the interaction - and changing attitudes, behaviour and relationships - between an employee work group and others outside the group, in particular the supervisor/foreman.
- The term *Group dynamics* is applied to the forces brought to bear by individuals, singly or collectively, in a group activity. The word *dynamics* implies change.
- Group dynamics emphasizes the influence of groups, group behaviour and inter-group conflict.
- The Lewin *group dynamics* analysis has been influential in shaping modern administrative theory. It has emphasized the persistent development and influence of informal organization, it has highlighted the role of group norms of behaviour and has suggested the importance of these variables in the working environment in so far as they contribute to the individual's feeling of security and the assurance with which he can predict the behaviour of associates.
- Group dynamics focuses a team work - team spirit which has an extensive history in military units and among athletic teams but has fairly recent applications in industry. Members of group remain in constant touch with each other, mutually discuss and furnish suggestions in order to achieve the company goals effectively. The group has common objectives to reach at.
- A Group
 - (i) provides security to its members from outside pressure;
 - (ii) provides companionship at or after the work;
 - (iii) provides norms (guides) for behaviour;
 - (iv) provides a personal touch or relationship;

- (4) Strong organizational stamina.
- (5) A high degree of employee interest in the job.
- (6) Reasonable employee initiative.
- (7) Pride in the organization.
- (8) Team spirit.
- (9) Zest or enthusiasm.
- (10) Resistance to frustration.
- (11) Staying quality.

— **Low morale.** Morale may be depressed by

- (i) Too fine division of authority and responsibility.
- (ii) Wrong or improper selection of employees.
- (iii) Too small a number of real executives.
- (iv) Too many foremen or supervisors.
- (v) Over-reliance on organization charts.

Low morale results in

- (i) A higher rate of absenteeism and labour turnover.
- (ii) Friction, jealousy and frustration among workers.
- (iii) More complaints and employee grievances.
- (iv) Enmity towards management.

- Many large organisations conduct morale surveys to explore how the workers feel about their working conditions, jobs, supervisors, and the company itself and such surveys generally lead to improved morale of the employees.

Factors Affecting Morale

Factors which tend to lower or improve the employee morale are :

1. Job Factors

- Nature of job.
- Fatigue and boredom associated with the job.
- Employees interest in the job.
- Job satisfaction.
- Confidence on individual members of the group.
- Confidence of different members of the group in the leadership at all levels.
- Nature of leadership and supervision, i.e., whether the leader/supervisor is just, impartial, helpful, social minded etc.?
- Working and environmental conditions, i.e., whether they are good and wholesome?
- Condition of working equipment.

2. Personal Factors, such as

- | | |
|--|-------------------------|
| — Background | — Intelligence |
| — Age | — Skill and proficiency |
| — Sex | — Training |
| — Mental and emotional condition of employee | — Experience, etc. |

3. Other Factors

- Organisational efficiency, i.e.,
 - (i) The way the organization is set up, the way the orders are given, the way information is passed up and down, the way things are provided, etc.
 - (ii) The way the informal organizations decide and think and work.
- Objects of the organization, i.e., whether they are clear or they confuse the employees.
- Unfair selections and promotions.
- Frustrations resulting from lack of recognition, i.e., attaching more importance to junior persons and neglecting seniors.
- Rewards and Incentives.

Methods to Measure Morale

Level of morale may be measured by,

- (A) The attitude questionnaire.
- (B) In-group versus out-group choices.
- (C) Other criteria.

A. The *attitude questionnaire* is the method most used to measure the morale of employees. From a general survey, questions relevant to the group conditions are used to develop a morale index by assigning values to alternative answers. The questions may look like, e.g.,

Q. 1. Do you feel that you are really a part of your work group? (Check one).

- Really a part of my work group.
- Included in most ways.
- Included in some ways, but not in others.
- Do not feel I really belong.

Q. 2. How do you rate your company with others as a place to work with.

- Very worst.
- Worse than average.
- Just average.
- Better than average.
- Very best.

B. *In-group versus out-group choices* technique determines the ratio of in-group choices to out-group choices or in terms of the percent of in-group choices to choices available. The purpose of the method is to know whether an individual would like to work with the persons of his own group or with those of another group. A number of questions such as follows may be asked to ascertain the preference of an individual.

Q. 1. With whom would you prefer to work?

Q. 2. Who would make a good supervisor?

C. Other criteria used to measure morale are:

- (a) Comparison of earlier and present value of productivity and waste (scrap) rate.
- (b) Comparison of earlier and present rates of absenteeism and labour turn-over.
- (c) Output and product quality.
- (d) Complaints and grievances records.

2. Take a sincere interest in subordinates as individual persons.
3. Promote healthy competition among the individual employees.
4. Find ways to develop and utilise the appeal of pride in or about the workplace. Let the subordinates feel pride in work or in job accomplishment.
5. Delegate a substantial amount of responsibility to the subordinates.
6. Fix fair wages and monetary individual or group incentives for the employees.
7. Formulate a suitable suggestion system.
8. If possible permit the employee's participation in management matters.
9. Provide opportunities for growth and promotion.
10. Promote good and satisfying interpersonal relationships at work and outside.
11. Promote good working conditions.
12. Formulate fair, clear, firm and consistent management policies.

Besides the above-mentioned positive motivating tools, there are a few negative motivational techniques also, e.g.,

1. Reprimand
2. Fines
3. Demotion
4. Lay off
5. Discharge

The proper proportioning of these two motivational techniques (i.e., Positive and Negative) is the mark of the skilful Manager, Executive or Supervisor.

19.12. WORKING, ENVIRONMENTAL CONDITIONS

Introduction

- Human work behaviour to a great extent can be influenced by the working environments or working conditions.
- Working conditions may be classed as follows :

1. Working conditions of physical nature, e.g.

- Illumination (Lighting),
- Heating,
- Ventilating,
- Air-conditioning, and
- Noise, etc.

Improper working conditions of physical nature increase fatigue and reduce output and product quality. (For details refer Chapter 4)

2. Working conditions related to time, e.g.

- Hours of work (8-hours day and 40-hours week are probably best in terms of efficiency and absenteeism).
- Rest pauses. Rest pauses such as tea and coffee breaks or otherwise are necessary to prevent excessive physiological and mental fatigue.

Scheduled rest pauses during the day were found to reduce unauthorized rest pauses and they increased the speed of work.

In the case of monitoring tasks (in which the attention demands are high) rest periods should be provided at 20- or 30-minute intervals.

In case of heavy physical works or those carried out in hot environments rest pauses should be fairly frequent.

As a general practice, rest pause should be provided before the build up of a substantial level of fatigue.

3. Working conditions related to social situation within which individual works, e.g.
 - Community attitude towards the objectives of the organisation.
 - Acceptance of company employees by the community.
 - Social welfare, etc.

19.13. INDUSTRIAL FATIGUE

Definition and Concept

- Working conditions of physical nature and those related to time, influence employee fatigue to a considerable extent.
- For practical purposes, fatigue may be defined as
 - (i) Negative appetite for activity; and
 - (ii) A reduction in the ability to do work as a consequence of previous work.

Nature of Fatigue

- Fatigue includes both mental and physical reactions as well as the phenomenon of monotony and boredom.

Monotony is a state of mind caused by performing repetitive tasks.

Boredom or lack of interest, is characterised by depression and a desire for change of work or activity.

- Fatigue occurs owing to variety of causes ranging from chemical to psychological. Fatigue associates with it three aspects, namely
 1. Reduction in quantity of work for a given amount of effort.
 2. A feeling of tiredness.
 3. Physiological change, e.g. the accumulation of lactic acid in the blood caused by the breaking down of glycogen, or sugar, in the blood.

Effects of Fatigue. Fatigue,

1. affects badly the muscles, nerves and mind of the workers;
2. decreases a worker's capacity to do more (further) work;
3. results in loss of worker's efficiency;
4. introduces a feeling of tiredness and weakness;
5. creates disinterest in the work;
6. disturbs chemical, psychological and physiological equilibrium;
7. gives rise to monotony and boredom;

Personnel Management

20.1. DEFINITION AND CONCEPT

- Management in industry inevitably sub-divides itself into a series of functions such as sales, production, finance, etc. *Personnel* is one of these functions.
- The personnel function exists in every enterprise regardless of its size and irrespective of the fact that whether or not there is a personnel department.
- In a small concern, the personnel function is carried on by the owner itself whereas as soon as the organisation reaches a certain size, the personnel function like other functions is given a separate organizational status.
- The *personnel function* is concerned with all of the human relationships among workers as people.
- The essentials of Personnel Management were first exemplified by the work of Robert Owen (1771-1858). He recognized the immense importance of the human factor in industry and he put efforts to apply this knowledge.
- Any industry depends upon human beings ; it has to acquire workers and it creates an acceptable environment and a rule-of-practice to encourage the greatest degree of participation from its employees.
- Personnel Management, Personnel Administration or Industrial Relations in an enterprise tends to attain maximum individual (employee) development, desirable working relationships between employees and employers and between groups of employees and effective moulding of human resources as contrasted with physical resources.
- *Personnel Management* may be defined as the Planning, Organising, Directing and Controlling of the Procurement, Development, Compensation, Integration and Maintenance of people (i.e., employees) for the purpose of contributing to the organizational goals.

The different words used in the above definition are explained below :

- (i) *Planning*. It means determination in advance of a personnel programme. It involves ability to think, analyze and to reach decisions.
- (ii) *Organizing*. It means (after determining a course of action) establishing an organization by designing the structure of relationships among jobs, personnel and physical factors to attain the company objectives.
- (iii) *Directing, Motivation or Actuation* means getting employees to go to work willingly and effectively.
- (iv) *Controlling*. It concerns with regulating activities in accordance with the personnel plan (formulated on the basis of organizational goals).
- (v) *Procurement* means obtaining proper kind and size of personnel necessary to achieve company goals.
- (vi) *Development* involves increasing of employee's skill, through training, that is necessary for proper job performance.

- (vi) *Compensation* means (adequate and equitable) remuneration of personnel for their contribution to achieve organizational goals;
- (vii) *Integration* is concerned with the attempt to effect a reasonable reconciliation of individual and organizational interest.
- (ix) *Maintenance* means sustaining and improving the conditions (e.g., health and safety measures, employee service programme, etc.), that have been established.

20.2 AIMS, OBJECTIVES OR FUNCTIONS OF PERSONNEL MANAGEMENT OR PERSONNEL DEPARTMENT

- Being used upon the definition of Personnel Management given in section 20.1, it is generally recognized that the following areas of the work situation in an industry are the province of the Personnel Department, i.e., Personnel Manager and the staff of his department.
- (a) *Procurement and Maintenance of adequate work-force (employees)* as regards to both — number and quality of personnel

- Recruitment
- Interviewing
- Testing
- Induction
- Placement

- Follow up of new employees for adjustment

- Merit rating

- Promotion, transfer and discharge

- Employment records.

(b) *Education and training of present employees*

- Job instruction : Apprentice training, vestibule schools

- Economic education

- Training plans : operative training, supervisory training, Executive training

- General industrial education

- Training materials and audio-visual training aids

- Reading rooms and libraries

- Records and statistics.

(c) *Maintaining Satisfactory Personnel Contacts and Employee Relationships*

- Job analysis, job specifications, etc.

- Merit rating of employees

- Wages and rewards

- Labour audit

- Labour records and labour statistics

- Regularization of employment

- Handling grievances

- Labour turn-over

- Labour market surveys

- Suggestion systems

- Morale studies.

- (i) Raises output,
 - (ii) Improves product quality,
 - (iii) Reduces total product cost,
 - (iv) Minimizes disputes and grievances, and
 - (v) Lowers the labour turn-over rates, etc.
- The applicant selected for the post should :
- (i) Be willing to work,
 - (ii) Be able to handle the job,
 - (iii) Be stable, i.e., stay with the organisation for a fair period,
 - (iv) Be able to fit in the work situation, and
 - (v) Have development and growth potentialities.

Functions of Employment Section of the Company

- (a) To hire right type of employees for specific company openings.
- (b) To maintain adequate supply of right kind of employees.
- (c) To develop job specifications.
- (d) To procure information about current wage rates.
- (e) To introduce selected employees with personnel policy of the company.
- (f) To follow up the new recruits for initial adjustment.
- (g) To look after employee counselling and operating the seniority system.
- (h) To keep records of employees, hired, resigned, discharged and transferred.

Sources of New Employees

- (a) *From within the Company*
 - By promotion
 - By transfer
 - Former employees who had good service records when they left.
- (b) *From outside the Company*
 - Friends and relatives of present employees duly recommended by them.
 - Through press and other advertisements.
 - Through employment agencies.
 - Through schools, colleges and universities.
 - Through labour unions.
 - From waiting lists.
 - As recommended by Professional bodies and societies.
 - Foreign sources.
 - From unsolicited applications received, both at the gate and through the mail.
 - Through trade associations.
 - From Government employment exchanges.
 - From labour contractors.
 - Through personnel consultants.
 - With the help of Notices exhibited at the factory gate.

SELECTION PROCESS OR TECHNIQUE

- After attracting a number of applicants through various sources described earlier, the next stage is the selection process, i.e., to select the persons most appropriate for the organization.

- The different procedural steps involved in the selection process are

- (A) (Obtaining) job descriptions,
- (B) Application forms,
- (C) Employment tests,
- (D) Interviewing,
- (E) Physical examination,
- (F) Induction or orientation.

(A) Job description

- The first important step of any selection process is to develop job descriptions for the positions to be advertised and filled.

- A *job description* is a combination of short statements that describe both the work to be performed and the essential requirements of the particular job.

- The *job description* includes

- (i) Job title.
- (ii) Department in which the job exists.
- (iii) Work to be performed by the new employee.
- (iv) Job responsibilities, e.g., care and maintenance of machine tools.
- (v) Job Knowledge, i.e., ability to read from job instructions and blue print.
- (vi) Mental concentration.
- (vii) Dexterity and accuracy.
- (viii) Machines, tools and processes to be handled.
- (ix) Relation with other jobs.
- (x) Qualification and experience required.
- (xi) Amount of supervision.
- (xii) Physical activities.
- (xiii) Working (environment) conditions, i.e., whether hazardous or safe.

- The *job description of Personnel Officer* may look like

Responsible for all personnel management functions involving industrial relations, personnel administration, manpower planning, selection, training and development, labour laws, welfare services, etc. will advise the management regarding labour disputes, grievance handling, disciplinary action, bipartite negotiations on a day-to-day basis and also coordinate with Government departments. Should be graduate having post-graduate qualification in Personnel Management or Industrial Relations in the age group of 30-40 with a minimum of 5/8 years' similar experience.

(B) Application Forms

- An application blank or form is the most universal mechanism used to screen the applicants to be called for interview and other tests for selection purposes.
- The contents of an application form can discourage unsuitable applicants and its design can, reflect a firm's dignity, reduce to a minimum the time required to fill it out and simplify its review.
- The application form may be used to get from the applicant, the information such as his age,

- Questions in intelligence tests are practical, job oriented and abstract type.
- Generally many industries make use of short, paper-and-pencil tests which give a rough approximation of the I.Q. (Intelligence Quotient) of the applicants.
- Intelligence tests can be employed by an organization for selecting all levels of employees taking from workers to managers.
- An example of an intelligence test is as follows :

Fill in the blank space :

16
37

28
49

41
62

58

(Ans. Seventy nine)

(d) Interest tests

- A person interested in a job will do it much better than the one who is uninterested. Interest is a main factor which contributes to the success on the job.
- Interest tests discover the patterns of an applicant's interests and thus suggest what types of work may be satisfying to the prospective employee.
- Interest tests measure an applicant's preferences for certain activities of either a vocational or avocational nature.
- Most widely used interest tests are

(i) Strong Vocational Interests Blank for men and women. The applicant is asked if he likes, dislikes or is indifferent to many examples of school/college subjects, amusements, occupations, particular activities, etc. and then his interests are compared with the interests of successful personnel in specific professions and occupations.

(ii) Kuder Preference Record.

The test deals with more basic interest groupings. These areas are mechanical, scientific, computational, musical, social service, etc.

- Interest tests are very useful in counselling situations where a person is in need of help and is willing to cooperate fully.

(e) Dexterity Tests

- They discover an applicant's cleverness to work with his hands and fingers when the job requires the skilful use of one's hands and body, e.g., assembling operations.

(f) Personality Tests

- An applicant may possess intelligence, aptitude, interest and what not, but if he lacks in personality, he may not be able to get along with and motivate other persons in the organization.
- A personality test measures an applicant's :

- (i) Self-action or knowledge of other people's behaviour.
- (ii) Social or unsocial tendencies.
- (iii) Emotional adjustment and instability.
- (iv) Vocational interests.
- (v) Originality.
- (vi) Motives and basic needs.
- (vii) Self-confidence, and decisiveness.

(viii) Capacity for interpersonal relations.

(ix) Optimism, Patience etc. **

— A few examples of personality tests are

(i) Do you ever feel that people are staring at and laughing at you : Yes/No.

(ii) Do you frequently wake up in a cold sweat : Yes/No.

— Personality tests are very useful in counselling and in selecting salesmen, supervisors, etc.

(D) INTERVIEWING

— An interview is a conversation (directed to a definite purpose) between an applicant and the interviewer and much of the interaction between these two is carried on by gestures, postures, facial expressions and other communicative behaviour.

— It is in the interview that both the prospective employee and the employer get the chance to learn and know about each other.

— The interview is a commonly used method of human evaluation and it is also probably the oldest.

— If an organization is asked to pick up a single method for selecting employees, it would choose interviewing most frequently.

Purpose of Employment Interview

(1) It measures all relevant attributes and integrates and clarifies all other information about the applicant.

— An interview helps studying the impact of personality of the applicant upon others.

— An interview helps exploring the innate abilities, e.g., quickness in the uptake, of the applicant.

— An interview helps studying the motivation and emotional adjustment of an applicant.

(2) It helps the employer to view the total individual (i.e., applicant) and to appraise the person and his behaviour directly.

(3) It measures the applicant against the specific requirements of the job and helps deciding whether there will be a good "fit".

(4) It helps finding the suitability of one or a few candidates from amongst the many.

(5) It gives the applicant a chance to learn the opportunities and job possibilities that exist in the organization.

Types of Interviews

(1) *Guided, directed or patterned interview* in which a list of questions (to be put up to the applicant) is prepared based on the analysis of the job specification.

— A patterned interview measures the personality traits such as self-reliance, emotional stability, ability to get along with others, willingness to take up responsibility etc.

— The typical employment interview is guided, nonetheless, as its average length is 30 minutes for plant employees and 45 minutes for office employees.

(2) *Unguided, nondirected or unpatterned interview* as its name implies is not directed by the interviewer; instead the applicant talks about what he chooses.

— Unguided interview is more often used in situations other than employment, e.g., counselling, handling grievances, etc.

Conducting the Interview—Procedure

The typical sequence of functions that occur in the process of interviewing are as follows :

- The main object of all industrial training is to prepare people to do efficiently their own particular tasks or to do another job equally well.
- Industrial training is based upon a specific need. It imparts knowledge and develops employees aptitude and skill for a particular industrial task.
- Education improves an employee and he can take up and handle jobs of higher responsibility whereas

Training prepares an individual so that he can accomplish his industrial task efficiently and effectively.

- Every industrial organisation realises the need of training the recruits before putting them on a (new) job. If there is no planned training programme, the employees train themselves by trial and or by observing others; this not only results in higher training costs (because of more work spoilage and scrap rate), the learning period gets considerably lengthened and even then employee is not able to learn the best operating methods.

20.5.2 Objectives, Aims or Need for Training

Training of employees is essential in order :

1. To ensure an adequate supply of properly trained employees at all levels of industry.
2. To improve the performance of each employee to the highest attainable level and to develop his potential so that he can take up jobs of higher responsibility.
3. To attain precision and clarity in the transition of business.
4. To increase productivity by conceptual skill, imagination and judgement of employees.
5. To reduce scrap rate.
6. To reduce accident rate.
7. To minimize absences.
8. To reduce fatigue and tardiness.
9. To minimize over-time.
10. To reduce labour turn-over.
11. To boost employee morale.
12. To promote cooperation and good relations between workers and management.
13. To reduce cost of product through economic and more efficient use of company resources.
14. To provide knowledge and appreciation of techniques necessary to enable a trainee to do his job.
15. To inculcate a broad understanding of relevant science and technology so that the trainees adjust to the changes in the nature of work.
16. To teach employees the standardized work methods.
17. To inculcate good work habits on the part of employees.
18. To promote team work.
19. To find out whether an employee is suited to the job.
20. To adjust employee's outlook to new needs of new times.

20.5.3 Advantages of Employee Training

1. Increased productivity.
2. Fast production rate and improved product quality
3. Reduced supervision of employees.
4. Better cooperation and team work among employees.

measured trait (e.g., ability, muscular coordination, work performance, etc.) forms a distribution resembling a *Normal Distribution* and individuals fall at different points along the performance continuum (i.e., the X-axis). Fig. 19.1 shows a normal distribution curve

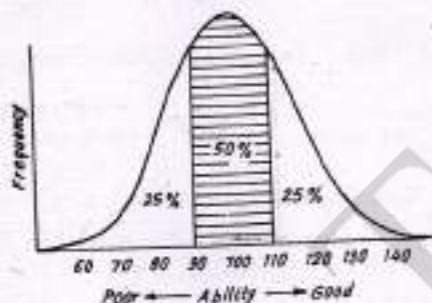


Fig. 19.1. Distribution of employees abilities.

- Fig. 19.1 shows that about 50% individuals are near average in ability. It is these employees that a supervisor is most likely to understand and it is their performance that creates in the supervisor the notion of what he can expect in the form of a day's work.
- 25% individuals below average in ability are problematic because either they complete less than what is expected of them or, if under supervisor's urge they tend to produce more, they do it at the cost of quality or safety.
- 25% individuals above average in ability also create problems sometimes as it is difficult to keep them busy; they may finish a day's work soon and refuse to do more work and thus cause difficulties for the supervisor by keeping themselves free (i.e., without work) for the rest of the day.
- The individuals differ from each other in certain aspects which are termed as *Individual Variables*. Individual variables play a major role and influence the performance of an employee at work. Individual variables are :

1. *Physical characteristics*

Heredity would seem to be of most importance in determining physical characteristics such as height, weight and strength.

2. *Intellectual factors*

- By intelligence is meant ability to learn.
- Differences in intelligence, also, are distributed as the Normal Distribution.

3. *Interest and motivation*

- An individual interested in a particular job will accomplish it in a better manner.
- Therefore, selection and placement of the employee should depend in part on his interests.
- OR the job may be modified to fit his interests.
- OR the employee should be motivated (financially or otherwise) to do that job.

1. Preparation for the interview

- Spell out the specific objectives of the interview.
- Select the appropriate type of interview i.e., guided or unguided.
- Determine the number of interviewers.
- Review all the information submitted by the applicant on the application form.
- Decide the length of interview.

2. Setting for the interview

- Decide the place for interview. The place should be private, comfortable and free from all disturbances.
- Mental setting will help the interviewee to feel at ease. Allow a little time to interviewee to get accustomed to you and your situation.

3. Conduct of interview

- Make interviewee feel that you have a basic liking and respect for people and you are interested in hearing the applicant.
- Begin with simple questions and encourage the interviewee to talk.
- Once you get into the main topic of interview, do everything to get interviewee talk freely with as little prodding from you as possible.
- Listen the interviewee attentively, patiently and, if possible, projectively (i.e. by projecting one's consciousness into that of another person).
- Do not run the risk of letting the interview loose direction, keep control of interview.

4. Close the interview

- The interviewer should make some overt sign (e.g. laying his pencil down, pushing back the chair), to indicate the end of interview.
- At the close of interview, watch for additional information in the casual remarks of interviewee.
- Give to the interviewee some type of answer or indication of future action.

5. Evaluate the interview

- The interview provides much opportunity for inferences, sound and unsound.
 - The applicant may be finally assessed on the basis of
- (a) *The Analytic Approach* in which a rating sheet is used and the applicant is rated on the basis of a number of factors predictive of success.
- (b) *The Integrative Approach* evaluates the applicant as a total integrated person, i.e. the applicant is assessed on the basis of overall fitness.
- From the interview, the interviewer concludes whether the applicant is :
 - (i) Dependable.
 - (ii) Adaptable.
 - (iii) Persevering.
 - (iv) Cooperative.
 - (v) A hard worker.
 - (vi) Able to work under pressure.
 - (vii) Positively motivated.
 - (viii) Good in human relations.
 - (ix) A turn-over problem.

(E) Physical Examination

- The physical examination as a step in the employment procedure is found in most businesses.
 - Many jobs require unusual stamina, strength or tolerance in unpleasant conditions.
- The physical examination reveals whether or not an applicant is fit for a particular job.

- *A physical examination may include*

- (i) Family medical history.
- (ii) Personal history of previous illness.
- (iii) Height, chest and weight measurements.
- (iv) General physical examination of the skin and joints.
- (v) Examination of eyes, nose, throat, teeth and ears.
- (vi) Chest X-ray.
- (vii) Check-up of heart and blood pressure.
- (viii) Urine and blood test, etc.

- *Purpose of physical examination*

- (i) To ascertain the physical capabilities of the applicant, i.e., can he work standing up? Can he lift heavy objects? etc.

Physical examination prevents employees from being assigned to jobs which are beyond their strength.

- (ii) To find if the applicant has the general physical characteristics required for the job.
- (iii) To find if the applicant is suffering from communicable diseases.
- (iv) To determine the exact state of health of the applicant in order to protect the company against unwarranted claims under workmen's compensation laws or against law suits for damages.
- (v) The company's general health programme is facilitated by initial physical examination. Later physical check-ups will indicate whether the employee's general health is improving or deteriorating.
- The physical examination may be conducted by the doctor of the industrial hospital or of a civil hospital.

(F) Induction and Orientation

- It has been reported by many concerns that over half of the voluntary (employee) quits occur within the first six months on the job and a large portion of these is because workers are introduced to their jobs in a haphazard manner.
- Induction implies introducing or orienting a new employee to the organisation.

20.5. EDUCATION AND TRAINING**20.5.1 Introduction**

- When the employment aspect of the personnel function has succeeded in providing suitable employees for various tasks, it is followed by an Education and Training aspect which brings employees to a standard where they can carry out industrial tasks efficiently.
- One of the characteristics of modern society is the increasing rapidity of change today compared with older social orders. This intensifies the need for study, adaptation and new education and training.
- In the field of education and training, personnel management deals with an extensive programme, ranging from the placement, induction and training of new recruits to the provision of courses for middle and higher management levels.
- Training is an ever-continuing process in all organisations and it is employed as a technique of control as well as of imparting information and developing new skills.

marital status, previous education and training, previous work experience, including nature of duties, salary, length of time on the job, reasons for leaving, etc.

- A duly filled application form helps determine which applicants meet the job requirements, because an application form elicits sufficient accurate information that the least likely applicants can be eliminated by simply reviewing the contents of the filled application forms.
- An application form tests an applicant's ability to write, to organise his thoughts and to present facts clearly and succinctly.
- An application form tells whether the candidate has consistently progressed to better jobs and whether his education, training and experience have been logically patterned.
- For assessing and screening purposes, the various questions listed in the application form may be weighted and scored according to their predictive value. Such scores are then matched against the scores of company employees with good tenure and performance records.
- An application form should be made simple, easy to fill and easy to check.

(C) Employment Tests

- Very often considerable training money is expended upon an employee when it is discovered that he is unsuited to do the job for which he was employed. For this reason and in order to avoid the re-occurrence of such a situation, employment tests are, sometimes considered an essential part of the selection programme.
- Tests are conducted as a means of scaling applicants in terms of their innate abilities.
- Tests are conducted as a means of scaling applicants in terms of their innate abilities.
- Tests are helpful in determining a minimum below which the candidate has little or no chance for reasonable success.
- A test is a rapid method of obtaining samples of behaviour to help the interviewer form a judgement to hire or not to hire a given applicant.
- An employment test measures selected psychological factors such as ability to reason, capacity for learning, temperament, specific aptitudes, physical or motor abilities (e.g., manual dexterity or eye-hand coordination), etc.
- *Characteristics of good employment tests*
 - (i) A test should be designed on the basis of a sound job analysis programme.
 - (ii) The test should be reliable, i.e., an applicant if tested even second or third time under same condition should achieve the same score.
 - (iii) The test should be valid, i.e. highly specific to the objective it intends to measure and to the particular business situation.
- *Advantages of a good test*
 - (i) A good test eliminates the possibility that the prejudice of interviewer will govern the selection decisions.
 - (ii) It uncovers the hidden talents of an applicant which might have been otherwise overlooked in the selection process.
 - (iii) A number of candidates can be tested at one time and a good amount of information about each applicant can be obtained in a relatively small duration of time.
 - (iv) Test score of an applicant is a positive point (reason) to accept him or to reject him.
 - (v) Tests tend to lower the cost of selection because a number of candidates can be tested simultaneously.

- Types of employment tests

A simple classification of tests used in selection would distinguish the following main types :

- (a) Achievement tests,
 - (b) Aptitude tests,
 - (c) Intelligence tests,
 - (d) Interest tests,
 - (e) Dexterity (motor) tests, and
 - (f) Personality tests.
- (a) **Achievement tests or Performance tests**
- When an applicant claims to know something, an achievement or performance test is given in order to give him a chance to demonstrate his ability and thus to measure what the applicant knows about a particular job or what is his degree of proficiency in doing that job.
 - Prospective stenographers are asked to take dictation and then type it out, a welder is asked to weld two metal pieces together, a machinist is asked to prepare a job involving many different machining operations, etc.
 - Achievement tests prove to be very useful in selecting employees at the lower levels, e.g., a welder, a typist, a driver, etc.
 - Performance tests are highly acceptable to both management and applicants because of their evident close relationship to the job in question.
 - **Trade Tests** measuring an applicant's (e.g., a welder's or turner's) trade knowledge and skill are a type of achievement tests. Trade tests may be oral, written, picture or performance type.
 - In general, performance tests achieve high validity when the tasks to be evaluated are representative and when the rating system is objective and uses appropriate standards.
- (b) **Aptitude Tests**
- An aptitude test explores inborn tendencies of an applicant to perform well in a particular field.
 - An aptitude test determines whether an applicant has the capacity or hidden ability to learn a given work if he is given proper training.
 - Examples of aptitude tests are : mechanical, clerical, musical, and motor capacity tests such as finger dexterity, eye hand coordination, etc.
 - An aptitude test is used to measure the job proficiency (from production records) and job training of an employee.
- (c) **Intelligence tests**
- Intelligence tests give an idea of mental quickness or quickness of perception and general knowledge of an applicant.
 - An intelligence test is probably the most widely administered standardized test in industry.
 - An intelligence test explores
 - Quick learning,
 - Alertness,
 - Comprehension, and
 - Reasoning.
 - Judgement making qualities of an applicant and his ability to deal with abstract symbols, ideas, words, number and so forth.

(d) Maintaining satisfactory group relationships, by

- Contacting employer's groups
- Contacting employee's representatives
- Contacting government agencies
- Integrating group interests.

(e) Maintaining employees health

- Health standards
- Sanitation control
- Physical examinations
- Treatment of minor injuries and diseases
- Hospitalization
- Personnel hygiene and health education
- Rest periods, Recreation, etc.

(f) Maintaining employees safety

- Safety standards
- Safety guards and inspection of safety equipments
- Safety programmes, safety publicity, safety rules and safety contests
- Fire protection and accident investigations
- Safety records and workmen compensation for injuries.

(g) Maintaining employees service activities (employee welfare)

- Credit unions
- Savings and investment plans
- Group insurance
- Profit sharing
- Pension
- Legal assistance
- Housing programme
- Company stores and restaurants
- Recreation plans.

20.3. PRINCIPLES (CHARACTERISTICS) OF A GOOD PERSONNEL POLICY

- A personnel policy is a directive, usually written, to help personnel department in accomplishing its objectives or functions.
- A personnel policy is dynamic to meet fundamental changes or the current situation.
- A personnel policy contains the information regarding
 - (i) Recruiting employees
 - (ii) Employment conditions
 - (iii) Promotions
 - (iv) Discharge
 - (v) Safety practices
 - (vi) Training
 - (vii) Financial aid
 - (viii) Health standards, etc.
 - (ix) Separation.
- Various characteristics/principles of a good personnel policy are :
 1. It should avoid opportunism and be stable.

2. It should have due regard for the human equation, the employees, the employers and the consumers (or public).
3. An employee should be able to approach personnel manager to express his grievances.
4. It should not contain ambiguities and uncertainties.
5. It should guarantee permanent employment to competent employees.
6. It should be flexible enough to meet varying needs of employees and the changing conditions.
7. It should have provision to train competent employees for promotion.
8. It should be easily understood by all concerned persons.
9. It should guard employees against unfair dismissal.
10. It should have a fair wage agreement system.
11. It should provide good working conditions, safety and medical benefits.
12. It should recognize individual differences in capacities, interests, emotional reactions, etc.
13. It should organise and encourage social facilities.
14. It should be above religious, social or political discrimination.
15. A worker or workers should have formal recognition in phases of management of their vital interest.
16. It should maintain effective consultation between employers and employees.

20.4. RECRUITMENT AND SELECTION OF EMPLOYEES

Introduction

- The first step in the development of a concern's personnel activity is to employ the right type of persons to operate the organization. If the organization does not possess right kind of people, it leads to lowered production and employee morale and increased absenteeism and labour turn over.
- Employing people is one of the most critical steps in the establishment and growth of a business.
- The basic purpose of the employment office of the company is to hire desirable employees for specific company openings.
- Recruitment is a major step in the total staffing process.
- *Recruitment* may be described as the process of getting potential employees willing to apply for a job with the concern or firm.
- In other words, recruitment develops and maintains adequate manpower to run an organization efficiently.
- The term *recruitment* is used to describe the attraction of applicants from among whom to select.
- *Recruitment* is the process of searching for prospective employees and stimulating them to apply for jobs in the concern.
- For this reason, recruitment is a positive process; it increases the number of candidates aspiring to take up a job with the organisation.
- As compared to *Recruitment*, *Selection* is a negative process because it picks out a few suitable persons from amongst a number of applicants and thus eliminates many candidates aspiring for the same post.
- Selection divides the applicants approaching for employment into the classes—those who will be offered employment and those who will not.
- A good and effective selection of employees :

8. increases tendency towards making accidents; and
9. increases absenteeism and labour turn-over rate.

Causes and Elimination of Fatigue

The various factors affecting fatigue and the methods to eliminate fatigue are briefed below :

1. Hours of work

In general, the highest productivity per hour and less fatigue is achieved with small number of working hours per day. Perhaps an eight-hour day with a lunch break of 45 to 60 minutes is a good solution.

2. Working days of a week

A five day week with 40 working hours (total) showed the highest hourly output.

3. Nature of work

- Complex muscular work may preferably be done with the help of suitable material handling devices.
- Minute and precise work imparts more fatigue.
- Mental task requiring continuous attention adds to fatigue rapidly.
- Work involving standing and abnormal posture tend to increase fatigue fast.

4. Working conditions

Improper working conditions such as-

- Improper light (illumination)
- Too cold or too hot atmosphere.
- Insufficient ventilation.
- Presence of bad smell, fumes, dust, smoke and flash,
- Noise,
- Heavy protective clothings, etc., add to the fatigue of the worker.

Besides the above listed working conditions of physical nature, the surrounding social situations also add to fatigue.

5. Rest pauses

- Suitable and well planned rest pauses/tea-coffee breaks within the work-hours tend to reduce the build-up of fatigue.
- In general, the duration of rest pause should be anywhere from 5 to 20 minutes, with heavier work requiring the upper limit.

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Methods to Improve Morale

A number of methods employed for improving morale of employees are :

- (1) Introduction of *profit sharing scheme* in which the employees in addition to their wages share a definite percentage of profits.
- (2) Giving proper status and recognition to all concerned.
- (3) Consulting the group on the matters related to work to be done by them.
- (4) Basing decisions on the concept of Democratic Leadership.
- (5) An effective two-way communication between the workers and the management.
- (6) Suitable Suggestion System.
- (7) Adequate grievance handling procedure.
- (8) Periodic conferences between workers and management to discuss employee-problems and difficulties.
- (9) Informal talks between individual workers and the management.
- (10) Adequate welfare schemes for the employees and their families.
- (11) Recreational facilities and social get-together programmes for the employees and their families.

19.11. MOTIVATION

Definition and Need of

- Certain workers generally come late, take more sick leaves or produce low quality products—perhaps they are less motivated or not motivated at all as compared to other workers.
- *Motivation* is the means or inducements which inspire or impel a person (to behave in a certain manner and) to intensify his willingness to use his capabilities and potentialities for achieving goals of the organisation in which he works.
- Behind *Motivation* (or the *will to do/achieve*) is mainly the psychological force ; physical or physiological factors exert comparatively lesser influence.
- What morale does to work-group, motivation does to an individual.

Motivation moves an individual into action and urges him to work with sincerity and loyalty.

- Motivation of workers is very important when a supervisor wants to get things accomplished by them at right time, in right quantity and of right quality.

Workers not properly motivated may not mentally accept the orders or directions with the result that the company goals may not be achieved effectively and efficiently.

Motive

- A detective or police seeks the motive (or reason) for crime, i.e., why the accused did the crime. Once the motive for crime has been uncovered, it provides an explanation for the crime.
- Therefore, *Motive* is a reason for the expression of a particular ability.
- Motive is an idea or emotion which prompts an individual to take a certain course of action. Motive influences the behaviour of an individual.

- Motives are based on physiological drives such as the innate tissue conditions of the organism to avoid pain, to need food, water, sleep, etc.
- Besides those based on physiological drives, there are social motives also, e.g., self-respect, social approval or recognition, etc.

Internal and External Motives

- Internal motives motivate people internally. Internal motivation starts from the ego needs of an individual.
- Examples of internal motives are :
 - (i) The need to get the job of one's choice.
 - (ii) The illusion of self-determination and freedom.
 - (iii) A sense of accomplishment in doing a job well.
- External motivation is stimulated by pay, incentives, praise or punishment.

Positive and Negative Motivation

- Positive motivation adds to an individual's existing set of satisfactions, e.g.,
 - A Better and more responsible job.
 - Higher wages, etc.
- Negative motivation influences the behaviour of an individual through a threatened loss e.g.,
 - Fear of losing one's present job.
 - Reduced wages, etc.

Factors Affecting Motivation

(a) Factors leading primarily towards motivation

1. *Achievement.* Personal satisfaction in job completion and problem solving.
2. *Advancement.* Promotion to the higher job/level.
3. *Growth.* Learning new skills which will offer greater possibility for advancement.
4. *Recognition.* Acknowledgement of a job done well.
5. *Responsibility and Authority* in relation to one's job.
6. *Work itself.* Actual job content and its positive or negative effect on the worker.

(b) Factors leading primarily towards dissatisfaction

1. *Company Policy and Administration.* Feelings about the inadequacy of company organization and management, policies and procedures.
2. *Job Security.* Tenure, company stability or instability.
3. *Interpersonal Relations.* Relations with supervisors, subordinates and peers.
4. *Salary.* Pay and fringe benefits.
5. *Status.* e.g., size of office, private secretary, air-conditioner, etc.
6. *Supervision.* Competency or technical ability of supervision.
7. *Working Conditions.* Physical environment associated with the job.
8. *Personal Life.* Personal factors (e.g., family problems) which affect the job.

Motivational Techniques

1. Praise the workers and give them credit for all good work done by them.

- (v) provides identity to its members and builds up their morale ; and
- (vi) imparts job satisfaction to its members.

19.8. THEORY X AND Y

(a) Theory-X

According to theory-X put forward by Douglas McGregor, the traditional framework for management thinking is based upon certain assumptions about human nature and human behaviour. It is an essentially negative approach to human relations in which a supervisor presumes that

1. The average person does not like to work and will avoid it if he can.
2. For this reason, most persons must be coerced, controlled, directed or threatened with punishment so that they start putting efforts to achieve goals of the organization.
3. The average human being prefers to be directed, wishes to avoid responsibility, has relatively little ambition and wants security above all. Therefore, employees must be pushed constantly and threatened with loss of security and other punishments when they do not produce.

(b) Theory-Y

- Theory-Y bases itself on recently accumulated knowledge about human behaviour.
- Theory-Y is an essentially positive approach to human relations in which the supervisor integrates the needs of his subordinates with the needs of his department. He presumes that the assumptions made in Theory-X do not portray the correct human nature and behaviour.
- Theory-Y emphasizes on satisfying the needs of employees so that they willingly commit to the goals of the organization.
- Theory-Y promotes good human relations and an atmosphere of good mutual understanding and cooperation.
- The assumptions of theory-Y as given by D. McGregor are as follows :
 1. The expenditure of physical and mental effort in work is as natural as in play or rest. The average human beings do not dislike work, given meaningful work, they will try hard to achieve.
 2. External control and threat of punishment are not the only means to bring about efforts towards organizational goals. Satisfied persons will themselves exert self-control in seeking to attain them.
 3. Commitment to organizational goals depends upon the rewards associated with their achievement. The most important rewards being those which satisfy needs for self-respect and personal improvement.
 4. The average man learns, under proper conditions, not only to accept but also to seek responsibility.
 5. The capacity to exercise a relatively high degree of imagination, ingenuity and creativity in the solution of organizational problems is widely (not narrowly) distributed in the population (people).
 6. Under the conditions of modern industrial life, the intellectual potentialities of the average men are only partially utilized.

19.9. HAWTHORNE EXPERIMENT

- The most famous of all human relations movement and research were the Hawthorne experiments (so named because they were carried on in the Hawthorne plant of Western Electric

Company of Chicago, U.S.A.)

- Dr. Elton Mayo led a team from Harvard University which cooperated with the Western Electric Co., in the period 1927-1936 to carry out Hawthorne experiments.
- The Hawthorne experiments :
 1. Recognised the importance of employee-attitudes—such as understanding, voluntary co-operation, and willing dedication—in the accomplishment of organizational goals.
 2. Found that employee performance is very much influenced by his attitude towards his job, associates and management.
 3. Proved that the organization/firm can gain only when its employees are satisfied and contented in their jobs.
 4. Pointed out that any change to be made should be explained and its meaning should be made clear to the employees.
The fact that a change is logical is not enough, because the employees may not appreciate the logic.
 5. Explored much of the information on group behaviour.
 6. Thus, have provided the basis for much of what we know about getting along with all, problem employees in particular.

19.10. MORALE

Definition and Concept

- Interest in industrial morale developed rapidly after the Second World War, though this word (i.e., morale) was in widespread use even long before.
- It is a measure of extent (or level as either high or low) of voluntary cooperation demonstrated by an individual or a work group and of the intensity of the desire to attain common goals.
- Morale is a mental condition or attitude of (individuals and) groups which determines their willingness to cooperate.
- Morale may also be defined as the extent to which an individual's needs are satisfied and the extent to which the individual perceives satisfaction as stemming from his total job situation.
- Morale is made up of two sets of elements—one set containing those which help to make a person satisfied with his job and a second set containing those (elements) which when, lacking, make him feel dissatisfied.
- The word morale generally has an implication of group reactions, i.e., what motivation does to the individual, morale does to the work group. Morale is an individual attitude in a group endeavour and a group attitude towards the goals of an organization.
- In other words, morale of a group depends on the interactions among individuals in the group such as a hockey team, military unit or a riveting gang.
- *High morale* is the confident spirit of whole-hearted cooperation in a common effort.

High morale implies

- (1) Perseverance at work.
- (2) Loyalty to organization and its leadership.
- (3) Good discipline or the voluntary conformance to rules, regulations and orders.

3. To related problems of organizations.
 - Financial remuneration.
 - Working conditions (environments).
 - Equipment design.
4. In connection with market research, sales and advertising.
5. To organizational behaviour.
6. In connection with Programme Development (research) and individual evaluation (consulting).
7. To find facts about existing methods and the development of better methods, e.g., new interviewing methods, different application blanks, etc.

19.5. INDIVIDUAL AND GROUP

- An individual is one whose performance is affected solely by his own characteristics such as brain, abilities, qualifications, motivation, adjustment, etc.
- Every individual is different from the other and each individual possesses a unique hierarchy of motives and a unique way of behaving.
- Individuals collect and form groups within which they live.
- Groups may be classed as
 - (i) *Primary groups*, where individuals are in face-to-face relationships with each other, where they interact directly and have some liberty of action in interpreting the roles required of them.
 - (ii) *Secondary groups*, where the relationships are more of contractual nature and where the roles must be played out in a more impersonal and stereotyped manner.

Industries normally require secondary grouping of their employees which are not always satisfying to the individual.

19.6. INDIVIDUAL DIFFERENCES IN BEHAVIOUR

- Individuals differ from one another in dozens of ways. Differences are present as regards physical appearance, abilities, education, aptitude, etc.
- Individuals differ and therefore, in industry, they are paid at different rates. One learns with little efforts and practice whereas another is not able to pick up so fast.
- The differences in individuals reflect in their performance and behaviour at work.
- Individual differences in behaviour, if (they are) identified and measured, help much in right selection, placement and imparting proper training to the individuals.
- Action or a peculiar behaviour of an individual to a particular situation is seldom spontaneous; it does have a cause behind.
- Research in behaviour in industry aims at discovering
 - (i) causes of behaviour, or
 - (ii) the factors which are correlated with behaviour even though they are not causative.
- For any given aspect of individual behaviour, there may be many contributing factors.
- If any aspect, factor or variable of individuals is subjected to measurement and plotted, the

- A democratic leader promotes participation of subordinates and develops strong team work.
- All policies come out of group discussions, the subordinates being constantly encouraged and assisted by the leader.
- The leader gives decision only after consulting his subordinates. Actually the decision emerges out of the subordinate group itself.
- Subordinates know the long term plans on which they are supposed to work, thus they are kept well informed.
- Division of tasks is left upon the group; individuals are free to work with whomsoever they choose.
- A democratic leader is objective or fact-minded in his praise and criticism; he tries to be a regular group member in spirit without doing too much of the work.

- *Democratic leadership*

(i) Motivates subordinates to work, and improves their attitude towards work.

(ii) Promotes healthier relations between workers and management.

(iii) Minimizes employee-grievances.

(iv) Raises the employee-morale.

- Democratic leadership works very well if the subordinates (also) feel their responsibility, tend to be reasonable and do not take undue advantage of the democratic leadership.

3. Free Rein or Laissez-Faire Leadership

- This is the most difficult to use type of leadership.
- The leader acts as an information centre and exercises minimum of control.
- The leader depends upon subordinate's sense of responsibility and good judgement to get the work done.
- There is a complete freedom for group or individual decision, with a minimum of leader participation.
- The leader supplies various materials, gives information when asked but takes no other part in work discussion.
- The leader makes no attempt to appraise or regulate the course of events.
- Actually, a Free Rein leader does not lead the subordinates but leaves them entirely to themselves; the responsibility for accomplishing most of the work lies on the shoulders of the subordinates.
- The subordinate group establishes its own goals and solves its own problems.
- The leader is simply a contact man, he ignores leader's contribution, he intervenes least and avoids power.
- Free Rein leadership can work only if the subordinates are highly educated, brilliant and they possess good sense of responsibility.

17.6. QUALITIES OF (GOOD) LEADERSHIP

1. **A sense of mission.** A devotion to the people and the organisation in which one serves.
2. **Accomplishment.** Effective use of time in meeting company goals and objectives.
3. **Education : broad as well as technical.**
4. **Acceptability.** From the subordinates ; respect from and confidence of others.
5. **Self-denial.** A willingness to forgo self-indulgences and the ability to bear the headaches the job entails.
6. **Acuteness.** A leader remains mentally alert and readily comprehends instructions, explanations and unusual circumstances.
7. **High intelligence.** A leader should be able to come down to the level necessary for the subordinates he is leading.
8. **High character.** Includes honesty, sincerity, and the courage to face hard facts, unpleasant situations, etc.
9. **Administration.** Ability to plan and organise the work, delegation of responsibility and authority, controlling position activities, etc.
10. **Maturity.** In coping with situations and making decisions, emotionally stable and unlikely to break down with frustration.
11. **Job Competence.** A leader knows well the job he supervises.
12. **Analysis and Judgement.** A leader performs critical evaluation of potential current problem areas ; he possesses wisdom to look into future.
13. **Initiative and drive.** Self-starting to achieve both personal and company objectives.
14. **Energy.** Good health, good nerves and boundless energy make even tough jobs easier.
15. **Attitude.** Enthusiastic, Optimistic, and Loyal attitude towards the organization.
16. **Personal compliance.** Degree to which leader does what is expected of him, such as setting good example by being punctual, honest, just etc.
17. **Constructive, creative and independent thinking.** Ability to originate and develop ideas intelligently and to make constructive suggestions and improvements.
18. **Dependability.** A leader meets schedules and dead lines and adheres to company policies.
19. **Group Spirit.**
20. **Flexibility.** A leader is adaptable, and quickly adjusts to changing conditions.
21. **Knowledge of industrial psychology and human relations.** A leader understands personnel interactions, has feel for individuals and recognises their problems; is considerate towards others; can motivate and get people to work together.
22. **Approachability.** The extent, to which he is willing to sit and talk with his subordinates and to which they are willing to talk things over with him.
23. **Open-mindedness.** A leader has open-mind and makes decisions without the influence of personal or emotional interests.
24. **Self-confidence.** Self assurance; self-reliance; inner security, etc.
25. **Cheerfulness and Socialness.** A leader remains always cheerful, he makes friends easily and has sincere interest in people.
26. **Verbal ability and communication.** Articulate; communicative and is generally understood by people at different organizational levels.
27. **Good poise and bearing.**
28. **Vision.** Possesses foresight, sees new trends and opportunities; anticipates future events, etc.

16.7. PUBLIC SECTOR**Concept of Public Sector**

- A public enterprise is one that is
 - (1) Owned by the state,
 - (2) Managed by the state, or
 - (3) Owned and managed by the state.
- The sector of public enterprises is popularly known as the *Public Sector*.
- Public enterprises are controlled and operated by the Government either solely or in association with private enterprises.
- Public enterprises are controlled and operated by the Government to produce and supply goods and services required by the society.
- Ultimate control of public enterprises remains with the state and the state runs it with a service motto.
- Its sphere embraces all units, irrespective of risks involved and profit expected.
- There is no dearth of capital in public sector and business expansion is not difficult.
- Public sector prevents concentration and unbalanced growth of industries.
- Public sectors are accountable in terms of their results to Parliament and State Legislature.
- A public enterprise is seldom as efficient as a private enterprise; wastage and inefficiency can seldom be reduced to a minimum.

Evolution of Public Sector

- The Industrial Revolution gave rise to many bitter social evils. It also gave birth to private capitalism. Consumers and workers were exploited and, therefore, there arose the need of State intervention in industrial field. The intervention led to evolution of public sector/enterprises.
- The evolution of public sector in India is recent. Prior to 1947, there was virtually no public sector barring the field of transport and communication, i.e., Railways, Posts and Telegraphs etc., are being managed by the Central Government since pre-independence period.
- Since independence, a large number of public enterprises have been established both by Central and State Governments. The Hindustan Shipyard, The Hindustan Steels, the Hindustan Machine Tools, The Bharat Heavy Electricals, Indian Telephone Industries, Indian Airlines, Life Insurance Corporation are a few examples of public sector.

Objectives of Public Sector

- (1) To provide basic infrastructure facilities for the growth of economy.
- (2) To promote rapid economic development.
- (3) To undertake economic activity strategically important for the growth of the country, which if left to private initiative would distort the national objective.
- (4) To have balanced regional development and even dispersal of economic activity throughout the country.
- (5) To avoid concentration of economic power in a few hands.
- (6) To create employment opportunities on an increasing scale.
- (7) To earn foreign exchange in order to export commodities not available in the country e.g., petroleum oil, sophisticated weapon systems etc.
- (8) To look after well-being and welfare of public.

nature of work to be accomplished through the organisation.

(b) **Deciding various activities**

- To achieve the objectives, the process of organisation is divided into functions, sub-functions and further sub-functions to be performed by an *individual*. The principles of division of work, specialization etc. are followed. This avoids duplication, confusion and wastage of men, machine, money and material.

(c) **Grouping of activities**

- Activities of similar nature (or closely related ones) are grouped under departments, sections or divisions. These may be grouped on the basis of use, coordination, policy and control etc. There may be different departments in an enterprise like Personnel, Finance, Purchase, Production, Sales etc.

(d) **Assignment of responsibilities of definite persons**

- Specific job assignments are made to different persons (subordinates) for ensuring a certainty of work performance. Right man is put on the right job.

(e) **Delegation of Authority**

- Corresponding to the responsibility given to a subordinate, authority is delegated to him, to enable him to show work performance.

(f) **Providing physical facilities and proper environment**

- Provision of right type of physical facilities and environment is essential for the smooth running and prosperity of the organisation.
- *Physical facilities include* - Proper machinery, tools etc.
- *Right environment* means proper lighting, ventilating and heating/cooling arrangements at the place of work, reasonable hours of work, rest intervals, safety devices, job security, job satisfaction and above all human approach by management.

3.6. ORGANISATION THEORY

Concept

- Organisation theory may be defined as the study of (i) structure (ii) functioning and (iii) performance of organisations AND (iv) the behaviour of groups and (v) individuals working in organisations.
- Organisation theory explains how organisations are actually designed and it offers suggestions as how they can be constructed to improve organisational effectiveness.
- Organisation theory helps people understand, diagnose and respond to *organizational needs and problems*.

Objectives/usefulness of

- The basic objective of *organisation theory* is to (i) furnish a general frame of reference for understanding and explaining behaviour of patterns in organisations, and (ii) for providing scientific basis for managerial actions concerned with predicting, controlling and influencing these behaviours, with a view to improve organisational effectiveness.

association and articles of association.

- (iv) A public company has to issue a prospectus to the public.
- (v) It has to allot shares within 180 days from the date of prospectus.
- (vi) It can start only after receiving the *certificate to commence business*.
- (vii) It has to hold a Statutory Meeting and to issue a Statutory Report to all members and also to the Registrar within a certain period.
- (viii) There is no restriction on the transfer of shares.
- (ix) Directors of the company are subject to rotation.
- (x) The public company must get its account audited every year by registered auditors.
- (xi) It has to send financial statements to all members and to the Registrar.
- (xii) It has to hold a general meeting every year.
- (xiii) The Managing Agent gets a fixed percentage of net profit as remuneration.

Advantages of Joint Stock Companies

- (i) A huge sum of money can be raised.
- (ii) It associates limited liability with it.
- (iii) Shares are transferable.
- (iv) Company's life is not affected by the life (death) of shareholders.
- (v) Services of specialists can be obtained.
- (vi) Risk of loss is divided among many shareholders.
- (vii) The company associates with it stability, efficiency and flexibility of management.

Disadvantages of Joint Stock Companies

- (i) A good deal of legal formalities is required for the formation of a joint stock company.
- (ii) Company is managed by big shareholders only.
- (iii) High paid officials manage the whole shows; they cannot have as high interests in the company as the proprietors can have.
- (iv) People can commit frauds with the company.
- (v) Board of directors and managers who remain familiar with the financial position of the company may sell or purchase shares for their personal profits.
- (vi) It is difficult to maintain secrecy as in partnership.
- (vii) The team spirit with which partnership works, is lacking in a joint stock company.
- (viii) Divided responsibility.

Applications of Joint Stock Companies

- (i) Steel mills.
- (ii) Fertiliser factories, and
- (iii) Engineering concerns, etc.

16.6. COOPERATIVE ORGANISATION (OR SOCIETIES)

Concept

- It is a form of private ownership which contains features of large partnership as well as some features of the corporation.

Applications. General Partnership does very well in

Law firms,
Retail trade organisation,
Medical clinics,
Small engineering firms, etc.

Disadvantages

- (i) Each partner has unlimited liability for the debts of the firm.
- (ii) Danger of disagreement and distrust among the partners.
- (iii) Authority being divided among the partners.
- (iv) Partnership lacks permanence and stability; it has limited life. Partnership may dissolve if a partner dies.
- (v) Investors and lenders hesitate to provide money because of the lack of stability of a partnership firm.
- (vi) All partners suffer because of the wrong steps taken by one partner.

(ii) Limited Partnership

- Limited partnership type of ownership overcomes the two main disadvantages [e.g. number (i) and (v) mentioned above] of general partnership.
- Limited partnership is an association of one or more general partners who manage the business and one or more limited partners whose liability is limited to the capital they have invested in the business.
- Limited partners share the profit but they do not participate or interfere with the control or management of the firm. Moreover limited partners have their liabilities limited to the amount of their investment.
- Thus, those investors and lenders who used to hesitate investing in the venture can do so without much risk.
- Limited partnership type of ownership is easy and less costly to form, and personal incentive to succeed is retained.
- A disadvantage associated with limited partnership is that the limited partner, though he invests in the business, has no voice in the management.

16.5. JOINT STOCK COMPANY

Concept

- Joint Stock Company overcomes many of the disadvantages associated with Partnership types of industrial ownership, such as :
 - (i) Difficulties in raising capital,
 - (ii) Easy disruption,
 - (iii) Lack of facility for centralised management, and
 - (iv) Unlimited liability, etc.
- A joint stock company is an Association of individuals, called shareholders, who join together for profit and agree to supply capital divided into shares that are transferable for carrying on a specific business.
- Death, insolvency, disablement or lunacy of the shareholders does not affect the joint stock company.
- A joint stock company consists of more than twenty persons for carrying any business other than

the banking business.

- These persons give a name to the company, mention the purpose for which it is formed, and state the nature and the amount of capital (shares) to be issued, etc., and submit the proposal to the Registrar of Companies. As the registrar issues a certificate in this connection, the company starts operating.
- The managing body of a joint stock company is the *Board of Directors* elected by the share holders. The Board of Directors
 - (i) makes policies ;
 - (ii) takes decisions ; and
 - (iii) runs the company efficiently.
- The liability of the members (or shareholders) of a joint stock company is limited to that capital only of which they hold the shares.
- Finance is raised by issuing shares, debentures, bank loans, loans from industrial and finance corporations.

Types of Joint Stock Company. There are two types of joint stock companies :

- (a) Private limited company,
- (b) Public limited company.

(a) Private Limited Company

- (i) The capital is collected from the private partners ; some of them may be active while others being sleeping.
- (ii) Private limited company restricts the right to transfer shares, avoids public to take up shares or debentures.
- (iii) The number of members is between 2 and 50, excluding employee and ex-employee shareholders.
- (iv) The company need not file documents such as consent of directors, list of directors, etc., with the Registrar of Joint Stock Companies.
- (v) The company need not obtain from the Registrar, a certificate of commencement of business.
- (vi) The company need not circulate the Balance Sheet, Profit and Loss Account, etc., among its members ; but it should hold its annual general meeting and place such financial statements in the meeting.
- (vii) A private company must get its accounts audited.
- (viii) A private company has to send a certificate along with the *annual return* to the Registrar of Joint Stock Companies stating that it does not have shareholders more than fifty excluding the employee and ex-employee shareholders.

Actually, a private joint stock company resembles much with partnership and has the advantage that big capital can be collected, than could be done so in partnership.

(b) Public Limited Company

- (i) In Public limited company, the capital is collected from the public by issuing shares having small face value (Rs. 50, 20, 10).
- (ii) The number of shareholders should not be less than seven, but there is no limit to their maximum number.
- (iii) A public limited company has to file with the Registrar of Joint Stock Companies, documents such as consent of the directors, list of directors, director's contract, etc., along with the memorandum of

(8) Taylor suggested a *Wage Incentive Scheme* known as *Taylor's Differential Piece Rate Plan*.

15.16. SCIENTIFIC MANAGEMENT

Introduction

The early decades of this century witnessed the emergence of *Scientific Management*. This school of thought attempted to introduce a *rational, systematic approach to work and to the management of work*.

- In his early writings F. W. Taylor referred to his ideas as *Task Management*. In 1910 Louis Brandeis coined the word *Scientific Management*.
- F. W. Taylor got recognition as the *Father of Scientific Management*. He wrote a book on "The Principles of Management" in the year 1911.
- The primary emphasis of *scientific management* was on planning, standardizing and improving human effort at the operative level in order to maximize output with minimum input.
- Taylor believed that managements should be based on objective assessment of facts, on measurement and not on guess work.
- Scientific Management is the result of applying scientific knowledge and the scientific methods to the various aspects of management and the problems that arise from them.
- Taylor thought that by maximizing the productive efficiency of each worker, scientific management would also maximize the earnings of the employees and employers.
- The upshot of the scientific management movement was a mechanistic view of the transformation process as well as a mechanistic view of the worker's role in the system.
- Scientific Management could be summarized as:
 - (i) Science, not rule of thumb,
 - (ii) Harmony, not discord,
 - (iii) Cooperation, not individualism,
 - (iv) Maximum output, in place of restricted output, and
 - (v) The development of each worker to his greatest efficiency and prosperity.

Opposition to Scientific Management

- *Scientific Management* was an innovation and, as such, received *tremendous opposition*. During Taylor's life time and in spite of support of other pioneers in the field such as Louis Brandeis, James Dodge, and Henry Towne, *opposition to this change retarded the spread of the basic idea of scientific management in the beginning*.
- *Primary resistance*, instead from workers community, came from management itself which was not prepared to discard old *rules of thumb* in favour of scientific approach (i.e., scientific management). An other cause for opposition was the feeling that scientific management treated workers like cogs in a well-oiled machine and that the system destroyed humanistic practices in industry.
- Later on when, with the use of scientific management, greater efficiency was achieved in industrial operations and productivity increased, principles of scientific management started spreading rapidly throughout the industry.

Basic Approach of Scientific Management

- (i) *Analyse work scientifically*. Investigate all aspects of work on a scientific basis rather than using rules of thumb.
- (ii) Provide specific guidelines for worker performance.
- (iii) Develop one best way of doing a job (using Time and Motion Studies).
- (iv) Select workers best suited to perform the specific tasks.
- (v) Train and develop each workman in the most efficient method for doing the job.

edge, skills and attitude to manage workers and work organizations effectively.

Objectives

1. To ensure the availability of Competent managers to achieve the goals of the organization.
2. To ensure optimum utilisation of human capital.
3. To prepare present employees for higher assignments.
4. To replace retiring executives with younger talents.
5. And as a result, to promote progress, productivity and profits of the enterprise.

Importance

In the words of *Peter Drucker*—An institution that cannot produce its own managers will die. Hence, the ability of an institution to produce managers is more important than its ability to produce goods efficiently and cheaply.

No modern business can grow and succeed without planned attention towards the development of certain attitudes, skills, knowledge and insights in its employees.

Techniques

Management development techniques may be classified as:-

(i) On the job experience and teaching techniques

- (a) Coaching and assigning challenging tasks.
- (b) Rotational assignments e.g., rotation among managerial training positions, creation of 'Assistant to.....', positions etc.
- (c) Multiple management, e.g., Committees, junior boards etc.
- (d) Conference programmes and problem solving committees.
- (e) Understudy for management succession.
- (f) Management workshop programmes.
- (g) Temporary promotions.
- (h) Planned reading programmes.

(ii) Off-the-job teaching techniques

- (a) Lectures and programmed instructions.
- (b) Case study and case problems.
- (c) Role playing.
- (d) Business games.
- (e) Conference, seminars, etc.
- (f) Project study.
- (g) Brain-storming method.
- (h) Observations tours and visits abroad, etc.

Junior managers/executive development programme

- (a) *Observation assignments*—to work under a number of managers to observe as how they perform managerial functions.
- (b) *Assignment to managerial positions*—the trainee is appointed to a supervisory job so that he learns to get things done through others.
- (c) *Job rotation among different managerial positions* to gain actual experience in managing.
- (d) *Serving on committees*—Committee experience will warn the young executive against believing that this point of view is always the right one to have, and it will show him the importance of having an open mind towards any problem.

Industrial Ownership

16.1. INTRODUCTION

- 'Industrial Ownership', 'Business organisation', 'Forms of Ownership of Industry', 'Types of Organisation in Industry', 'Business Enterprises', 'Types of Ownership', etc., all convey the same meaning.
- To start a business enterprise the most important thing required is the capital.
- If the capital is provided by single individual, it is known as *Individual ownership*, *Individual entrepreneur organisation*, *Single ownership* or *Individual proprietorship*, etc.
- If the capital is supplied by two or more persons, it refers to *partnership organisation*.
- If the capital is provided by many persons in the form of shares to an institute with a legal entity, it is called a *Joint Stock Company*.
- There are other forms of ownership also, but they are merely outgrowths of the three types mentioned above.

16.2. TYPES OF OWNERSHIP

The different types of ownership are

1. Single ownership (Private Undertaking).
2. Partnership.
3. Joint Stock Companies.
4. Cooperative organisation.
5. State and central Government owned.

16.3. SINGLE OWNERSHIP

Concept

- Ownership when applied to an industrial enterprise means title to and possession of the assets of the enterprise, the power to determine the policies of operation, and the right to receive and dispose of the proceeds.
- It is called a single ownership when an individual exercises and enjoys these rights in his own interest.
- A business owned by one man is called single ownership.
- Single ownership does well for those enterprises which require little capital and lend themselves readily to control by one person.
- Examples of enterprises run by single owner are printing press, auto repair shop, wood working plant, a small fabrication shop, etc., i.e., retail trades, service industries and small engineering firms.
- In single ownership, one person contributes the original assets to start the business, maintains and controls business operations, reaps full benefit in terms of profit and is fully liable for all

4. Staffing

- Staffing is the process by which managers select, train, promote and retire their subordinates.
- Staffing involves the developing and placing of qualified people in the various jobs in the organisation.
- Staffing is a continuous process. The aim is to have appropriate persons to move into vacated positions or positions newly created in the enterprise.

5. Directing

- Directing is the process by which actual performance of subordinates is guided towards common goals of the enterprise.
- Directing involves motivating, guiding and supervising subordinates towards company objectives.
- Directing thus includes:

(i) Giving instructions to subordinates.

(ii) Guiding the subordinates to do the work.

(iii) Supervising the subordinates to make certain that the work done by them is as per the plans established.

- Directing involves functions such as

(a) Leadership,

(b) Communication,

(c) Motivation, and

(d) Supervision.

(a) Leadership

- Leadership is the quality of the behaviour of the persons (Managers) whereby they inspire confidence and trust in their subordinates, get maximum cooperation from them and guide their activities in organized effort.
- Leadership is more than personal ability and skill.

(b) Communication

- Communicating is the process by which ideas are transmitted, received and understood by others for the purpose of effecting desired results.
- Communication may be verbal or written orders, reports, instruction, etc.
- A manager communicates to his subordinates as what they should do.
- An ineffective communication leads to confusion, misunderstanding, dissatisfaction and sometimes even strikes.

(c) Motivation

- Motivating means inspiring the subordinates to do a work or to achieve company objectives effectively and efficiently.

(d) Supervision

- Supervision is necessary in order to ensure,
 - (i) that the work is going on as per the plan established, and
 - (ii) that the workers are doing as they were directed to do.

6. Coordinating

- Coordinating means achieving harmony of individual effort towards the accomplishment of company objectives.

In other words, the dovetailing and harmonising of all the company assets and employees into a coherent whole is known as *coordination*.

- Ineffective coordination between different functions of a business enterprise (such as production, sales, administration, etc.) can ruin the enterprise.
- Coordination involves making plans that coordinate the activities of subordinates, regulate their activities on the job and regulate their communications.
- Besides other factors, informal relationships within an organization also tend to facilitate coordination, because workers who like each other outside the factory, prefer to work together on the job also.

(7) Controlling

- Controlling is the process that measures current performance and guides it towards some predetermined goal.
- Controlling involves :
 - (i) the monitoring of programme activities to make sure that end objectives are being met.
 - (ii) the initiation of corrective action as required to over-come problems, if any, hindering the accomplishment of objectives.
- Checks and examinations are required on a periodic basis to ensure that the things are proceeding as per plans established.
- Controlling is necessary to ensure that orders are not misunderstood, rules are not violated and objectives have not been unknowingly shifted. Control means control of persons and other things.
- Controlling is a continuous process which measures the progress of operations, (compares) verifies their conformity with the predetermined plan and takes corrective action, if required.
- As explained above, controlling, process
 - (i) Sets standards,
 - (ii) Measures job performance, and
 - (iii) Takes corrective action, if required.

8. Decision Making

- Decision making is the process by which a course of action is consciously chosen from available alternatives for the purpose of achieving desired results.
- An outstanding quality of a successful manager is his ability to make sound and logical decisions.
- Management decisions range from establishing consumer operational development needs to the selection of a preferred system design configuration to many other aspects of a business enterprise.

15.26. LEVELS OF MANAGEMENT

Management/Industrial Management has got the following activity levels.

1. Top Management.
2. Upper Middle Management.
3. Middle Management.
4. Lower Management (Foremen etc.)
5. Operating force or Rank and File workman.

1. Top Management

- Top Management includes
 - (a) Board of Directors.

- Remuneration should
 - (i) be fair, and
 - (ii) bring maximum satisfaction to both employees and the employer.

8. Centralisation of Authority

- Centralisation of authority means that the authority is in the hands of center, i.e., the authority is not dispersed among different sections.
- In a business organisation, authority should be centralised only to that degree or extent which is essential for the best overall performance.
- The degree of centralization is decided by keeping in view the nature, size and complexity of the (business) enterprise.

9. Scalar Chain

- Managers may be regarded as a chain of superiors. There should be an unbroken line of authority and command through all levels from the highest (i.e., general manager) to the lowest ranks (employee).
- The chain of superiors should be short-circuited, when following it strictly will be detrimental to performance.

10. Order

- This promotes the idea that everything (e.g., materials) and everyone (human being) has his place in the organisation.
- Materials and human beings should be arranged such that right material (thing)/person is in the right place.

11. Equity of Treatment

- Manager should have fairness in treatment for all his subordinates.
- Manager should deal with his subordinates with kindness and justice.
- This will make employees more loyal and devoted towards the management/enterprise.

12. Stability

Stable and secure work force is an asset to the enterprise, because unnecessary labour turnover is costly.

- An average employee who stays with the concern is much better than outstanding employees who merely come and go.
- Instability is the result of bad management.

13. Initiative

- Initiative is one of the keenest satisfactions for an intelligent employee.
- Managers should sacrifice their personal vanity in order to permit their subordinates to exercise their own initiative.
- A manager should encourage his subordinates to take initiative.

14. Esprit de Corps

- This principle of management emphasizes the need for teamwork (harmony, and proper understanding) among the employees and shows the importance of communications in obtaining such team-work.

15.23. PRINCIPLE OF EXCEPTION

- The distinguishing features of this approach are frequent measurement and evaluation of actual progress and comparison with the appropriate target figures.

Management is called upon to make a decision on future action only if this comparison reveals an actual or expected divergence or variance.

- According to principle of exception, one reports only those things and at that time when they (things) require an action by the management. It is assumed that unreported events are going as per the schedule.
- In practice, then, control by exception means, comparing
 - (a) actual performance with expected performance and
 - (b) actual costs with target costs, in such a way that suitable corrective action can be taken if things go wrong.
- The principle of exception consists of a number of related parts which may be summarised as follows:-
 - (a) Each person performs the work allotted to him in the prescribed manner without infringement on the work of others.
 - (b) The work is carried out with minimum amount of instruction and supervision. As a corollary of this, a subordinate should only consult his superior when there are unusual occurrences or emergencies.
 - (c) Matters which are not proceeding according to plan are reported upon so that corrective action can be taken. This allows managers to concentrate on important matters and disregard any others.
- Control by exception depends for its effectiveness upon a number of factors, for example:
 - (1) The validity of the target figures.
 - (2) Both targets and actual results must be linked with managerial responsibilities – otherwise it will be difficult to make corrective action effective.
 - (3) Control reports must be issued sufficiently quickly and frequently to enable corrective action to be taken before it is too late.

15.24. PROCESS OF MANAGEMENT

- The *Process of management* involves the determination of *objectives*, putting them into action and achieving the desired goals.
- *Management process* is the methodology of getting the things done. The process, in general, is defined as a series of actions or operations (functions) conducting to an end.
- The logic of the management process is that particular *functions* are performed in a sequence through time.
- Whatever functions are performed by a manager and the sequence in which they are performed, is designated as *Management Process*.
- Management process involves,
 - 1. Planning
 - 2. Organising
 - 3. Actuating, and
 - 4. Controlling, for achieving business goals.

1. Planning

- Planning involves the formulation of *what* is to be done, *how*, *when* and *where* it is to be done, who is to do it and what results are to be evaluated.
- Planning means looking ahead, it is mental work, it is selecting from among many choices following the procedure given below:-

- (ii) The choice of ways and means, and
- (iii) The direction of the people in some group purpose.
- Administration makes policies and decides the goals/targets to be achieved. It is not directly concerned with the implementation of policies.
- The functions of administration are legislative and largely determinative.
- Administration does not need technical ability.
- It is not productive in character.
- Administration coordinates finance, production and distribution.
- It frames the organisational structure and exercises control over the enterprise.
- Administration is the master of industry. It relates to top-level management. Persons like owners or the Board of Directors are in charge of it.
- An Administrator
 - (a) organises his own work and that of his subordinates;
 - (b) delegates responsibility and authority; and
 - (c) measures, evaluates and controls position activities.

15.3. ORGANISATION

- Organisation is the frame work of management.
- Organisation is the function of putting together the different parts of an enterprise into working order.
- Organisation is a system,
 - It is a group of persons,
 - It is a structure of relationships among the individuals working together for a common goal.
- Organization is concerned with the building, developing and maintaining of a structure of working relationships in order to accomplish the objectives of the enterprise.
- Organisation means the determination and assignment of *duties* to individuals and also the establishment and the maintenance of authority relationships among the grouped activities.
- *Organising* is the determining, grouping and arranging of the various activities deemed necessary for the attainment of the objectives,
 - (ii) the assigning of people to those activities,
 - (iii) the providing of suitable physical factors of environment, and
 - (iv) the indicating of the relative authority delegated to each individual charged with the execution of each respective activity.

For further details refer article no 2.1.

15.4. DIFFERENCE AND RELATIONSHIP BETWEEN MANAGEMENT, ADMINISTRATION AND ORGANISATION

- *Administration* determines the objectives and policies of the enterprise, *Management* carries out these policies to achieve objectives of the enterprise.
- For *Administration* and *Management* to function effectively, there must be proper structuring of the enterprise and this is known as *organization* (structure). Organisation has been termed the keystone on which the entire structure of any enterprise is based.
- *Administration* gives proper direction; it is a directing (or direction) function. *Management* properly executes; it is an execution function. And, organisation is an effective machinery for

Supervisory and Leadership

17.1. INTRODUCTION

- A Foreman generally designated by Supervisor (in most of the industries) is a person in charge of, and coordinator of, the activities of a group of workers engaged in one type of task.
- A Foreman/supervisor is a vital link between the management and the workers.
- A foreman is the person who actually gives practical shape to the policies of the enterprise, with the help of workmen.
- Information, both vertically upwards or downwards passes through the foreman.
- A foreman is concerned with the direct supervision of the workers.

17.2. DUTIES AND RESPONSIBILITIES OF A FOREMAN/THE SUPERVISOR'S JOB

1. Towards Management

- To transmit management policies to workers.
- To accept full responsibility for all the work in his department.
- To transmit worker's feelings to management.
- To keep management informed of the work-progress.
- To get the required production out in time.
- Refer promptly the matters to management which need their attention.
- To take up cases of promotion, transfer and dismissal of workers with the management.
- To make plans and devise methods to boost productive efficiency and product quality.
- Devise ways to minimize waste and scrap.
- To keep records for future action.
- To render reports to management as desired.

2. Towards Workers

- To instruct workers about,
 - (i) Company policies and procedures.
 - (ii) The right method of doing the job.
 - (iii) The job ahead.

- To listen patiently the workers, their suggestions and complaints.
- To maintain discipline.
- To develop a sense of belonging in the workers.
- To maintain neat, clean and safe working conditions.
- Divide work among workers in accordance with their capacity and skill.
- To represent workers to management.
- Encourage and train workers to take responsibilities.
- To promote and transfer workers in an impartial manner.
- Develop harmony, cooperation and team work.
- To rate workers for determining their wage rates.
- To train the workers on the job.
- Develop worker's initiative and interest in the job and to motivate them.
- Setting good example in punctuality, temperament, leadership, efficiency, etc.

3. Towards Fellow Supervisors

- To cooperate with them in making company policies a success.
- To give respect to suggestions of fellow supervisors.
- To coordinate work with other departments.
- Passing any information pertaining to other associates, to them.
- Sitting together with other colleagues to solve common problems.
- Encouraging interchange of good workers through promotion and transfer, etc.
- To avoid the creation of ill-feeling among fellow supervisors.

4. Towards Work

- To plan the work.
- To make sure that the material is available for the work.
- To make sure that the necessary equipment and tools are also available.
- To lay out each job.
- To distribute work to workforce as per individual capabilities.
- To see that the work is being accomplished as per the scheduled plan.
- To ensure proper material handling.
- To ensure smooth flow of work.
- To coordinate work of different sections.

Disadvantages

1. Product cost will increase because of high salaries of staff executives.
2. At times the staff department may infringe upon the rights and responsibilities of the line organisation, thus weakening the line organisation when its (i.e., staff department's) true function is to strengthen this organisation.
3. Line and staff organisation may get confusion in case functions are not clear.
4. Frictions and jealousies if developed between line and staff executives may cause harm to the enterprise.
5. Line executives if they start depending too much on staff executives may lose their initiative, drive and ingenuity.

Application. Line and staff organisation is very common among the medium and larger enterprises.

3.12. COMMITTEES

Concept and Need

- A committee is a group of people who work collectively, discuss, decide and recommend solutions to the problems (of a concern) which possibly cannot be solved by an individual.
- A committee consists of a group of men conversant with a subject; naturally their advice will be much superior to that of one man.
- Committees work very well in large complex corporate organisations having multifaceted problems too big and too complex to be dealt effectively by one person.
- In a committee, ideas put forth by several persons are pooled and offered for criticism; the ideas are developed and thus recommendations are made as regards procedure and policies.

Principles

1. The number of persons in a committee should depend upon the need and be optimum minimum (about 5 to 10 persons).
 2. Responsibility, authority, objectives and duties of the committee should be clearly defined.
 3. Agenda of the committee should be prepared and communicated to the committee members at least a week before they meet for discussions.
 4. Problems which can be taken care of by an individual should not be included in the agenda of the committee.
 5. Committee meetings should begin and end on prefixed timings.
 6. Problems not related to the subject-matter at hand should not be discussed because it will simply waste time.
 7. The operation of the committee should be a cooperative development.
 8. The recommendations made by the committee should be published and circulated to interested and concerned persons.
- The committee should be apprised of the action taken based upon its recommendations.
9. A committee must be dissolved after its purpose is over.

Types

- (a) A Standing or Permanent Committee.
- (b) A Temporary Committee.

3.17. DEPARTMENTATION

Introduction

- When the size of an enterprise grows, the number of employees (persons) also increases. There is a limitation on the number of persons an enterprise can manage directly. This limitation restricts the size of enterprise if the enterprise does not opt for the device of *Departmentation* (i.e. *horizontal differentiation*).
- Departmentalisation is the process of breaking down an enterprise into various departments.
- Hence, departmentation or grouping of activities into departments is very essential because it limits the number of subordinates (man power) to be supervised by a manager; it would have otherwise been very difficult to manage a team of large number of subordinates by a single superior and thus the size of the business enterprise would be very limited.
- Identifying and grouping of similar activities on some logical basis so that a team of persons can be organized in order to attain the objectives of the enterprise may be called *departmentation*.
- A department is a work group combined together for performing certain functions of similar nature. The process of division of the enterprise into different parts is broadly called *departmentation* or *departmentalisation* and it is done for the purpose of administration.

Aims of Departmentation

- (i) To group activities and personnel to make manageable units.
- (ii) To bring specialisation in the performance of various activities.
- (iii) To fix responsibility of the heads of various departments for the achievement of organization goals.

Advantages of Departmentation

- (i) Since every-one knows precisely his duties and authority, the *efficiency* of the enterprise increases.
- (ii) As jobs are well-defined and responsibilities well clarified, it is easy to fix accountability for the results.
- (iii) The departmental managers are given opportunity to take initiative and learn new managerial skills.
- (iv) Departmentation provides a basis on which top management can coordinate the activities of different departments.

Methods of Departmentation

Departmentation is the process which is used to group the activities of the enterprise into various divisions for the purpose of efficient management. Different methods of creating departments in an enterprise are discussed below :-

(a) By Function

- Departmentalization by function is shown in Fig. 3.11, wherein the activities of the organization are divided into the *primary functions* to be performed—*manufacturing, marketing, engineering, research and development, employee relations and finance*.

- Organisation structure marks lines of authority, responsibility and co-ordination.
- A few commonly known forms of organisation structures or types of organisations are:
 - (a) Line, Military or Scalar Organisation.
 - (b) Functional Organisation.
 - (c) Line and Staff Organisation.

3.11.1. Line, Military or Scalar Organisation

- It is the simplest form of organisation structure, (Fig. 3.5).
- It was called military organisation because it resembled to olden military organisations.
- Line organisation is based upon relative authority and responsibility rather than on the nature and kind of operation or activities.
- The authority flows directly from the Works Manager (WM) to Superintendent to Foremen (F/M) and from them to workers.
- Line organisation is direct and people at different levels know to whom they are accountable.
- The immediate superior (or boss) gives orders to the subordinates, assigns duties, dismisses and takes disciplinary action against them.
- Any enterprise that starts small probably starts with a line type of organisation.

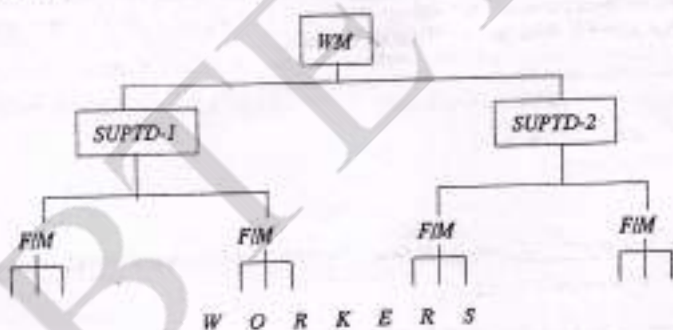


Fig. 3.5. Line Organisation.

Advantages

- (i) It is simple and easy to understand.
- (ii) It is flexible: easy to expand and contract.
- (iii) It makes clear division of authority.
- (iv) There is clear channel of communication, with no confusion at all.
- (v) It encourages speedy action.
- (vi) It is strong in discipline as it fixes responsibility on an individual.

- (vi) It is capable of developing the all-round executive at the higher levels of authority.

Disadvantages

- (i) It neglects specialists.
- (ii) It overloads a few key executives.
- (iii) It requires a high type of supervisory personnel to meet the challenges imposed in the absence of specialists as advisors.
- (iv) It is limited to very small concerns.
- (v) It encourages dictatorial way of working.
- (vi) In line organisations provisions are seldom made to train, develop and replace top executives.
- (vii) Due to lack of specialisation perhaps there is more wastage of materials and manhours.

Applications. Line organisation is suitable for,

- (i) small concerns free from all complexities; and
- (ii) automatic and continuous process industries such as paper, sugar, textile, etc.

3.11.2. Functional Organisation (Fig. 3.6)

- F.W. Taylor suggested functional organisation because it was difficult to find all-round persons qualified to work at middle management levels in the line organisation.
- Functional organisation is also a line type of organisation with the difference that instead of one foreman (which being master or specialist of everything and therefore hard to find) there are eight functional foremen; four of them located on the shop floor and remaining four in the office, but everyone having direct and equal authority over the workers.
- Each functional foreman who is a specialist in an activity is in charge of one function, e.g.

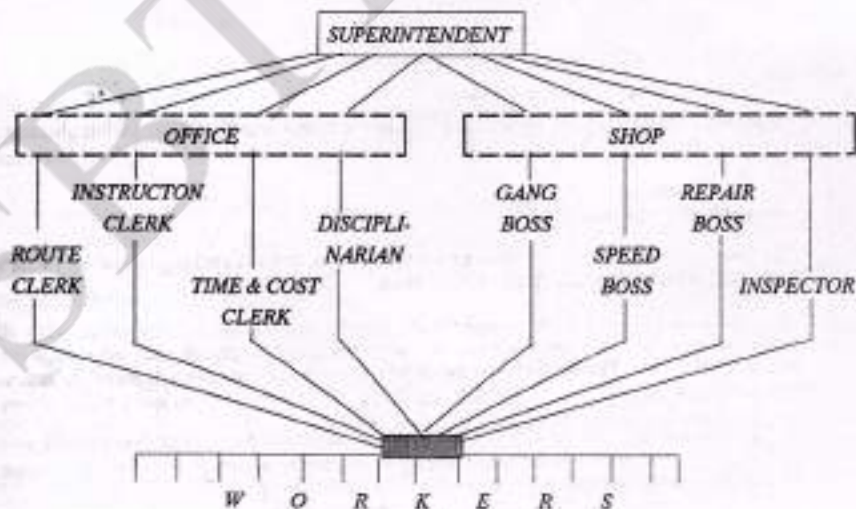


Fig. 3.6. Taylor's functional organisation.

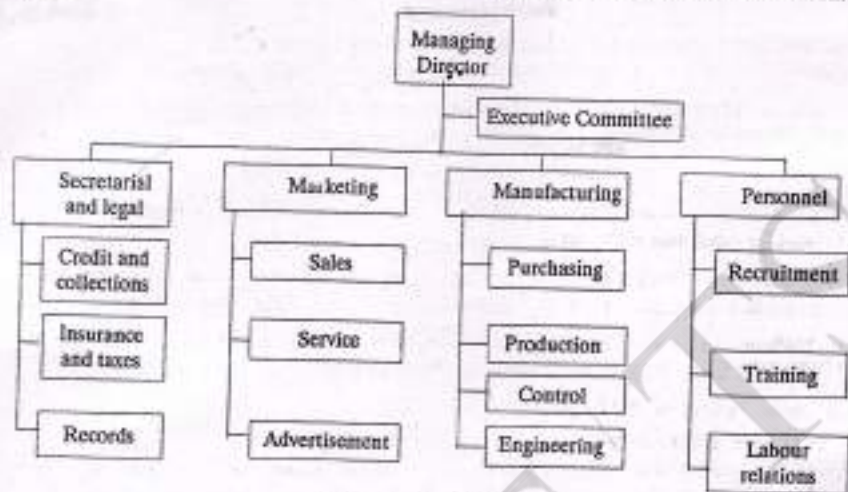


Fig. 3.2. Organisation chart.

An Organisation Chart shows

1. The interrelationship and relative position of each department of the company.
2. The lines of command, i.e., Authority and Responsibility.
3. Relationships between different managers (i.e., by virtue of their status in the organisation).
4. Kinds of managerial relationship which exist (i.e., line, staff and functional).
5. Sometimes, the names of managers along with the number of persons they supervise.
6. And brings to notice an illogical grouping of functions.
7. And pinpoints the omission of a particular function.

Advantages of Organisation Chart

1. An organisation chart tells quickly as to who is responsible for a particular function.
2. It pinpoints the weakness of the organisation (refer points 6 and 7 above).
3. Information contained in the organisation chart supplements the details available in organisation manual.
4. An organisation chart can serve as a training device and as a guide in planning for expansion.
5. An organisation chart is useful in showing the nature of organisation, and changes, if any, in the existing staff and the new-comers.

Limitations of Organisation Chart

1. An organisation chart needs frequent updating.
2. It shows a static picture of the dynamic business.
3. It induces certain structural rigidity and may encourage red tape. This is because an organisation chart marks definite channels through which information must flow. Short cuts, sometimes, may improve efficiency.
4. It is very difficult to portray human relationships on an organisation chart.

Use. Besides certain weaknesses, an organisation chart serves very useful purpose especially when it is drafted by an expert.

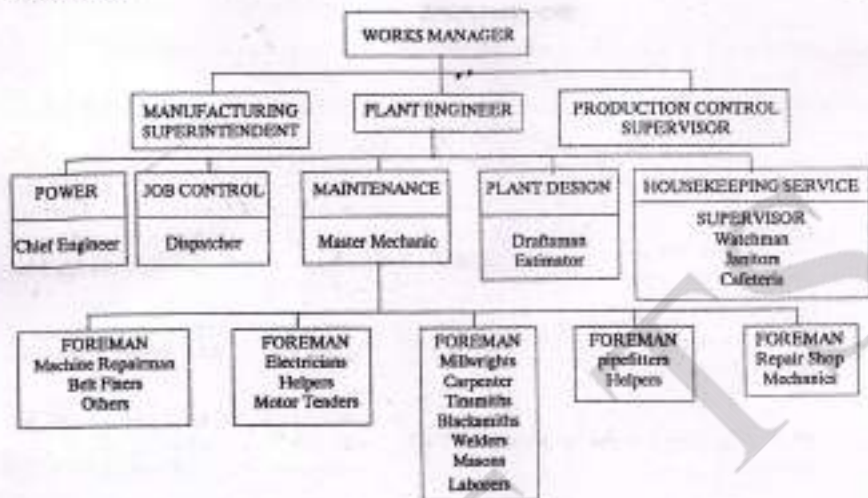


Fig. 3.3. Organization chart of a plant maintenance department.

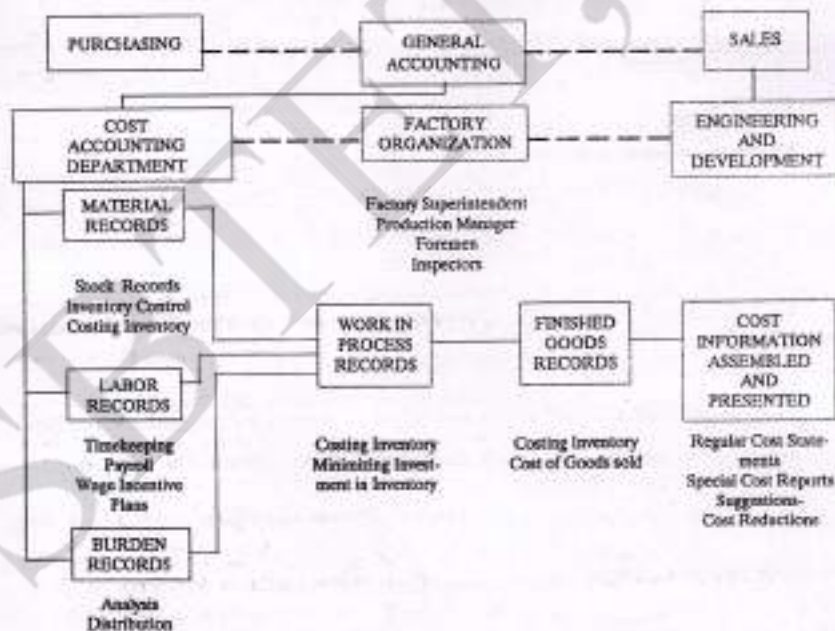


Fig. 3.4. Functional chart of the organization of a cost department.

(iii) is valuable in training new personnel.

- An organisation manual is written information about the various positions in an organisation and is generally kept in loose leaf form to facilitate revision which is very necessary if the (organisation) manual has to remain useful and purposeful.

(iii) Standard Practice Instructions

- They describe how the various tasks are to be performed in the organisation.
- Examples of various tasks and operations are—receiving materials from the suppliers, calculating vacation salaries, requisitioning supplies etc.

(6) Effective Delegation

- Effective delegation is said to be existing when an executive instead of doing all the thinking for the unit himself, passes down to his subordinates any task on which they can take decisions themselves and perform it efficiently and effectively.
- By doing so, the executive gives a chance to his subordinates to think and to develop and at the same time keeps himself free to deal with managerial responsibilities such as handling special problems that arise, co-ordinating, planning improvements etc.

(7) Communication

- Communication serves as a linking process by which parts of an organisation are tied together.
- Communicating means transmitting instructions and information within the organisation and to outside customers, suppliers, etc., i.e., to all those who are affected.
- Since, employees in any organisation possess different levels of education and ability, an ineffective and improper communication may lead to fears, mistrust, confusion and even strikes.
- Good communication is essential if all employees are to know what to do in order to achieve the goals of the organisation.
- For better results, it should be a free two-way communication. Not only the executive should pass down information to the subordinates, there should be feedback, i.e., replies should come from those also who are given instructions.
- A narrow span of control improves communication, helps implementing decisions correctly, and the executive can visualise a clear picture of the effects of his decisions.

- Types of Communication

(i) *Downward communication* i.e., the transmission of instructions and information from top executive downwards to the lowest grade employee.

(ii) *Upward communication* i.e., the transmission of feedback, orientation, complaints, suggestions for improvements etc., from the lowest grade employees to top executive.

(iii) *Horizontal communication* i.e., the transmission of information between persons having the same level of authority in the organisation.

(iv) *Unofficial communications* or rumours which are inevitable in any organisation, sometimes, may be correct but they present the distorted picture. The damaging effects of such unofficial communications can be minimized by effective official communication.

- *Communication systems and equipments.* Communication systems and equipments have been

discussed in chapter 7.

(8) Line and Staff Functions

- All activities of an organisation can be classed into two main categories :

- (a) Primary activities, and
- (b) Supporting activities.

For example, in Army, Infantry and Artillery perform primary activity, i.e., fighting whereas Corps of EME, AMC (Army Medical Corps), ASC (Army Supply Corps) etc., perform different supporting activities.

Primary activities or line functions are those which contribute directly and vitally to the objectives of an organisation. Examples of line functions in a business organisation are production, sales, etc.

Supporting activities or staff functions are those that aid the line or are auxiliary to line functions. Examples of staff functions in a business organisation are Accounting, Administration, Personnel, Maintenance, etc.

The concept of line and staff functions is very valuable in organisational planning.

(9) Balance, Stability and Flexibility

(a) **Balance.** All units of an organisation should be balanced (i.e., developed in proportion to its contribution to the overall success of the organisation).

- In the absence of such balance (between different units or departments), the goals of the organisation cannot be achieved economically and effectively.
- For example, if the purchase department is underdeveloped (i.e., it has neither adequate staff, nor resources, nor authority, etc.) as compared to other departments, it will seriously handicap the firm that may otherwise be very strong and modern in Production and Sales.

(b) **Stability.** Organisational stability refers to the capacity to withstand the losses of key personnel (if they leave to join another concern) without serious loss to the effectiveness of the organisation in performing its work.

- A long range planning programme with regard to manpower requirements accompanied by positive executive training and development programmes will add to the organizational stability.

(c) **Flexibility.** Organisational flexibility specifies the capacity to adjust work assignments, personnel and facilities to temporary changes in the volume of work. Flexibility is the ability to bend and blend without (and before) experiencing any serious setback.

3.8. ORGANISATIONAL STRUCTURE

Concept

- No organisation can work without people. *Organisation structure* simply means the *systematic arrangement* of the people working for the organization in order to achieve predecided goals.
- *Organisation structure* is concerned with the establishment of positions (persons) and the relationships between positions.
- The structure provides an appropriate framework for authority and responsibility relationships between various positions.
- The organisation structure is generally shown on an *organisation chart*.
- The structure has two dimensions i.e., horizontal and vertical.

- (2) Unlike classical static structure, modern theory is *dynamic* in interaction with the structure. It is constantly subject to change as environment changes. Organisation *adapts* itself suitably to the changing environment and it survives.
- (3) Modern Theory is both *macro* and *micro* in its approach. It is *micro* when considered with respect to the entire nation or industry. It is *macro* with respect to internal parts of the organisation. Hence the theory is *multi-level* and *multi-dimensional*.
- (4) In contrast to *classical*, *modernists* view individual as complex being who can be motivated in multitude of ways. Modern Theory is thus *multi-motivated*.
- (5) Modern Theory is *multidisciplinary* in the sense that it heavily draws its concepts from the various disciplines such as economics, sociology, engineering, psychology, anthropology etc., for problem solving and decision-making.
- (6) Modern Theory does not dispute the principles of both the earlier theories but suggests that they are incomplete in the sense that they deal only with structural aspects and overlooked the totally integrative systems approaches to human process in the organisations.
- (7) According to system's approach, the total system should be studied as a whole and not in parts.
 - Though the Modern Theory has contributed a lot to the organisation, yet it is not free from criticisms:
- (1) The Theory has not lived up to the expectations it raised at the beginning. It promised to provide an adequate and comprehensive explanation of organisation, but this promise does not seem to be fulfilled.
- (2) Though critics regard it an important theory of organisation, it has not yet developed sufficiently as a theory of explanation in the realm of human behaviour.

3.7. PRINCIPLES OF ORGANISATION

Introduction

- A principle is a general rule or truth that may be expected to apply under similar conditions anywhere.
- Organising being a universal problem for all business concerns, many principles have been designed as guidelines in considering the organisational needs of a concern and for successful organisational relationships.
- Principles of organisation assist in arriving at the final structure of an industrial organisation to carry out the basic objectives of the organisation.

A few common principles of organisation have been listed and explained below :

1. Consideration of objectives.
2. Relationship of basic components of the organisation.
3. Responsibility and authority.
4. Span of control.
5. Dividing and grouping work (including coordination).
6. Effective delegation.
7. Communication.
8. Line and staff relationships.

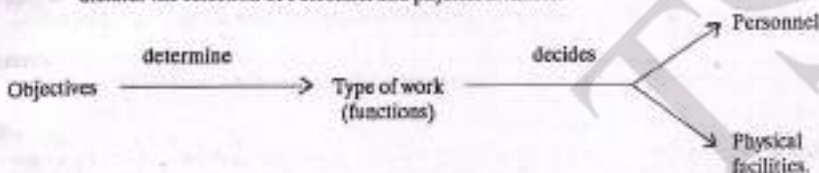
9. Balance, stability and flexibility.

(1) Consideration of Objectives

- Since the objectives of the enterprise have an important bearing on the organisation structure, only those objectives should be taken up and accomplished for which there is real need in the organisation e.g., measures may be taken to increase productivity, improve product quality etc.

(2) Relationship of Basic Components of the Organisation

- Objectives as decided in step-I above determine the work to be performed and the type of work dictates the selection of Personnel and physical facilities.



(3) Responsibility and Authority

- Responsibility** means accountability. It may be considered as the obligation of a subordinate to his boss to do a work given to him.
- Authority** means right (to command) and power to act.
- Since the top man in the organisation cannot do each and everything himself alone, a definite chain of responsibility and authority is provided from the top executive to each employee, of course through several levels or layers in between.

As far as possible a person should take direct orders from only one superior and he should know to whom he is accountable.

- Lines of responsibility should be made very clear in order to facilitate ready flow of communication and control.
- Authority empowers the superior to make a subordinate to do the work. Everybody in the organisation, from top level downwards, possesses some authority to secure cooperation from subordinates.
- Lines of authority should be very clearly established in the structure of organisation in order to avoid overlapping actions, omission of acts etc.
- Authority and responsibility must go together if the goals of the organisation are to be achieved efficiently and effectively.
- Whenever an employee is made responsible to accomplish a particular task, he must be given due authority also to control and direct efforts towards completing the task.
- When an employee is authorised to take up a job, he is held responsible for its performance also.
- Whereas authority to command and act can be delegated, the responsibility cannot. The responsibility of the boss for the acts of his subordinates is absolute. The chief executive is still held responsible for poor quality of the products made by his subordinates.

of human relationships.

- Narrow span of control is not fit for the present environment.

(iv) *Bureaucratic behaviour*

- Weber's ideal bureaucracy, the main constituent of classical theory, suggests the strict adherence to rules and regulations through mindless application of the letters of the rule. In today's world where problem-solving ability, innovativeness and creativity are required, the bureaucratic approach appears to be inadequate.

(v) *Neglect of human factor for focus on Anatomy of Organisations*

- The Classical Theory does not envisage the development of informal groups and there is no room for emotions and sentiments of people at work. The Theory recognises tasks and not the people.

(vi) *Little scope for integration*

- The Classical Theory provides little scope for integrating people with the organisation. Goal setting and decision-making is by the top without consulting the subordinates.

3.6.2 NEO-CLASSICAL ORGANISATION THEORY

Concept

- The neo-classical theory has introduced the *human relations* approach in the classical theory of organisation.
- The neo-classicists, view organisation as a combination of formal and informal forms of organisation. The informal part (form) was missing in classical approach.
- The inspiration of the neo-classical theorists were the *Hawthorne Experiments* conducted by Mayo and his associates from 1924 to 1932.

Difference between Classical Theory and Neo-classical Theory

Basis	Classical Theory	Neo-classical Theory
1. Structure	Impersonal, mechanical	Organisation is a social system.
2. Focus	On work and economic needs of workers	On small groups. On emotional and human qualities of employees
3. Emphasis	On order and rationality	On personal, security, and social needs of workers while achieving objectives of the organisation.
4. Behaviour	Organisational behaviour is a product of rules and regulations	Behaviour is a product of feelings and sentiments and attitudes.
5. Practices	Authoritarian practices, elaborate rules and regulations to obtain results.	Democratic practices. Involvement of employees in decision-making. Recognises the importance of human dignity and values.
6. Results	Work alienation, dissatisfaction	Happy and satisfied employees trying to increase production.

Propositions of Theory

The main propositions of Neo-classical Theory are listed below:

- (1) The organisation in general is a social system composed of several interacting parts.
- (2) The social environments on the job affect people and are also affected by them.
- (3) Besides formal organisation, informal organisation also exists and it affects and is affected by formal organisation.
- (4) Integration between organisational and individual goals is a must.
- (5) People are interdependent and their behaviour can be predicted in terms of social factors.
- (6) Money is only one of the motivators but not the sole. Men are diversely motivated and socio-psychological factors are more important.
- (7) Man's approach is not always rational. He behaves irrationally as far as rewards from the job are concerned.
- (8) Both way communication is necessary for sound functioning of the organisation.
- (9) Team work is essential for higher productivity.

Criticisms of Neo-classical Theory

Though, neo-classical theory is an improvement over the classical theory, it offers a more humanistic view towards people at work, recognises informal group, group norms, informal leader, non-economic rewards etc, even then it is subject to certain criticisms as explained below.

- (1) *Certain assumptions are not true* and as a result there are conflicts in the interests of various groups in the organisation.
- (2) The Theory has limited applicability and is not suitable for all organisations.
- (3) It lacks unified approach of the Organisation Theory.
- (4) The Theory lays more emphasis on human aspect and other aspects of the organisation have been ignored or neglected.

3.6.3. MODERN ORGANISATION THEORY

Concept

- The Modern Organisation Theory is of recent origin having developed in sixties and flourished in seventies. The source of inspiration for modern theory is the Systems Analysis.
- The modern theory has an analytical base, it relies on empirical research and above all has, integrating nature. It is highly constructive.
- The theory views the organisation as a system and studies it in its totality as a complex system of human interrelationships.
- The theory gives answers of many complex questions ignored by classical or neo-classical theorists. The important questions are
 - (i) What are strategic parts of the system ?
 - (ii) What is the nature of their interdependency ?

10.1. INTRODUCTION

Planning by network analysis, probably, got recognition in the year 1955 when dramatic reductions in time (about 70%) were experienced in connection with the overhaul of generating plant by Central Electricity Generating Board in Great Britain.

Network analysis is a system which plans projects both large and small by analysing the project activities. Projects are broken down to individual tasks or activities, which are arranged in logical sequence. It is also decided as which tasks will be performed simultaneously and which others sequentially. A network diagram is constructed, which presents visually the relationship between all the activities involved. Time, costs and other resources are allocated to different activities.

Network analysis helps designing, planning, coordinating, controlling and in decision making in order to accomplish the project economically in the minimum available time with the limited available resources.

Network techniques were developed from the Milestone chart and Bar chart. These conventional planning methods, because of their inherent limitations could not be utilized for planning large and complex projects. They had the following Disadvantages:

- (a) A bar chart becomes too cumbersome while dealing with big and complex projects when the activities are to be considered in detail and their interaction or interdependencies are to be studied clearly.
- (b) A bar chart does not point out as which tasks should be given priorities as regards the resources (i.e., men, money, materials, and machinery).
- (c) The effects of changes in schedule cannot be evaluated with the help of a bar chart.
- (d) A bar chart neither satisfactorily tells the times at which the activities begin and end nor it indicates tolerances in activity timings.
- (e) A bar chart does not show the continuing interrelationship of the activities, especially if the number of activities is large and they change in time scale and resources.
- (f) A bar chart does not predict satisfactorily, well in advance the effects of inevitable snags and thus a corrective action cannot be taken in time.
- (g) Bar charting is simply a scheduling operation, whereas network techniques plan as well as schedule.
- (h) A bar chart does not normally indicate work progress, which is very essential.

10.2. NETWORK TECHNIQUES

A number of network techniques have been developed and a few of them are named below :

- | | | | |
|----|------------|---|---|
| 1. | P.E.R.T. | : | Programme Evaluation and Review Technique. |
| 2. | C.P.M. | : | Critical Path Method. |
| 3. | R.A.M.S. | : | Resource Allocation and Multiproject Scheduling. |
| 4. | P.E.P. | : | Programme Evaluation Procedure. |
| 5. | C.O.P.A.C. | : | Critical Operating Production Allocation Control. |

6. M.A.P. : Manpower Allocation Procedure.
7. R.P.S.M. : Resource Planning and Scheduling Method.
8. L.C.S. : Least Cost Scheduling.
9. M.O.S.S. : Multi-operation Scheduling System.
10. P.C.S. : Project Control System.
11. G.E.R.T. : Graphical Evaluation Review Technique.

The most commonly known and used Network Techniques are PERT and CPM; and they will be discussed in brief.

10.3. TERMS RELATED TO NETWORK PLANNING METHODS

(a) **Event.** An event is a specific instant of time which marks the start and the end of an activity. Event consumes neither time nor resources. It is represented by a circle and the event number is written within the circle (Fig. 10.1). Event and node are synonyms. Examples of events are—start the motor, loan approved, etc.

(b) **Activity.** Every project consists of a number of job operations or tasks which are called activities. An activity is an element of project and it may be a process, a material handling or material procurement cycle, etc. For example, 'Install machinery', 'Arrange foreign exchange' are activities.

An activity is shown by an arrow and it begins and ends with an event. Unlike event, an activity consumes time and resources. An activity may be performed by an individual or a group of individuals. An activity is normally given a name like, A, B, C, etc., which is marked below the arrow and the estimated time to accomplish the activity is marked above the arrow (Fig. 10.1).

Activities are classified as :

(i) **Critical activities.** In a network diagram, critical activities are those which if consume more than their estimated time, the project will be delayed. An activity is called critical if its earliest start time plus the time taken by it is equal to the latest finishing time. A critical activity (e.g., A, C or E) is marked either by a thick arrow or as in Fig. 10.1, to distinguish it from a non-critical activity.

(ii) **Non-critical activities.** Such activities have provision (float or slack) so that, even if they consume a specified time over and above the estimated time, the project will not be delayed. In Fig. 10.1, activities B and D are non-critical activities.

(iii) **Dummy activities.** When two activities start at the same instant of time (like activities C and D in Fig. 10.1), the head events are joined by a dotted arrow and this is known as a dummy activity (activity F in Fig. 10.1). Dummy activity does not consume time. A dummy activity may be non-critical or critical. It becomes a critical activity when its earliest start time (EST) is same as its latest finishing time (LFT).

(c) **Critical Path.** It is that sequence of activities which decide the total project duration. Critical path is formed by critical activities. In Fig. 10.1, path 1-2-4-5 is the critical path. A critical path consumes maximum resources. It is the longest path and consumes maximum time. A critical path has zero float. The expected completion dates cannot be met, if even one critical activity is delayed. A dummy activity joining two critical activities is also a critical activity. A critical path reveals those activities which must be manipulated by some means or the other if the scheduled completion dates are to be met.

(d) **Duration.** Duration is the estimated or actual time required to complete a task or an activity.

(e) **Total project time.** It is the time which will be taken to complete a project and is found from the sequence of critical activities. In other words it is the duration of critical path.

(f) **Earliest start time (EST).** It is the earliest possible time at which an activity can start and is calculated by moving from first to last event in a network diagram (Fig. 10.1).

(g) **Earliest finish time (EFT).** It is the earliest possible time at which an activity can finish.

$$EFT = EST + \text{duration of that activity.}$$

the first one. For example

LFT for activity $F = 18$

LFT for activity C and $E = 18 - \text{duration of activity } F = 15$

LFT for activity $D = LFT$ for activity $E - \text{duration of activity } E$
 $= 15 - 3 = 12$ and so on.

(3) LST for each activity is calculated from the relation,

$LST = LFT$ of an activity - duration of that activity.

For example, LST of activity $D = 12 - 4 = 8$.

(4) EFT for each activity is calculated from the relation

$EFT = EST$ of an activity + duration of that activity.

For example, EFT of activity $D = 4 + 4 = 8$.

(5) Total float $= (LST - EST)$ or $(LFT - EFT)$

For example, total float for activity

$D = (8 - 4)$ or $(12 - 8) = 4$.

(6) Free float $= EST$ of tail event - EST of head event - activity duration.

For example, free float for activity D (Fig. 10.2)

$= 8 - 4 - 4 = 0$

(7) Independent float $= EST$ of tail event - LFT of head event - activity duration.

For example, Independent float for activity D

$= 8 - 4 - 4 = 0$

(8) Critical path is one which consumes maximum time and it is 1-2-3-5-6. The total project duration, therefore, is

$4 + 6 + 5 + 3 = 18$ days.

10.4. PROGRAMME EVALUATION REVIEW TECHNIQUE (PERT)

Introduction. PERT was first used in 1957 as a method of planning and controlling the Polaris Missiles Programme by Booz, Allen and Hamilton together with U.S. Naval department. The aim was to finish the project two years in advance. PERT describes basic network technique which includes planning, monitoring and control of projects. PERT finds applications in planning and control of complex set of tasks, functions and relationships. It is a very important technique in the field of project Management. PERT is commonly employed for conducting the initial review of a project. PERT is a very useful device for planning the time and resources. It represents an important step in the development of managerial science. It points out potentially troublesome areas (which may disrupt programme objectives) against which a timely action can be taken to prevent their occurrences. PERT helps in decision making.

PERT, actually, developed as a research and development planning tool where activity timings could not be estimated with enough certainty. To some extent a similar situation occurs in design work also. PERT can be employed at those places where a project cannot be easily defined in terms of time or resources required. Of course, events can be readily defined which means it is known that, first, part A will be manufactured, only then subassembly S can be built and so on. PERT technique proves very much advantageous when used for non-repetitive type of projects, $R \ \& \ D$, prototype production, defence projects, etc.

Because of the uncertainty of activity timings, PERT acquired the shape of a probabilistic model. It uses linear programming and probability concepts for planning and controlling activities. Probability concept helps in estimating activity timings; and the maximization of (attainment of) the predefined

objectives is achieved through the Linear programming feature of PERT. The statistical probability feature of PERT foretells the probability of reaching the specified target dates. PERT is mainly concerned with events and is thus an event-oriented system.

The basic tool used in PERT technique is the network or flow plan. Network consists of a series of related events and activities. An important point is that, as a person plans the activities in his mind, so the flow plan (or diagram) evolves and, it even points out the gaps in the drawing. The network thus drawn shows, how various activities of a project depend on each other and that certain activities have to be completed before the others can start.

Techniques. The PERT planning technique consists of the following steps:

- (1) The project is broken down into different activities systematically.
- (2) Activities are arranged in logical sequence.
- (3) The network diagram is drawn. Events and activities are numbered.
- (4) Using three times estimate, the expected time for each activity is calculated.
- (5) Standard deviation and variance for each activity are computed.
- (6) Earliest starting times and latest finishing times are calculated.
- (7) Expected time, earliest starting time, and latest finishing times are marked on the network diagram.
- (8) Slack is calculated.
- (9) Critical path(s) are identified and marked on the network diagram.
- (10) Length of critical path or total project duration is found out.
- (11) Lastly, the probability that the project will finish at due date is calculated.

Example 10.2 explains in detail the PERT planning technique.

Example 10.2 : A small engineering project consists of 9 activities. Three time estimates for each activity are given in Table 10.2.

- (a) Calculate values of expected time (t_e), standard deviation (S) and variance (V) for each activity.
- (b) Draw the network diagram and mark t_e on each activity.
- (c) Calculate *EST* and *LFT* and mark them on the network diagram.
- (d) Calculate total slack for each activity.
- (e) Identify the critical path(s) and mark on the network diagram.
- (f) Find the length of critical paths or the total project duration.
- (g) Calculate variance of critical path.
- (h) Calculate the probability that jobs on critical path will be finished by the due date of 38 days.
- (i) Calculate the approximate probability that the jobs on the next most critical path will be completed by the due date of 38 days.
- (j) Estimate the probability that the entire project will be completed by the due date of 38 days.

Explain it.

- (k) If the project due date changes to 35 days what is the probability of not meeting the due date.
- (l) Find the due date which has a probability of 94.5% of being met.

Solution: The concept of expected time and the estimation of variability of activity times (which is necessary before solving the problem) is given below.

1. Estimation of Activity Time. For dealing with uncertainties associated with different activities, PERT approach computes expected time for each activity from the following three time estimates :

- (a) *Optimistic time (t_o)*. It is the shortest possible time in which an activity can be completed if everything goes exceptionally well.

(h) The probability that the project will meet the scheduled or the due date is calculated from the following relation

$$Z = \frac{D - T_e}{S_t} \quad \text{---(4)}$$

where T_e is the total project duration = 33 days

S_t is the standard deviation

$$= \sqrt{\text{Variance of the project}} = \sqrt{25} = 5$$

D is the due or scheduled date (time) = 38 days.

Z is the number of standard deviations by which D exceeds T_e .

Substituting different values in equation (4).

$$Z = \frac{38 - 33}{5} = 1; \text{ for the value of } Z = 1 \text{ the corresponding value of probability can be read from}$$

Table 10.4 and this is 0.841.

TABLE 10.4
Standard Normal Distribution

Z	Probability of meeting due or scheduled date	Z	Probability of meeting due or scheduled date
2.8	0.997	-0.2	0.421
2.6	0.995	-0.4	0.345
2.4	0.992	-0.6	0.274
2.2	0.986	-0.8	0.212
2.0	0.977	-1.0	0.159
1.8	0.964	-1.2	0.115
1.6	0.945	-1.4	0.081
1.4	0.919	-1.6	0.055
1.2	0.885	-1.8	0.036
1.0	0.841	-2.0	0.023
0.8	0.788	-2.2	0.014
0.6	0.726	-2.4	0.008
0.4	0.655	-2.6	0.005
0.2	0.579	-2.8	0.003
0.0	0.500		

(i) The next most critical path is 1-6-7-8, of 31 days duration.

Variance of the path = 1 + 16 + 16 = 33

Therefore, $S_t = \sqrt{33} = 5.74$

$$\text{and } Z = \frac{D - T_e}{S_t} = \frac{38 - 31}{5.74} = 1.22$$

From Table 10.4 for $Z = 1.22$, the approximate probability of meeting due date is 0.888.

(j) To complete the project, there are three paths from first to last event,

(a) 1-2-3-5-8 (33 days)

(b) 1-2-4-5-8 (19 days)

(c) 1-6-7-8 (31 days)

Path (b) involves much less time, so its probability of completing in 38 days is very high.

Paths (a) and (c) are independent of each other and the probabilities of paths (a) and (c) to complete in due time of 38 days are 0.841 and 0.888 respectively. Therefore the probability of their both being completed in 38 days is $= 0.841 \times 0.888 = 0.7468$.

$$(k) \text{ Again } Z = \frac{D - T_s}{S_s} = \frac{35 - 33}{5} = 0.4$$

From Table 10.4 for $Z = 0.4$, the probability of meeting due date is 0.655; and hence the probability of not meeting the due date

$$= 1 - 0.655 = 0.345$$

(l) From Table 10.4, for the probability of 94.5% or 0.945, the value of $Z = 1.6$

$$\text{and } Z = \frac{D - T_s}{S_s}, \text{ therefore } 1.6 = \frac{D - 33}{5}$$

and thus $D = 41$ days.

10.5. CRITICAL PATH METHOD (CPM), CRITICAL PATH PLANNING (CPP), CRITICAL PATH ANALYSIS (CPA)

Introduction. The E.I. du Pont de Nemours Company (USA) in the year 1958 while overhauling a chemical plant employed a technique called Critical Path Method to schedule and control the project and experienced a good amount of saving. Unlike PERT, CPM developed in civilian business and engineering industry where activity timings were relatively well known.

CPM is applicable to both large and small projects, taking from space programmes to wedding or horse shows. It is widely recognized and is the most versatile and potent management planning technique.

CPM is a technique, used for planning and controlling the most logical and economic sequence of operations for accomplishing a project. The project is analysed into different activities whose relationships, as in PERT, are shown on the network diagram. The network is then utilized for optimising the use of resources, progress and control.

Difference between PERT and CPM. The fundamental network of PERT and CPM are though identical, yet there are (certain) differences in details as mentioned below:

PERT

- (1) A probabilistic model with uncertainty in activity duration. Expected time is calculated from t_o , t_m and t_p .
- (2) An event-oriented approach.
- (3) PERT terminology uses words like network diagram, events, and slack.
- (4) The use of dummy activities is required for representing the proper sequencing.
- (5) PERT basically does not demarcate between critical and non-critical activities.
- (6) PERT finds applications in projects where resources (men, materials and specially money) are always made available as and when required.

CPM

A deterministic model with well-known activity (single) times based upon past experience.

It assumes that, the expected time is actually the time taken.

An activity-oriented system.

CPM terminology employs words like arrow diagram, nodes, and float.

The use of dummy activities is not necessary. The arrow diagram thus becomes slightly simpler.

CPM marks critical activities.

CPM is employed to those projects where minimum overall costs is of primary importance. There is better utilization of resources.

(i) **Dispatching.** It is the transition from planning to action phase. In this phase the worker is ordered to start the actual work.

(j) **Progress reporting :**

- (i) Data regarding the job progress is collected.
- (ii) It is interpreted by comparison with the preset level of performance.

(k) **Corrective action :**

- (i) Expediting means taking action if the progress reporting (j) indicates a deviation of the plan from the originally set targets.
- (ii) Replanning—Replanning of the whole affair becomes essential, in case expediting fails to bring the deviated plan to its actual (right) path.

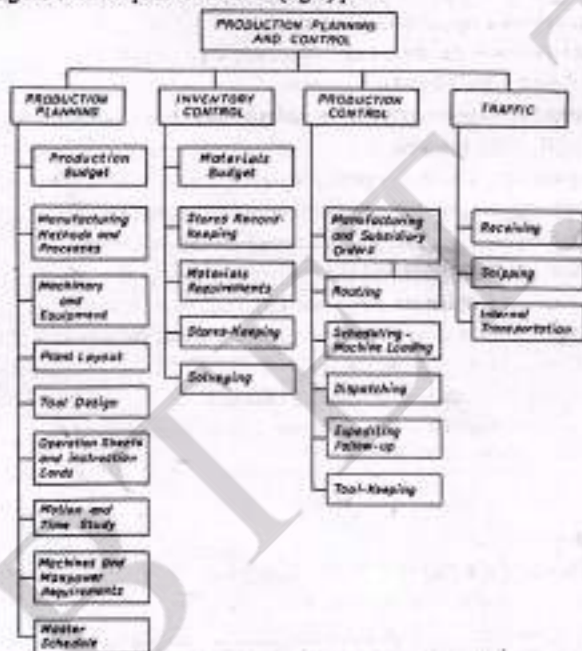


Fig. 7.1. Functional organisation of production planning and control.

7.2. CONTINUOUS AND INTERMITTENT PRODUCTION

Continuous production involves a continuous or almost continuous physical flow of material. It makes use of special purpose machines, and produces standardized items in large quantities. Chemical processing, cigarette manufacturing, and cement manufacturing are some of the industries engaged in continuous production. Continuous production system can be divided into two categories.

- (A) Mass and flow line production,
- (B) Continuous or process production.

An intermittent production system is typified by the intermittent or interrupted flow of material through the plant. It makes use of general purpose machines and produces components different in nature and in small quantities. Machine shops, repair and maintenance shops, welding shops, etc., are some of

the examples of intermittent production. Intermittent production can be classified as,

- (C) Batch production, and
- (D) Job production.

(a) Characteristics of Mass and Flow Production

Mass production means the production of items on large scale, employing very specialized machines and processes. Items like metal screws and plastic products are made in mass production and their cycle of manufacture involves one or more operations on the raw material on one machine. Items like air conditioners, T.V. sets and motor cycles come under flow production and are manufactured in continuous stages from process to process. In this type of production there is a continuous and steady flow of materials.

Various characteristics of mass and flow production are .

- (1) There is scope for considerable division of labour.
- (2) Machinery is laid as per the sequence of production.
- (3) Material handling is reduced to minimum.
- (4) Very little time is spent on the resetting of machines.
- (5) The flow of work is balanced.
- (6) Work cycles are short and of repetitive nature.
- (7) Time study can be applied, to advantage, to different operations.
- (8) Work-in-progress is small as compared to intermittent production.
- (9) Procedures (methods), tools and material handling need proper attention.
- (10) Plant layout and facilities are designed to suit production requirements.
- (11) Flow production is preferred where there is a continuous and regular product demand.
- (12) It offers lowest production cost per unit.

(b) Characteristics of Continuous or Process Production

Continuous or process production is useful where the product consumes fast (electricity, petrol, chemicals, etc.), and has continuous demand.

Various characteristics of continuous or process production are :

- (1) All products undergo the same process. Raw material enters at one point and leaves as finished product at another.
- (2) Material handling is automatic.
- (3) Plant layout is as per the requirements of production.
- (4) Both types of workers, i.e., semi-skilled and skilled are employed.
- (5) Outputs and inputs are, respectively, measured and regulated, using sophisticated controls.
- (6) Machinery employed is one built to the needs.
- (7) Good plant maintenance and effective quality control are the essential requirements.

(c) Characteristics of Batch Production

- (1) It is a very common type of production.
- (2) Articles are manufactured in batches as per the specific order procured.
- (3) Drugs, clothes, paints, parts manufactured on turret lathes, forging machines and sheet metal presses are a few examples of batch production.
- (4) Division of labour is possible.
- (5) Flow of material is intermittent.

- (6) Plant layout is of the process type.
- (7) Automation of processes and mechanisation of material handling may be resorted to.
- (8) Proper maintenance of equipment and machinery is essential.
- (9) Process and product planning is done for each batch.
- (10) Expediting and corrective action are very necessary.
- (11) A good production control system must be developed.

(d) Characteristics of Job Order Production

- (1) Flow of material and parts from one location to another is intermittent or discontinuous.
- (2) Mechanisation and division of labour is not economical.
- (3) Each job order is different from the previous as regards its type, specifications, quality and quantity.
- (4) Product design takes a lot of time.
- (5) Prior planning becomes difficult.
- (6) Schedule is prepared for each component of the product, giving the starting and finishing time.
- (7) General purpose machinery and a flexible layout are preferred.
- (8) Skilled workers and factory made special attachments or accessories do the needful.
- (9) High degree of control is essential.
- (10) Products like a special purpose equipment, an uncommon material handling device, a special heat treatment furnace, a large turbogenerator, a special electronic equipment, etc., are job order production items.
- (11) The number of items to be manufactured is very small, it may be even one item.

7.3. JOB SHOP, OPEN JOB SHOP, CLOSED JOB SHOP

A job shop involves intermittent production [already explained under section 7.2 (d)]. Figure 7.2 shows a job shop configuration. A job shop consists of a number of machine centres, each with a fundamentally different activity.

A few characteristics of job shop are :

- (a) A job shop can produce a variety of jobs in small batches.
- (b) It utilizes general purpose equipment which can be outfitted with special tools, fixtures and dies to do a number of different operations; and thus different jobs can be made with the same basic machinery.
- (c) In a job shop, the material in-process follows different processing patterns in batches through the shop facilities.
- (d) Unlike flow shop, in a job shop, the work does not flow in serial fashion, i.e., it is not a serially utilized facility. In flow shop, work would have moved from operation 1, 2, 3, 4, 5, FP, with no IPG. On the other hand in job shop, the job moves through different routes depending upon the work to be done.
- (e) A job shop makes to order. Normally job shops are not open to orders from just any source. They, on the other hand, operate within a field. Examples are, sheet metal fabricating plants, aerospace industry, automobile service centres, etc.
- (f) A job shop requires highly skilled workers.
- (g) Job shops normally employ overtime.

Closed Job Shop. A closed job shop is one which is closed to job orders from outside the organization. The machine shop of a big concern making automobile parts is an example of a closed job shop. It produces inventoriable items of standard design, which have demand in the market. The same items are produced repetitively in cycles.

Open Job Shop. It produces to order and a similar order may never be repeated. An open job shop makes products as per the requirements of the customers. There may be even one (time large) product/project. The difference between open job shop and a large project is of the scale and complexity of the product.

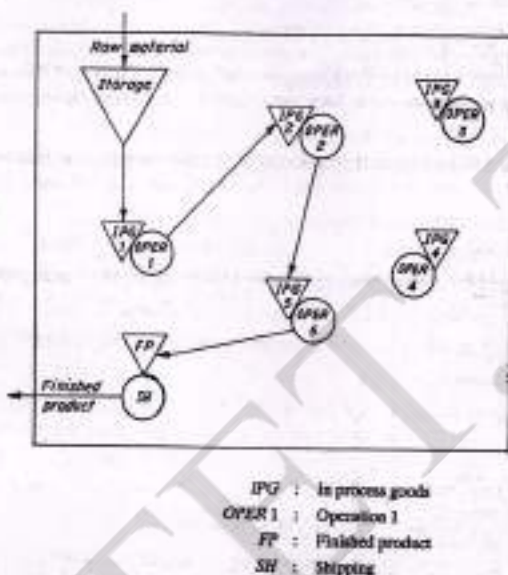


Fig. 7.2. A job shop configuration.

7.4 ONE-TIME LARGE PROJECTS

One-time large projects have the following characteristics :

- (a) In one-time large projects, normally one large product is manufactured at a time.
- (b) One-time large project differs from job shop in the sense that there is a vast difference between the two as regards the size and scope of the products to be manufactured.
- (c) In job shop, the job moves from one facility to another, whereas in one-time large projects, the product being very bulky, the materials and other major components remain at a fixed place whereas workers, tools, portable equipments and other attachments are brought to that place.
- (d) A job shop has a process layout whereas one-time large projects prefer static product layout.
- (e) In large projects, normally all the activities are planned at one time, using network analysis techniques (refer Chapter 10).
- (f) Updating the network is the most important factor which controls the project performance.
- (g) One-time large projects are controlled from the progress reports on different activities. The schedules of activities are periodically recomputed.
- (h) Examples of one-time large projects are, fabrication of ships, space vehicles, erection of bridges, repair of big aircrafts, etc.

SALES					CAPACITY
	PERIOD-1	PERIOD-2	PERIOD-3	P-1	
INITIAL INVENTORY	0	5	10	0	20
REGULAR Pm-1	25	30	30	40	30
Over-time Pm-1	20	25	40	40	30
REGULAR Pm-2	27	28	40	30	30
Over-time Pm-2	22	30	35	40	40
REGULAR Pm-3	23	27	25	30	30
Over-time Pm-3	24	25	30	35	40
DEMAND	10	65	50	40	225

Fig. 7.14. Distribution matrix with capacity, demand and cost values.

In order to find optimum solution consider the distribution matrix of Fig. 7.14 where capacities and demands have been shown along with the various cost values. The costs have been calculated by assuming that

$$c = \text{Rs. } 5, \quad r = \text{Rs. } 25, \quad t = \text{Rs. } 30 \quad \text{and} \quad b = \text{Rs. } 2.$$

This distribution matrix can be solved by using the North-West corner method as described in Chapter 11. The solution matrix thus obtained will show the number of units which should be assigned to regular production, and to over-time production in three different periods in order to minimize the total cost.

7.9. PROCESS PLANNING

Definition and Concept

- Process planning means the preparation of work detail plan.
- Since a process is required to manufacture a product, it is necessary to plan the process.
- Process planning is determining the most economical method of performing an operation or activity.
- Process planning comes after it has been decided as what is to be made.
- Process planning develops the broad plan of manufacture for the component or product.
- Process planning takes as its input the drawings or other specifications which show what is to be made and forecasts or orders which indicate the product quantity to be manufactured.

Information Required to do Process Planning

- Quantity of work to be done along with product specifications.

5. Make the process layout indicating every operation and the sequence in which each operation is to be carried out.

6. Find set-up time and standard time for each operation.

7. Manifest process planning by documents such as Operation and Route sheets, which summarize the operations required, the preferred sequence of operations, auxiliary tools required, estimated operation times etc. (Refer Fig. 7.27).

7.10. ECONOMIC BATCH QUANTITY

- If the number of components to be produced is very large, they cannot be manufactured in one batch.
- Under such conditions it is required to find out—how many pieces (or components) should be produced in one batch so that it is most economical; and this batch size is known as *Economic Batch Quantity*.

- There are two types of costs (Fig. 7.15)

(a) Which increase with the batch size, such as :

- (i) Working capital investment in materials and labour,
- (ii) Cost of handling and storing materials,
- (iii) Insurance and tax charges, and
- (iv) Interest on capital investment, etc.

(b) Which decrease with the batch size, such as :

- (i) Cost (per unit) of setting up machines,
- (ii) Cost of preparing paper work that enters and controls the production of the order, e.g., cost of preparing process sheets, issuing shop order, etc.

The above-mentioned costs, i.e., (a) and (b) are plotted and the total cost curve is determined by adding (a) and (b) cost curves graphically (refer Fig. 7.15).

- Mathematically, *EBQ* can be determined as follows :

Assume :

Q is economic batch quantity.

R is annual requirements.

S is preparation and set-up cost, each time a new batch is started.

C is constant cost per piece (material, direct labour and overheads).

and i is inventory carrying charge rate per year (it is usually between 0.1 and 0.25).

Therefore,

$$\text{Average inventory} = \frac{Q}{2}$$

Value of average inventory

$$= \frac{Q}{2} \times C$$

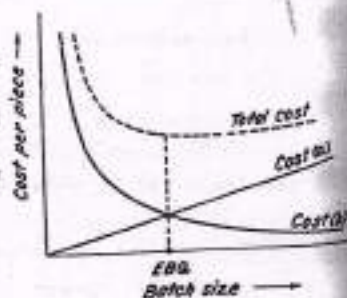


Fig. 7.15. Economic Batch Quantity (*EBQ*).

schedule is actually the basis for all subsequent scheduling techniques.

MASTER SCHEDULE FOR THE FOUNDRY SHOP			
Maximum Production 100 hrs Minimum Production 8 hrs			
WEEK-1	WEEK-2	WEEK-3	WEEK-4
18	18	20	15
21	21	12	10
20	28	40	
21			

Fig. 7.18. Master schedule for a foundry shop.

A Master Schedule possesses the following advantages, disadvantages and applications.

Advantages

1. It is simple and easy to understand,
2. It can be kept running (i.e., current),
3. It involves less cost to make it and maintain,
4. It can be maintained by non-technical staff, and
5. A certain percentage of total weekly capacity can be allocated for rush orders.

Disadvantages

1. It provides only overall picture, and
2. It does not give detailed information.

Applications

It finds applications :

1. In big firms, for the purpose of loading the entire plant,
2. In Research and Development organisations, and
3. For the overall planning in foundries, computer centres, repair shops, etc.

After framing the overall picture of production requirements through a Master Schedule chart, the detailed schedules are thought of and made for each component, and subassemblies so that all parts are available at the time of assembly. There are a number of visual aids and techniques, both in the form of conventional charts and commercially available boards, which aid in detailed scheduling. The technique to be employed for scheduling purposes depends upon the type of production (intermittent or continuous), type and frequency of tasks, demand patterns, etc. A useful scheduling device normally portrays planned production, actual performance and their comparison. Actually, the Gantt Chart (refer Fig. 7.20) forms the basis of commonly used scheduling techniques.

Some of the techniques (besides master schedule) employed for Loading and Scheduling purposes are :

- (a) Perpetual schedule ;
- (b) Order schedule ;
- (c) Loading by schedule period ;

(d) Commercial devices.

(a) **Perpetual Scheduling.** Like master scheduling, it is also simple and easy to understand, is kept current, involves less costs and can be maintained by clerical staff. But, the information which it provides is very gross and at the same time it is not clear from the chart—when the work will take place.

Making of perpetual schedule involves two steps:

(i) Preparation of Load Analysis sheet from the orders in hand. Figure 7.19 shows a load analysis sheet.

LOAD ANALYSIS SHEET			
ORDER NO.	LOAD IN HOURS/DAYS		
	SECTION A	SECTION B	SECTION C
X-320	25	10	16
Y-210	10	15	10
Y-314	18	20	8
Z-150	8	26	—
⋮	⋮	⋮	⋮

Fig. 7.19. Load analysis sheet.

(ii) The total load against each section is added up and knowing the weekly capacity of a section (department), the number of weeks load against each department is calculated and plotted on a Gantt load chart as shown in Fig. 7.20.

GANTT LOAD CHART				
	WEEK-1	WEEK-2	WEEK-3	WEEK-4
SECTION A	[Shaded bar]			
SECTION B	[Shaded bar with dotted line]			
SECTION C	[Shaded bar]			

Fig. 7.20. Gantt load chart.

The shaded bars show the actual work load against each section.

Additional information, if any (regarding the work load), can be indicated by dotted line.

(b) **Order Scheduling.** It is a most elaborate technique. Fig. 7.21 shows an order schedule chart. Time is marked horizontally and the vertical axis shows the particular facility (say a machine). The information required to generate an order schedule is, regarding the number of parts to be manufactured, name of the machines, their set-up times, total production time and the date of completion of the order.

The scheduling is started by placing the last operation at the date of completion and then working

The bottom (12 mm) of the card is coloured and the card is cut to a length depending upon the time the job will take on a particular machine. The black strips in Fig. 7.24 correspond to the coloured bottoms of the cards and indicate which machine will be busy during which period. The progress made against each order can also be shown by strips of other colours.

7.15. MANUFACTURING SCHEDULE

- A master schedule is too general to permit adequate day-to-day planning by line supervision, and is usually unnecessary in a small organisation.
- Weekly departmental *manufacturing schedules* supplement the master schedule and must be made to reflect immediate factors, some of which are
 - (1) Tool downtime due to broken and worn tools,
 - (2) Equipment downtime for repair and maintenance,
 - (3) Shortages and defects in materials,
 - (4) Absenteeism and
 - (5) Cancellations and rush orders.
- The weekly schedule should take advantage of the most economical setup sequence in a process where more than one part is produced on the same line. It is important to arrange the order of work on the weekly schedule, to minimize setup time.

Sometimes much of the same tooling can be used for certain operations on parts A and C. Part B, requiring a different setup on the same machine, should then follow part C rather than precede it. The operating supervisor can help greatly in working out these combinations.

- Successive master schedules are corrected from the variations reflected in the manufacturing schedules. Weekly manpower requirements are based on the manufacturing schedules and excessive fluctuations must be avoided.

7.16. SCHEDULING AND THE COMPUTER

- Since Scheduling is the main process carried out in production control, it is worth to consider the relationship between the computer and scheduling.
- The computer is an extremely versatile tool which can be programmed to undertake almost any data processing task.
- In many types of industry, much of the data required for scheduling is relatively fixed in relation to time. In this category can be included the data contained in parts lists, route cards and plant lists. Many of the data processing needs of production control use this type of data. Examples are, *explosion** to find parts requirements, *implosion*** to find the requirement of common materials and loading to calculate forward loads on machines and direct workers. For these types of data processing, the computer is ideal.
- Continuous data (such as store receipts, store issues, products dispatched etc.) is used by production control in the compilation of stock records, shortage lists and operations statistics.

* An explosive industry produces a small number of different products, by joining a large number of different components e.g. Machine Assembly.

** An implosive industry produces a large number of different products from a small number of different material items or components e.g. Foundry.

the various shops. Dispatch function determines by whom the job shall be done and it co-ordinates production. It is the key point of a production communication system. It creates a direct link between production and sales.

A dispatcher is familiar with the productive capacity of each equipment. He always keeps an eye over the progress of orders which move at different speeds on different routes.

Dispatch Procedure. The product is broken into different components and components into operations. A route sheet for the part (component) C having three operations on it is shown in Fig. 7.26.

The various steps of dispatch procedure for each operation are listed below, in sequence.

ROUTE SHEET PART C
MATERIAL
Operation-1
Operation-2
Operation-3

(a) **Store Issue Order.** Authorise stores (department) to deliver required raw material.

(b) **Tool Order.** Authorise tool store to release the necessary tools. The tools can be collected by the tool room attendant.

(c) **Job Order.** Instruct the worker to proceed with the operation.

(d) **Time Ticket.** It records the beginning and ending time of the operations and forms the basis for worker's pay.

Fig. 7.26. Route sheet.

(e) **Inspection Order.** Notify the inspectors to carry out necessary inspections and report the quality of the component.

(f) **Move Order.** Authorise the movement of materials and components from one facility (machine) to another for further operations.

In addition, there are certain other dispatch aspects which have to be taken care of,

1. All production information should be available before hand.
2. Various order cards, and specification drawings should be ready.
3. Equipments should be ready for use.
4. Progress of various orders should be properly recorded on the Gantt charts or display boards.
5. All production records should be properly maintained.

Centralized and Decentralized Dispatching. Dispatch function may be centralized or decentralized.

In a *Centralized* dispatch system, a central dispatching department, orders directly to the work station. It maintains a full record of the characteristics and capacity of each equipment and work load against each machine. The orders are given to the shop supervisor, who runs his machines accordingly. In most of the cases, the supervisor can also give suggestions as regards loading of men and machines under him. A centralized system has the following advantages :

1. A greater degree of overall control can be achieved.
2. Effective co-ordination between different facilities is possible.
3. It has greater flexibility.
4. Because of urgency of orders, changes in schedules can be affected rapidly without upsetting the whole system.
5. Progress of orders can be readily assessed at any time because all the information is available at a central place.
6. There is effective and better utilization of manpower and machinery.

In a *Decentralized* dispatching system the shop supervisor performs the dispatch functions. He decides the sequence of handling different orders. He dispatches the orders and materials to each equipment and worker, and is required to complete the work within the prescribed duration. In case he

(d) The next step is to determine the lot size or the number of components to be manufactured in one lot or batch. In the case of an order from a particular customer, it is generally equal to a number within 10% of the order quantity. In other cases the principle of economic batch quantity can be applied (refer Chapter 24) to determine the batch size.

(e) Standard scrap factors (single or cumulative) and the places (i.e., after a particular operation or assembly) where scrap is very likely to occur are identified. The actual scrap in each batch can be recorded on the control chart. Causes for points out of control limits are explored and corrected. The variables like workers, machinery and schedules may also be adjusted to minimize scrap.

(f) The cost of the component is analysed and estimated through the information obtained in steps (a) to (e) above. The cost consists of material and labour charges, and other specific and general indirect expenses.

7.20. PROGRESS CONTROL

Introduction. Once the actual production has started, it becomes essential to keep an eye at the progress of the work so that, if required, timely corrective action can be taken. Progress control means—trying to achieve the standards set, i.e., a certain level of efficiency or a certain volume of production in a specified duration. The system of progress control should be such that it furnishes timely, adequate and accurate information about the progress made, delays and under- or over-loading.

Steps Involved in Progress Control

- (a) Setting up a system to watch and record the progress of the operating facility (production section).
- (b) Making a report of the work progress or work accomplishment.
- (c) Transmission of report to :
 1. Control group for necessary control action, and
 2. Accounting group for recording material and labour expenditures.
- (d) Interpretation of the information contained in the progress report by the control group.
- (e) Taking corrective action, if necessary.

The above-mentioned five steps have been briefly discussed as under :

(a) **System to Record the Work Accomplishment.** Progress charts are normally employed for this purpose. They compare the work progress against a prescribed target, and point out the failure to achieve the same; thus progress charts draw attention for an action or investigation.

The chart construction may have the following four forms :

1. The Bar chart,
2. The Curve chart,
3. The Gantt chart, and
4. Mechanical chart.

1. **The Bar Chart** (Fig. 7.28) consists of a number of bars. Each bar has its length proportional to the activity duration. A bar chart is generally used to point out and analyze interrelated data which otherwise is difficult to read.

2. **A Curve Chart** is a graph between two variables (like, number of days and number of items produced) marked along X and Y axis. As the days pass, the number of items being produced are marked over the graph. When all such points are joined they indicate the production trend (See Fig. 7.29).

Both the bar and curve charts show the past data. They are not readily adaptable to current or future action.

ahead of the schedule. Order C-300 which started on the scheduled date, due to some reasons, has got delayed by one week.

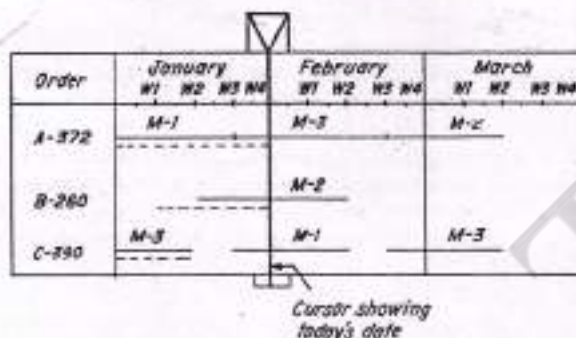


Fig. 7.30. Order control Gantt chart.

(ii) **Machine Load Chart.** Time is marked along the horizontal axis and various machines are listed along the vertical axis (See Fig. 7.31). The amount of work planned and the actual progress made have been shown by firm and dotted lines respectively. Orders by their numbers have been marked on the horizontal firm lines. Cursor set at today's date shows that machine-3 is working as per schedule. Machine-2 started work on order B-260 before the scheduled date and the progress is very good. Machine-1 which completed the order A-372 in time, for some reasons could not take up the order C-390.

From the above Gantt charts the progress of various orders and machine loading can be seen at a glance. Order C-390 has fallen behind the schedule and needs expediting (control action). Machine-1 is loaded up to the middle of February, however machine-2 is available for the third week of February, whereas Machine-3 can be booked only after the middle of March.

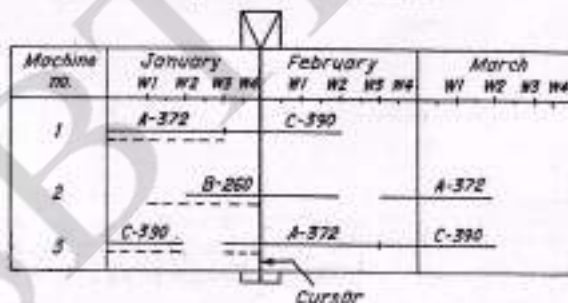


Fig. 7.31. Machine load Gantt chart.

4. Mechanical Charts. They include wall charts, visible index files and other scheduling devices like Produc-Trol board, Board master, Sched-U-Graph, etc. which are commercially available. These equipments have added signalling devices like pegs, strings, clips, etc., to focus the attention on the situations needing corrective action.

(b) Making a Report of Work Accomplishment

1. The progress report should contain the following information in order to evaluate actual performance against the anticipated plan and to take corrective action, if any :

(i) *Job Identification.* It includes order number and operation number.

(ii) *Time of report,* and

(iii) *Work completed.*

2. A progress report should contain absolute minimum of information.

3. *Progress Reporting Time.* Progress can be reported :

(i) at fixed intervals of time, i.e., weekly, monthly, or yearly depending upon the project duration ;

(ii) after the work has been completed, or after each stage of the work is completed ; it depends upon the size of the work ;

(iii) by using the principle of 'Management by Exception'; according to which, one reports only those things and at that time when they (things) require an action by the planning group. It is assumed that unreported events are going as per the schedule.

(c) *Transmission of Report.* The progress report may be transmitted by employing any one of the following systems :

(i) *Written system* (pre-written papers),

(ii) *Oral system* (Telephone, radio, etc.), and

(iii) *Electronic system* (Teleautograph, teletype equipment, etc.).

(i) *Written System*

Advantages

(1) It provides a record for future reference,

(2) The chances of misinterpreting the report are minimised, and

(3) A good amount of necessary information can be supplied.

Disadvantages

(1) There are chances of papers being misplaced in transit ;

(2) Generally, it takes more time for the report to reach the other end ;

(3) File keeping is necessary ; and

(4) There is a tendency to send large amount of information.

(ii) *Oral System*

Advantages

(1) Progress can be reported in no time.

(2) Doubts, if any, can be clarified instantly, and

(3) File work is very much minimized.

Disadvantages

(1) There is no detailed record for future reference,

(2) There are more chances of misinterpreting the report, and in addition

(3) Only brief information can be sent.

(iii) *Electronic System*

Advantages

(1) It possesses all the advantages of the written system, and

(2) Progress can be reported much faster.

Disadvantages

(1) Equipments required are costly, and

(2) Trained operators are needed.

Based upon the above systems the commonly used techniques for sending progress reports are :

(i) *Pre-written or Pre typed Papers.* These are sent through messengers from one department to another.

(ii) *Pre-written Papers Using Pneumatic Tube Equipment.* Papers are put inside a capsule, which is then placed inside a tube, running from one department to another. The capsule is shot by air to its destination.

(iii) *Teletype Equipment.* It has a key board similar to a typewriter. Pressing different keys gives rise to electric signals which are transmitted to receiving stations where the message is recorded.

(iv) *Telaugraph Equipment.* There is a sending unit and a receiving unit. The sending unit has a stylus which is used to write the report. A pen in the receiving unit records the exact movements of the stylus (of the sending unit) and thus besides the written matter sketches and graphs can also be communicated.

(v) *Telephone and Intercommunication Equipment.*

(vi) *Radio and Loudspeaker.* They are especially useful for outdoor applications to control the movements of materials handling equipments and earth moving machinery.

(vii) *Closed Circuit T.V.* It is employed for keeping an eye over the processes emitting harmful radiations.

(e) **Corrective Action.** Factors creating the need for corrective action are,

(A) *External Factors.* These factors are beyond the control of the organisation ; for example :

(i) Change in the priority of orders due to the arrival of some new orders or due to the cancellation of a few previous orders ;

(ii) Delay in receiving equipments, tools, or raw material. This may be due to strike or theft at the vendor's end or due to the reasons that the raw material which arrived earlier was substandard and hence, was returned for replacement ;

(iii) Unexpected rush orders.

(B) *Internal Factors.* These factors results from within the organisation ; for example :

(i) Labour turnover or mass absenteeism,

(ii) Lack of necessary instructions and materials,

(iii) Late starting of the work, tea breaks, etc.

Methods to take Corrective Action

(1) *Schedule Flexibility.* It means keeping the schedule flexible to accommodate unexpected events. Planning is done only for a percentage of the total working time (say for seven hours out of eight hours shift) and the remaining time is kept free to take care of the unexpected jobs. The percentage of time kept free for rush order, etc., is decided from the past experience.

(2) *Capacity Modification.* The following three methods can be employed for modifying the capacity of an organisation :

(a) Changing the number of working hours, either by employing more workers or by using over-time with the same number of workers.

(b) Changing the amount of work within the plant by appropriate Make/Buy decisions or by subcontracting the work to others.

(3) *Schedule Modification.* If the situation is otherwise non-manageable even after adopting the above-mentioned measures, the previously established plan can be modified to suit the new set of conditions.

(c) **Follow Up or Expediting.** The manufacturing activity of a factory is said to be in control when the actual performance is as per the planned performance. Follow up or expediting regulates the progress of materials and the components through the production process. Follow up serves as a catalytic agent to fuse the various separate and unrelated production activities into the unified whole that means progress. Follow up is concerned with the reporting of production date and the investigating of any deviation from the predetermined production (or time) schedules. Follow up ensures that the promise (i.e. of delivery dates) is backed up by performance.

— The work within the organisation can be expedited by the following two principles :

- (i) The exception principle, and
- (ii) The fathering principle.

In *exception principle*, the scheduling group (on the basis of progress reports), explores the jobs behind the schedule. The expediting group takes up such jobs, procures necessary materials, tools, etc., i.e., (expediting group) solves all problems related to these jobs and intimates the scheduling group to reschedule them.

According to *fathering principle* each expeditor is made responsible for a job or a group of jobs for which he arranges the tools, materials, equipment, etc. Such a system works very well for controlling large projects.

7.21. FLOW CONTROL OF MATERIAL, COMPONENT PARTS AND SUBASSEMBLIES TO MATCH THOSE OF FINISHED (FINAL) PRODUCT

The function of Flow (Production) Control is to match up the rates of flow of parts, subassemblies and final assemblies. Each part should be ready before the time of subassembling and each subassembly should be made available at the time and place of assembly in order to make the final product. Flow control achieves this by keeping the parts and subassemblies flowing to the assembly line.

Flow control can be perfected through the following :

(a) **Operation Time.** It amounts the time required to manufacture each part, to make one subassembly and to execute one assembly. This information can be had from the operation sheet.

(b) **Line Balancing.** The assembly line should be balanced, (refer Chapter 4). Each work station should have the same operating time and the various operations should be sequenced properly. There should be perfect balance between the output rates of the parts and the subassemblies. However, it is not always possible that the parts reach in a steady stream immediately before subassembly. This may be because of the limitations as regards materials, men and equipments or it may be economical to manufacture and supply parts in batches. The flow control section has to cope with such situations and thus carry big inventories and arrange facilities for storage.

(c) **Routing and Scheduling.** A combination route and schedule chart showing the fabrication of parts subassemblies and final assembly (See Fig. 7.32) in proper sequence, upon a time scale proves to be very advantageous, especially, when there is smooth flow of work. The chart shows that the fabrication of parts V and W starts on the 4th day and the work on parts U, X, Y, and Z is taken up on the fifth day. All the components should be ready to make subassembly at the beginning of the 8th day and subassemblies should be made available for the assembly of final product on the 12th day. The assembly is over at the end of 13th day and the final product can be shipped on the 14th day.

Knowing the delivery date and the time required to fabricate each part, subassembly and assembly, the chart can be worked out from right to left. Thus obtained date for starting the fabrication of parts and then modified in the light of existing shop loading conditions (known from Produc-Trol board or Sched-U-Graph, (section 7.14) is used to arrive at the actual date to start the manufacture of each part.

temporary storage of in-process inventory and material handling.

Routing in continuous industries does not present any problem because of the product type of layout, where the equipment is laid as per the sequence of operations required to be performed on the components (from raw material to the finished products).

In open job shops, since, every time the job is new, though operation sheets (sometimes) may serve the purpose, but the route sheets will have to be revised and this involves a greater amount of work and expertise.

Routing Procedure. Various procedural steps are as follows :

(a) The finished product is analysed from the manufacturing standpoint in order to decide how many components can be made in the plant and how many others will be purchased (Make/Buy decision) from outside through vendors, by subcontracting, etc. Make/buy decision depends upon the work load in the plant, availability of equipment and personnel to manufacture all components, and the economy associated with making all components within the plant itself.

(b) A parts list and a bill of materials is prepared showing name of the part, quantity, material specifications, amount of materials required, etc. The necessary materials, thus, can be procured.

(c) From production standards—machine capacities, machine characteristics and the operations which must be performed at each stage of manufacture are established and listed in proper sequence on an operation and route sheet, (See fig. 7.27). The place where these operations will be performed is also decided.

Actually, operation sheet and route sheet are separate. An operation sheet shows every thing about the operations, i.e., operation description, their sequence, type of machinery, tools, set up and operation times, whereas a route sheet besides listing the sequence of operations and relation between operation and machine, also details the section (department) and the machines to whom the work will flow. First two columns of Fig. 7.27 are mainly those of route sheet which show the manufacturing route for given component.

OPERATION & ROUTE SHEET								
Component No.			Drawing					
Name of Component			Quantity					
Material			To be completed on					
ROUTING		OPERATION NO.	OPERATION DESCRIPTION	TOOLS REQUIRED	MATERIALS REQUIRED	TIME		
SECTION	MACHINE					SET UP	OPERATION	TOTAL

Fig. 7.27. Operation and route sheet.

The difference between an operation sheet and a route sheet is that an operation sheet remains same for the components if the order is repeated but the route sheet may have to be revised if certain machines are already committed to other orders (jobs) on hand. Except this small difference, both the sheets contain practically the same information and thus are generally combined into one sheet known as 'operation and route sheets'.

3. *The Gantt Chart* was developed by Henry L. Gantt. It is frequently used to keep track of multiple machine schedules. Gantt chart is actually a modified bar chart, wherein load is marked against a time scale with one horizontal bar or line allocated to each machine. A Gantt chart displays the following :

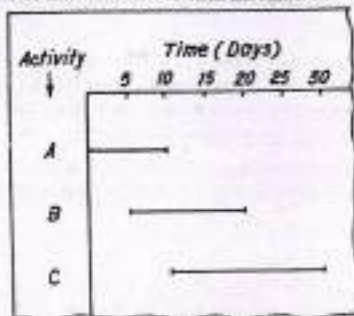


Fig. 7.28. A bar chart.

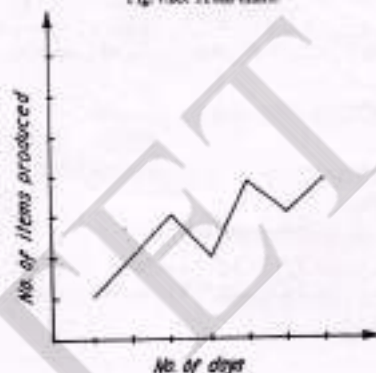


Fig. 7.29. A curve chart.

- (1) Plans for future,
- (2) Progress on present operations,
- (3) Past achievements till date,
- (4) Relationship among several variables,
- (5) It focuses attention on situations threatening delays,
- (6) It tells whether a plan has fallen short and if the delivery dates can be met, and
- (7) A cursor attached to the Gantt chart (See Fig. 7.30) can be moved across the chart to know the work progress till any particular day.

Two basic types of Gantt chart are used extensively for production control.

(i) **Order Control Chart.** Time (in weeks/days) is marked along the horizontal axis and orders in hand are listed along the vertical axis (See Fig. 7.30). The amount of work planned or scheduled is shown by the firm line and the machine on which the order will be processed is marked on the line. The actual progress of various orders is shown dotted. Cursor placed at today's date indicates that order A-372 is going as per schedule. Work on order B-260, started one week before the schedule (starting) date and it is about 70% complete which otherwise would have been only 50% as per the plan. Thus order B-260 is

Computer, again, can do the actual data processing much more accurately and quickly than is possible manually.

A.B.C. Co., Ltd.	Period : 2nd Quarter 1991		
Production order	Date : 15.3.1991		
Item	April	May	June
1 Ton Air conditioners	550	450	350
1.5 Ton Air conditioners	600	500	400
Water coolers	500	400	300
Approval	PPC Manager _____ Sales Manager _____ Production Manager _____		

Fig. 7.25. Production order.

7.17. CONTROL OF PRODUCTION (PRODUCTION CONTROL)

Scheduling completes the planning phase of Production Planning and control. The next is 'Dispatching', the action phase which has been discussed under Section 7.18. After dispatching is the control phase or control of production which consists of two parts (a) Progress reporting, and (b) Corrective action. Both these parts have been discussed in the Section 7.20 under Progress control. Production control phase or progress control means the same thing. The concept of control and control of production is as follows :

A control system involves four stages namely: (i) Observation, (ii) Analysis, (iii) Corrective action, and (iv) Post-operation evaluation. A production control system considers these elements in its different functions.

The control of production is necessary to be sure that the production schedules are being met and the job will be delivered as per the predecided (scheduled) plans. Production control involves an information feedback mechanism and a system of corrective action. Production control follows up the scheduled plans, compares the actual output with the planned one, and points out deviation, if any, so that the same can be corrected through the adjustments of men, materials and machines.

In brief, a production control group:

- (a) receives work progress reports;
- (b) compares them with the scheduled plans;
- (c) removes causes of delays in production;
- (d) modifies the schedules or plant capacities; and
- (e) expedites the work.

7.18. DISPATCHING

Introduction. Dispatch function executes planning function. It is concerned with getting the work started. Dispatching ensures that the plans are properly implemented. It is the physical handing over of a manufacturing order to the operating facility (a worker) through the release of orders and instructions in accordance with a previously developed plan of activity (time and sequence) established by the scheduling section of the production planning and control department. Dispatcher transmits orders to

suspects delay, with due reasons of the same, he informs the production control department. A decentralised dispatching system has the following advantages:

1. Much of the red tape is minimized.
2. Shop supervisor knows best about his shop, therefore, the work can be accomplished by the most appropriate worker and the machine.
3. Elaborate reports and duplication of postings can be avoided.
4. Communication gap is reduced.
5. It is easy to solve day-to-day problems.
6. It keeps the natural urge of a section to be self-sufficient.

The advantages of a centralized system, more or less give an idea about the disadvantages of the decentralised system and vice versa.

Level of Dispatch Office. Dispatching can be introduced at Plant Manager's level, Shop Superintendent's level, at the level of Shop Supervisor or at a Specialist's level.

Dispatching, at the level of *Plant Manager* though keeps him informed about all the plant activities and seeks his guidance, yet it may not work very well; because, firstly he (Plant Manager) does not have time to go through each and every detail carefully and secondly it takes a long time for the information to pass down the line to the workers.

Dispatching at *Shop Superintendent's* level, again, though keeps him better informed, but does not function well because his basic nature of duties (to look whether the operating facility is performing the scheduled work at an acceptable level of performance or not) do not leave much spare time with him to take care of the overall dispatch function in detail.

Dispatching when introduced at *Shop Supervisor's* level, seems to be the best. This system possesses the following *Advantages*:

1. Higher levels are not disturbed.
 2. Shop supervisor knows best about his shop and thus dispatching can be more effective.
 3. The schedule is passed on to the workers in no time.
- The *Disadvantage* in this case is that clerical work for the supervisor increases.

Introducing dispatching at the level of a *Specialist* (a dispatcher not from within the line organization) has the following advantages and disadvantages.

Advantages

- (1) Shop supervisor is relieved of the clerical work.
- (2) The system provides extra manpower.
- (3) The system provides special guidance and advice.
- (4) Dispatching is done more efficiently.
- (5) Effective co-ordination can be attained.

Disadvantage

The traditionally acceptable practice, that a supervisor assigns the job to the workers under him and supervises them, is lost.

7.19. ROUTING

Introduction. Routing lays down the flow of work in the plant. It determines what work is to be done and where and how it will be done. Taking from raw material to the finished product, routing decides the path and sequence of operations to be performed on the job from one machine to another. The purpose is to establish the optimum sequence of operations. Routing is related to considerations of layout,

backwards. For example, if order *X* takes 3 days to complete and it is to be delivered to the customer on 7th of January, the work will be started on 5th of January.

Order schedule chart has the following advantages and limitations.

Advantages

- (1) It is very detailed.
- (2) The earliest possible completion dates can be met.

Limitations

- (1) It is very costly.
- (2) It requires accurate (production) time standards and good communication system.
- (3) It is difficult to maintain effectively if there are many active orders.

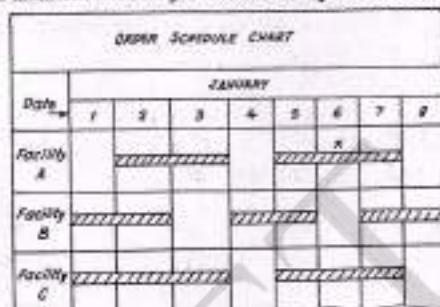


Fig. 7.21. Order schedule chart.

(c) **Loading by Schedule Period.** The task is broken into different operations which will be required to turn raw material into finished product. A Gantt type of chart (See Fig. 7.22) is employed for scheduling purposes. The rows, mark different facilities and each column denotes a time period (TP). There are as many time periods as the number of operations. The first operation is carried out in the time period-1, second operation in time period-2 and so on. It is however not specified that, within the timeperiod, when the operation will start and finish; but the operation is very much supposed to be completed during that particular time period. The shop supervisor does the detailed scheduling within the framework of the specified time period.

The shaded bars show the work ahead of each facility.

This type of scheduling involves a longer in-process (total) time because only one operation is to be performed in one time period. However, this makes it more flexible as an operation can be taken up at the most convenient time within the specified time period.

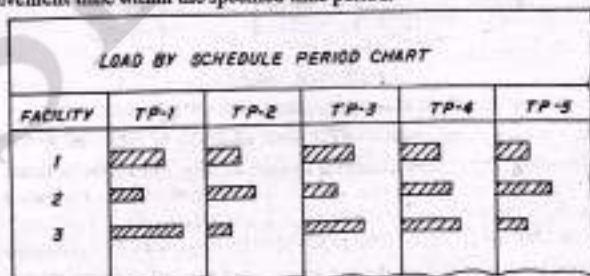


Fig. 7.22. Load by schedule period chart.

(c) Some of the Commercial Devices for Loading and Scheduling are :

- Produc-Trol Board,
 - Sched-U-Graph,
 - Board master,
 - Magnetic boards, and
 - Roll charts, etc.
- (a) Produc-Trol Board. Fig. 7.23 show a Produc-Trol board.

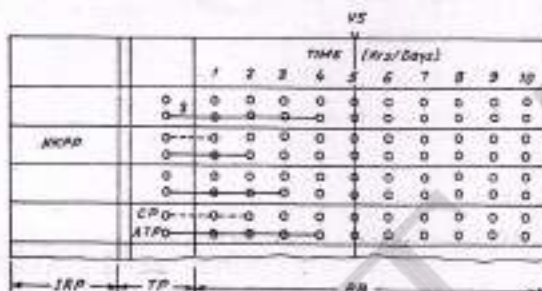


Fig. 7.23. Produc-Trol Board.

IRP : Index record panel.

TP : Tape pegs.

S : Strings.

PB : Peg board having two rows of holes for each pocket.

HKPP : Heavy craft paper pockets. Each machine is assigned a pocket. A card bearing information pertaining to the machine is inserted in the pocket.

ATP : It is a tape peg showing actual work load for each machine.

CP : It is a coloured peg (shown dotted) that gives special information ; for example last week's load.

VS : Vertical string showing today's date and the work load position.

(b) Sched-U-Graph. It is shown in Fig. 7.24.

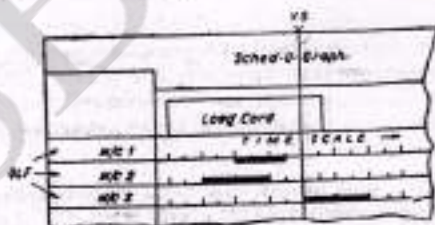


Fig. 7.24. Sched-U-Graph.

OLF : Overlapping flap. Every flap is projecting about 12 mm below (out) the previous one, and has bottom (12 mm) portion transparent. A card is made for each operation (to be done) on a machine. The card has written on it every thing about a job.

- Quality of work to be completed.
- Availability of equipments, tools and personnel (giving dates, etc.).
- Sequence in which operations will be performed on the raw material.
- Names of equipments on which the operations will be performed.
- Standard time for each operation.
- When the operations will be performed.

Process Planning Procedure

The different steps involved are :

1. Selection of Process :

- A process is necessary in order to shape, form, condition and join materials and components with the help of machines and labour in order to convert raw material into a finished product.
- One should select the most economical process (A breakeven chart similar to one discussed in Chapter 27 may be useful for the purpose) and sequence that satisfies the product specifications.
- The selection of process depends upon :

(a) *Current production commitments*: If enough work has already been allocated to more efficient equipments, the current work may have to be passed on to less efficient machines to complete the same in time.

(b) *Delivery date*: An early delivery date may :

- (i) Force the use of less efficient machines,
- (ii) Rule out the use of special tools and jigs as they will take time for design and fabrication.

(c) *Quantity to be produced* :

- Small quantity will not probably justify the high cost of preparation and efficient set-ups. Thus, quite possible they may have to be made on less efficient machines and vice-versa.

(d) *Quality standards* :

- Quality standards may limit the choice of making the product on a particular machine, etc.

2. Selection of Material

- Material should be of right quality and chemical composition as per the product specifications.
- Shape and size of material should restrict the scrap (i.e., material removed for getting the product shape).

3. Selection of Jigs, Fixtures and Other Special Attachments. These supporting devices are necessary :

- to give higher production rate ;
- to reduce cost of production per piece.

4. Selection of Cutting Tools and Inspection Gauges. They, respectively, are necessary to :

- Reduce production time.
- Inspect accurately and at a faster rate.

Scheduling and Control of production have one stage in between them, which is known as *dispatching* and it will be discussed under Sec. 7.18. In general, first of all the order is scheduled, then it is dispatched for necessary operation (on the raw material) and lastly the progress of the order is tracked, to be certain that the schedule is being met. This (last) phase of tracking the progress of an order and making corrections (if necessary) is known as *control of production*.

7.14. SCHEDULING

Concept. In brief, scheduling means—when and in what sequence the work will be done. It involves deciding as to when the work will start and in a certain duration of time how much work will be finished. Scheduling deals with orders and machines, i.e., it determines which order will be taken up on which machine and in which department by which operator. While doing so, the aim is to schedule as large amount of work as the plant facilities can conveniently handle by maintaining a free flow of material along the production line.

Scheduling may be called the time phase of Loading. Loading means the assignment of task or work to a facility whereas scheduling includes in addition, the specification of time and sequence in which the order/work will be taken up.

A production schedule is similar to a railway time table and shows which machine is doing what and when. A production schedule, is a statement of target dates for all orders or operations in hand and reveals their starting and finishing dates. Scheduling finalises the planning phase of Production Planning and Control System.

Factors Affecting Scheduling. The following factors affect production scheduling and are considered before establishing the scheduling plan.

(a) *External factors :*

1. Customer's demand,
2. Customer's delivery dates, and
3. Stock of goods already lying with the dealers and retailers.

(b) *Internal factors :*

1. Stock of finished goods with the firm,
2. Time interval to process finished goods from raw material. In other words—how much time will be required to manufacture each component, subassembly and then assembly (i.e., the final product),
3. Availability of equipment and machinery ; their total capacity and specifications,
4. Availability of materials ; their quantity and specifications,
5. Availability of manpower (number, type and kind of skills),
6. Additional manufacturing facilities if required, and
7. Feasibility of economic production runs.

Scheduling Procedure and Techniques. Scheduling normally starts with the *Master Schedule*. Figure 7.18 shows the master schedule for a foundry shop.

A master schedule resembles central office which possesses information about all the orders in hand. Master schedule, in Fig. 7.18, is a weekly breakdown of the production requirements. The total capacity in any week is of 100 hours of work in the foundry shop.

As the orders are received, depending upon their delivery dates (or priorities, if any) they are marked on the master schedule. When the shop capacity is full for the present week the newly acquired orders are carried over to the next week and so on. A master schedule is thus updated continuously, it depicts a running total of the production requirements and shows the work ahead—yet to be completed. Master

7.5. FORECASTING

7.5.1. Definition and Concept

1. Forecasting means estimation of type, quantity and quality of future work e.g. sales etc.
2. The survival of a manufacturing enterprise depends on its ability to assess, with reasonable accuracy, the market trends several years ahead.
3. Forecasters will be able to make use of sales trends, but these must be considered in the light of expected introduction of new materials, fashion changes, policies of competitors, unseasonable weather, threat of war and the general economic situation expected in the country and foreign markets. These circumstances and others necessitate changes in sales forecast from time to time during the forecast period.
4. Forecast represents a commitment on the part of the sales department and each of its divisions of expected sales. It becomes a goal against which the effectiveness of the sales department will be measured.
5. Forecasting plays a crucial role in the development of plans for the future.
6. Sales budget (estimate) forms the basis for manufacturing budget. It is the sales forecast which enables to determine production quantities, labour, equipment and raw material requirement. (Refer to Chapter No. 28).
7. A sales forecast should be
 - Accurate,
 - Simple and easy to understand, and
 - Economical.

7.5.2. Purpose (or Need) of Sales Forecasting

Sales forecasting is essential because,

- (i) It determines the volume of production and the production rate.
- (ii) It forms basis for production budget [step (6) above], labour budget, material budget, etc.
- (iii) It suggests the need for plant expansion.
- (iv) It emphasizes the need for product research development.
- (v) It suggests the need for changes in production methods.
- (vi) It helps establishing pricing policies.
- (vii) It helps deciding the extent of advertising, product distribution, etc.

7.5.3. Sales forecasting, Basic elements of

- Forecasting means predicting future events by the best possible means.
- In any sales forecasting analysis, there are four basic elements of economic data that should be used:
 1. Trends
 2. Cycles
 3. Seasonal variations
 4. Irregular variations.
- Trends are the long term, long range movements of a series of economic data. They have little relationship to the month-to-month changes that take place, and they manifest their direction slowly.

- Cycles are of shorter duration and they are usually featured by alternate periods of expansion and contraction.
- Seasonal variations occur within a certain period of year and recur at about the same time and to approximately the same extent from year to year.
- Irregular variations are the result of unforeseen or non-recurring events that have an economic influence. A strike in a key industry might cause an irregular variation.

7.5.4. Sales Forecasting Techniques

Forecasting is the formal process of predicting future events that will significantly affect the functioning of the enterprise.

- Sales forecasting techniques may be categorized as follows :

- (a) Historic estimate,
- (b) Sales force estimate,
- (c) Trend line (or Time series analysis) technique,
- (d) Market survey,
- (e) Delphi method,
- (f) Judgemental techniques,
- (g) Prior knowledge,
- (h) Forecasting by past average,
- (i) Forecasting from last period's sales,
- (j) Forecasting by Moving average,
- (k) Forecasting by Weighted Moving average,
- (l) Forecasting by Exponential Smoothing,
- (m) Correlation Analysis,
- (n) Linear Regression Analysis.

(a) Historic estimate

- This technique makes use of the assumption that *what happened in past will happen in future*. For example if a concern has sold 5000 blankets in winter last year, it will be able to sell the same quantity in winter this year also.
- Historic estimate is useful if the activity is affected by pattern of seasonality.
- It is useful for determining model, size and colour distribution.
- It is successful only when pattern of events remains unchanged, i.e., if economy is static. This is rarely true except for short periods of time.
- Historic estimate is not scientifically valid and thus it is not an accurate method ; the total sales forecast provided by this method should be modified by other techniques.

(b) Sales force estimate

- This technique is based upon the principle—that the persons in contact with the market know best about the future market trends.
- Individual salesmen make sales estimates of their territories and submit it with the District Sales Manager who analyses it, modifies it and sends the same to Factory Sales Manager. Factory Sales

are classified as *Do* and *Ancillary* activities. Ancillary activities are those which support *Do* activities. For example, cutting of threads on a bar is *Do* activity whereas making the set up for cutting threads is an *Ancillary* activity. After identification, *Do* activities are subjected to systematic questioning technique embodying series of questions as regards purpose, place, sequence, person and means.

The second method is to *trade off* or transfer some resources from the activities having float to the critical activities, in order to reduce their duration. Trading off-redistributes the resources and accompanies changes in duration. The resources may be workforce, amount of equipment and machinery, money, (better and more suitable) materials, etc.

Even by using work study techniques, trade off and other possible methods, if efficiency does not improve and the project duration is not shortened, then the only alternative left is *network contraction* or *compression*. In other words, when all those techniques, which can reduce project duration at almost zero additional cost, fail, then *network contraction*, expediting or *crashing* of activities is resorted to. This system of improvement involves extra cost because extra money is spent on overtime engagement of workforce, purchase of additional machinery, use of better materials, skilled workers, etc. The cost increases, as more and more activities are crashed and in turn, of course the project duration decreases. One has to strike a balance between the extra money spent and the project time saved.

There are two types of activities—*critical* and *non-critical*. Crashing non-critical activities does not serve any purpose as they do not control the project duration and completing them (still) earlier does no benefit rather increases work-in-progress. Therefore, crashing is centred on critical activities only which can reduce project duration if completed earlier.

Crashing of critical activities is started, in a systematic manner, from that (critical) activity which has least cost-time slope, i.e., which is cheapest to crash. Activities are crashed one after the other till the activity duration cannot be reduced further or the duration of original critical path gets shortened beyond a certain limit that another critical path comes into the picture. Under such circumstances if there are more than one critical paths, then, one activity in each of the critical paths is chosen for crashing by the same amount of time. The crashing continues to the point, whereafter further decrease in project duration is not possible, because, either the network reaches the compression limit set or the cost of crashing is more than the amount of saving in return.

The following terms need to be explained before (actually) crashing the network.

Normal Cost (N_c). It is the lowest cost of completing an activity in the minimum time, employing normal means, i.e., not using overtime or other special resources.

Normal Time (N_T). It is the minimum time required to achieve the normal cost.

Crash Cost (C_c). It is the least cost of completing an activity by employing all possible means like overtime, additional machinery, proper materials, etc.

Crash Time (C_T). It is the absolute minimum time associated with the crash cost.

Cost-time slope or slope of activity cost line (Fig. 10.7),

$$S = \frac{C_c - N_c}{N_T - C_T}$$

Table 10.4 shows estimated normal and crash values of time and cost for each activity. Slope and the maximum compression for each activity has been calculated. Maximum compression is the difference between normal time and crash time.

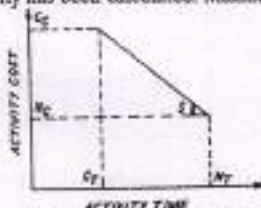


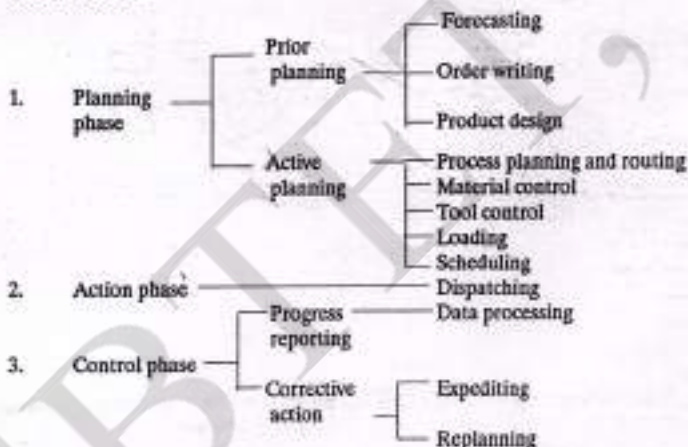
Fig. 10.7. Cost-time slope of an activity.

Production Planning and Control

7.1. INTRODUCTION

Products are manufactured by the transformation of raw material (into finished goods). This is how production is achieved. Planning looks ahead, anticipates possible difficulties and decides in advance as to how the production, best, be carried out. The control phase makes sure that the programmed production is constantly maintained.

A production planning and control system has many functions to perform, some, before the arrival of raw materials and tools, and others while the raw material undergoes processing. The various functions are as follows :



(a) *Forecasting.* Estimation of type, quantity and quality of future work.

(b) *Order writing.* Giving authority to one or more persons to undertake a particular job.

(c) *Product design.* Collection of information regarding specifications, bill of materials, drawings, etc.

(d) *Process planning and routing.* Finding the most economical process of doing a work and (then) deciding how and where the work will be done.

(e) *Material control.* It involves determining the requirements and control of materials.

(f) *Tool control.* It involves determining the requirements and control of tools used.

(g) *Loading.* Assignment of work to manpower, machinery, etc.

(h) *Scheduling.* It is the time phase of loading and determines when and in what sequence the work will be carried out. It fixes the starting as well as the finishing time for the job.

- (7) Especially suitable in defence projects and R & D where activity times cannot be reliably predicted. Suitable for problems in industrial setting, plant maintenance, civil construction projects, etc.

Technique. CPM employs the following steps for accomplishing a project planning.

- (1) Break down the project into various activities systematically.
- (2) Label all activities.
- (3) Arrange all the activities in logical sequence.
- (4) Construct the arrow diagram.
- (5) Number all the nodes (events) and activities.
- (6) Find the time for each activity.
- (7) Mark the activity times on the arrow diagram.
- (8) Calculate early and late, start and finishing times.
- (9) Tabulate various times and mark EST and LFT on the arrow diagram.
- (10) Calculate total float for each activity.
- (11) Identify the critical activities and mark the critical path on the arrow diagram.
- (12) Calculate the total project duration.
- (13) If it is intended to reduce the total project duration, crash the critical activities of the network.
- (14) Optimise the cost
- (15) Update the Network
- (16) Smooth the network resources.

Example 10.3 explains CPM technique in detail.

Example 10.3: It is required to fabricate tanks for an electroplating shop. The activities involved are as follows:

(a) Order material for the tanks, (b) Await delivery of the material, (c) Collect tooling equipment for tank fabrication, (d) Fabricate the tanks, (e) Test the tanks against leakage, (f) Obtain pre-cut rubber lining from the market, (g) Fix lining on the inside of the tanks, and (h) Paint the tanks from outside.

Using the activities listed above construct an arrow diagram for the fabrication of tanks and explain in detail the CPM-planning scheduling and control technique.

Solution: From the given data, the following arrow diagram has been constructed (Fig. 10.5)

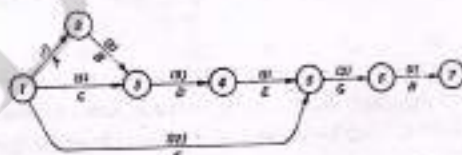


Fig. 10.5. Arrow diagram.

E. 10.3 (a). ESTIMATING ACTIVITY TIME (DURATION)

After the arrow diagram has been drawn and various activities marked on the same, the next step is to estimate time for each activity. The time estimate should be as realistic as possible and preferably based upon past experience, i.e., time values can be taken from similar/same activities accomplished earlier. Estimation of duration is no problem for an experienced estimator, but for a new person if past data is not available, it is better to use PERT technique for estimating time. The estimator after consulting

others and from his own judgement finds three time estimates to calculate the expected time. After the project is over, the estimator must always be intimated about the actual time taken to complete the activities, which he estimated earlier. This feed-back information helps a lot in imparting experience to a new estimator and at the same time it is a record for future estimation.

Assume that the estimator, basing upon his past experience, gives the following time values to different activities.

Activity	A	B	C	D	E	F	G	H
Duration (Days)	1	3	5	3	1	12	3	1

The duration is marked on the network diagram (Fig. 10.5).

E. 10.3 (b). PREPARATION OF ANALYSIS TABLE

EST and LFT are calculated (as explained earlier) and marked on the arrow diagram (Fig. 10.6).

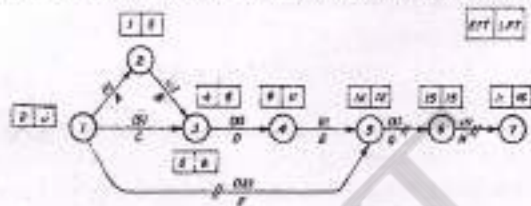


Fig. 10.6. Arrow diagram showing EST and LFT.

ANALYSIS TABLE 10.3

Activity	Duration	EST (6-2)	LST (2+3)	EFT	LFT	Total Time (6-3)	Total Float (4-3)	Remarks
1	2	3	4	5	6	7	8	9
1-2(A)	1	0	4	1	5	5	4	
2-3(B)	3	1	5	4	8	7	4	
1-3(C)	5	0	3	5	8	8	3	
3-4(D)	3	5	8	8	11	6	3	
4-5(E)	1	8	11	9	12	4	3	
1-5(F)	12	0	0	12	12	12	0	Critical
5-6(G)	3	12	12	15	15	3	0	Critical
6-7(H)	1	15	15	16	16	1	0	Critical

The analysis Table 10.3 recognises the critical activities (i.e., activities with zero float) which are marked on the arrow diagram (Fig. 10.6) and thus the critical path 1-5-6-7 is established. The total project duration is $12+3+1=16$ days.

E. 10.3(c). CRASHING OF NETWORK

Many times it is felt that the project duration as estimated from normal arrow diagram is long and it is desired by management to accomplish the project in a shorter duration of time in order to secure progress payments or to avoid lateness penalties, etc. To do so various possibilities are explored. Work study techniques of systematic questioning (as in critical examination under method study) are employed to every (critical) activity to seek the possibilities of reducing their duration. The critical path activities

(b) *Most likely time (t_m)*. It is the time in which the activity is normally expected to complete under normal contingencies.

(c) *Pessimistic time (t_p)*. It is the time which an activity will take to complete in case of difficulty, i.e., if mostly the things go wrong. It is the longest of all the three time estimates.

The t_o , t_m and t_p are combined statistically to develop the expected time (t_e) for an activity. The fundamental assumption in PERT is that the three time estimates form the end points and mode of Beta distribution (Fig. 10.3). It is further assumed that t_o and t_p are about equally likely to occur whereas the probability of occurrence of t_m is 4 times that of t_o or t_p .

Therefore, t_e is given by,

$$t_e = \frac{t_o + (t_m \times 4) + t_p}{6} \quad \dots(1)$$

(2) *Estimation of Variability of Activity Times*. The purpose is to find, how reliable t_e as got from equation (1) is

Assume

Case I

$$t_o = 5$$

$$t_m = 6$$

$$t_p = 7$$

$$t_e = \frac{5 + (6 \times 4) + 7}{6}$$

$$t_e = 6$$

$$t_e = t_m$$

Case II

$$t_o = 5$$

$$t_m = 10$$

$$t_p = 21$$

$$t_e = \frac{5 + (10 \times 4) + 21}{6}$$

$$t_e = 11$$

$$t_e \text{ is not equal to } t_m$$

This indicates that, if the time required for an activity shows high variability (Case II) and there is wide range of $(21 - 5 = 16)$ three times estimates, the certainty and confidence to correctly anticipate the actual time from relation (1) decreases and thus the need to measure the variability in the time of an activity arises. Knowing the variability, the reliability of t_e values can be assessed. PERT, using statistical probability concept, employs standard deviation (S) and variance (V) as measures of variability. They are given by,

$$S_i = \left[\frac{t_p - t_o}{6} \right] \quad \dots(2)$$

$$V_i = \left[\frac{t_p - t_o}{6} \right]^2 = (S_i)^2 \quad \dots(3)$$

Thus for cases I and II above

$$(S_i)_1 = \left[\frac{7 - 5}{6} \right] = \frac{1}{6} ; (S_i)_2 = \frac{21 - 5}{6} = 2.66$$

$$(V_i)_1 = \left[\frac{1}{6} \right]^2 = \frac{1}{36} ; (V_i)_2 = 7.1$$

This supports the above concept.

Coming to the actual problem :

(a) The Table 10.2 gives the values of t_o , t_m and t_p for each activity. The values of t_e , S_i and V_i are calculated by using equations (1), (2), and (3) and have been added in the Table 10.2.

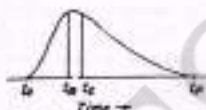


Fig. 10.3. PERT time estimates - Beta distribution.

TABLE 10.2

← DAYS →

Activity	t_o	t_m	t_p	t_s	S	V
1-2	2	5	14	6	2	4
1-6	2	5	8	5	1	1
2-3	5	11	29	13	4	16
2-4	1	4	7	4	1	1
3-5	5	11	17	11	2	4
4-5	2	5	14	6	2	4
6-7	3	9	27	11	4	16
5-8	2	2	8	3	1	1
7-8	7	13	31	15	4	16

The network diagram is given below with T_o , EST , LFT and critical path marked on the same.

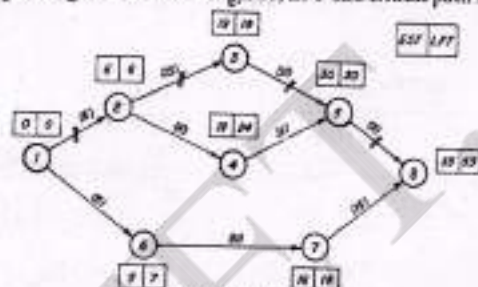


Fig. 10.4. Arrow diagram.

(d)

TABLE 10.3

Activity	EST	LST	Total slack $LST - EST$
1-2	0	0	0
1-6	0	2	2
2-3	6	6	0
2-4	6	20	14
3-5	19	19	0
4-5	10	24	14
6-7	5	7	2
5-8	30	30	0
7-8	16	18	2

(e) Critical path is 1-2-3-5-8 and it is marked on the network diagram.

(f) The length of the critical path or the total project duration (T_p) is sum of the duration of each critical activity, i.e., $6 + 13 + 11 + 3 = 33$ days.

(g) Variance of the critical path is sum of the variance of each critical activity, i.e., $4 + 16 + 4 + 1 = 25$.

(h) **Latest finish time (LFT).** It is calculated by moving backward, i.e., from last event to first event of the network diagram. It is the last event time of the head event.

(i) **Latest start time (LST).** It is the latest possible time by which an activity can start.

$$LST = LFT - \text{duration of that activity.}$$

Example 10.1 explains the method of calculating EST, EFT, LFT and LST.

(j) **Float or slack.** Slack is with reference to an event and float is with respect to an activity. In other words, slack is used with PERT and float with CPM—but in general practice, they may be used interchangeably. It may be float or slack, it means spare time, a margin of extra time over and above its duration which a non-critical activity can consume without delaying the project. Float is the difference between the time available for completing an activity and the time necessary to complete the same.

(i) **Total Float.** It is the additional time which a non-critical activity can consume without increasing the project duration. However, total float may affect the floats in previous and subsequent activities.

$$\text{Total float} = (LST - EST) \text{ or } (LFT - EFT) \text{ and it can be negative also.}$$

(ii) **Free Float.** If all the non-critical activities start as early as possible, the surplus time is the free float. Free float if used, does not change the float in later activities. In other words if an activity is delayed by the free float period, the succeeding activity will not be delayed, in turn.

$$\text{Free float} = EST \text{ of tail event} - EST \text{ of head event} - \text{activity duration.}$$

(iii) **Independent Float.** The use of independent float of an activity does not change the float in other activities. Independent float can be used to advantage if one is interested to reduce the effort on a non-critical activity in order to apply the same (effort) on a critical activity thereby reducing the project duration. The independent float associated with an activity is not reduced by delaying previous operations whereas such a reduction can be noticed with free float.

$\text{Independent float} = EST \text{ of tail (succeeding) event} - LFT \text{ of head (preceding) event} - \text{activity duration.}$

Independent float, if it turns out to be negative, is taken as zero.

(k) **Network diagram or Arrow diagram.** Network diagram is the basic feature of network planning. It is a diagram (Fig. 10.1) which represents all the events and activities in sequence (in which they are required to be performed to complete the project), along with their interrelationships and interdependencies.

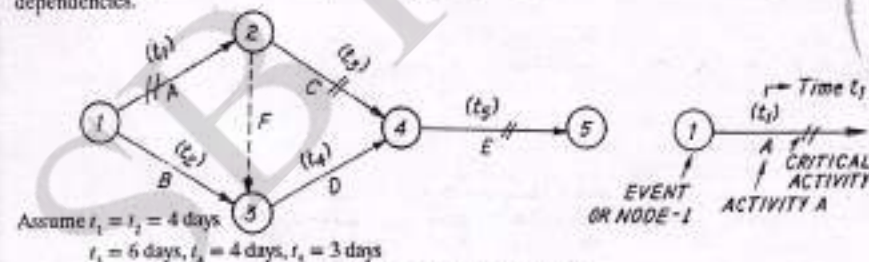


Fig. 10.1. Network (Arrow) diagram.

Arrow diagram is the visual presentation of the complete task (activities) by means of arrows. It is the most frequently used form of network diagram where every activity is represented by an arrow and the activity sequences are indicated by the direction of arrows. For example, Fig. 10.1 shows that activity C and D can start only after A and B are complete. Dotted arrow (dummy activity) shows that A and B finish at the same time (i.e., $t_1 = t_2$) and C and D start at the same time. There are two paths to complete the project and they are 1-2-4-5 or 1-3-4-5.

In an arrow diagram, the length or the inclination of the arrow does not have any significance.

Arrow diagrams are very useful as they provide detailed information for making decisions in connection with large and complex projects.

Example 10.1. A small engineering project consists of 6 activities namely *A, B, C, D, E* and *F* with duration of 4, 6, 5, 4, 3 and 3 days respectively. Draw the network diagram and calculate *EST, LST, EFT, LFT* and floats. Mark the critical path and find total project duration.

Solution :

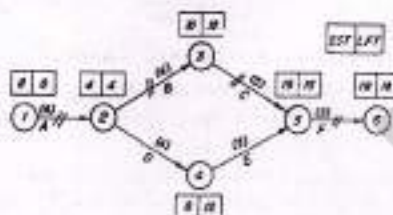


Fig. 10.2. Network diagram.

(1) *EST* is calculated by starting from event-1, i.e., activity *A* and giving it a time 0 (*EST*).

Now *EST* of activity *B* = 0 + duration of activity *A* = 4

EST of activity *C* = *EST* of activity *B* + duration of activity *B* = 4 + 6 = 10 and so on.

EST of activity *F* can be found by following two paths, i.e., 1-2-3-5 and 1-2-4-5. The path 1-2-3-5 gives 15th day whereas the path 1-2-4-5 estimates 11th day as *EST* of activity *F*.

TABLE 10.1

Activity	Duration (days)	EST	LST	EFT	LFT	Total Float	Free Float	Independent Float
A	4	0	0	4	4	0	0	0
B	6	4	4	10	10	0	0	0
C	5	10	10	15	15	0	0	0
D	4	4	8	8	12	4	0	0
E	3	8	12	11	15	4	4	0
F	3	15	15	18	18	0	0	0
Col. 1	Col. 2	Col. 3 from N.W. diagram	Col. 4 LFT - D	Col. 5 EST + D	Col. 6 from N.W. diagram	Col. 7 LST - EST or LFT - EFT		

Naturally the bigger value (15) is selected because until activity *C* is completed which ought to finish on 15th day, activity *F* cannot be started.

EST for other activities is calculated by proceeding similarly, in the forward direction from the first event to the last event.

(2) *LFT* is calculated in a similar manner as *EST* but by proceeding backward from the last event to