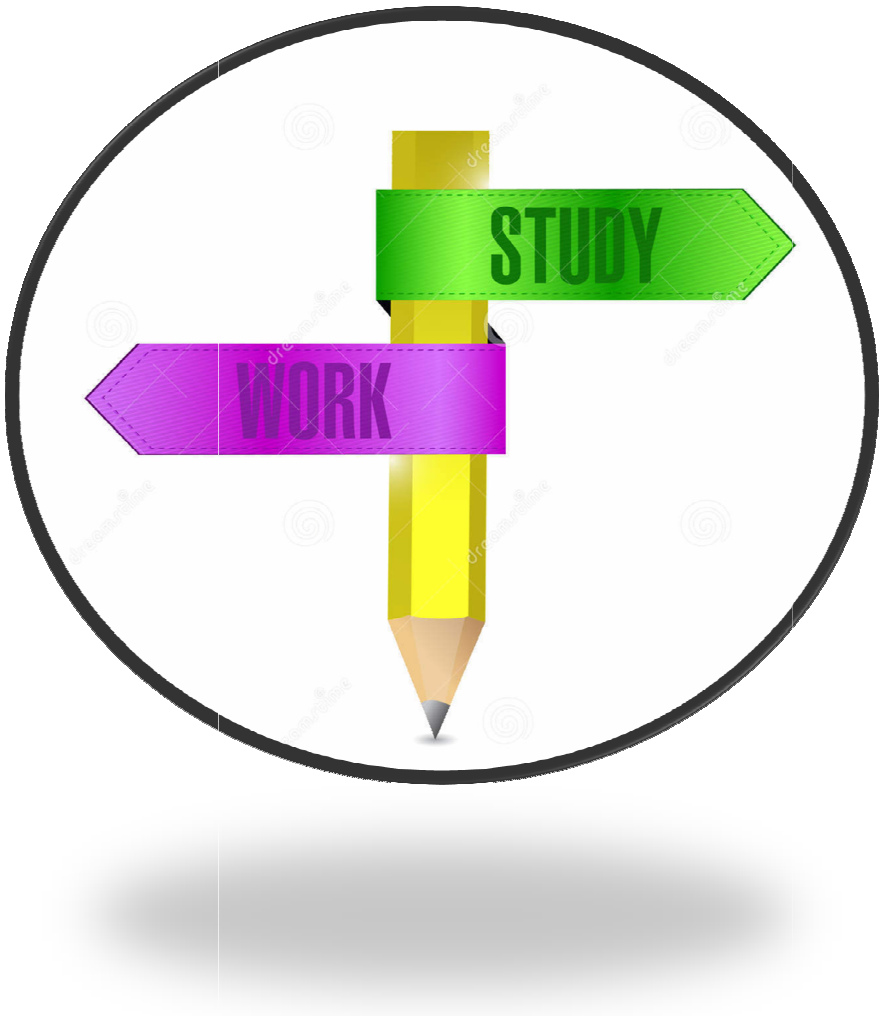
WORK STUDY –

METHOD STUDY

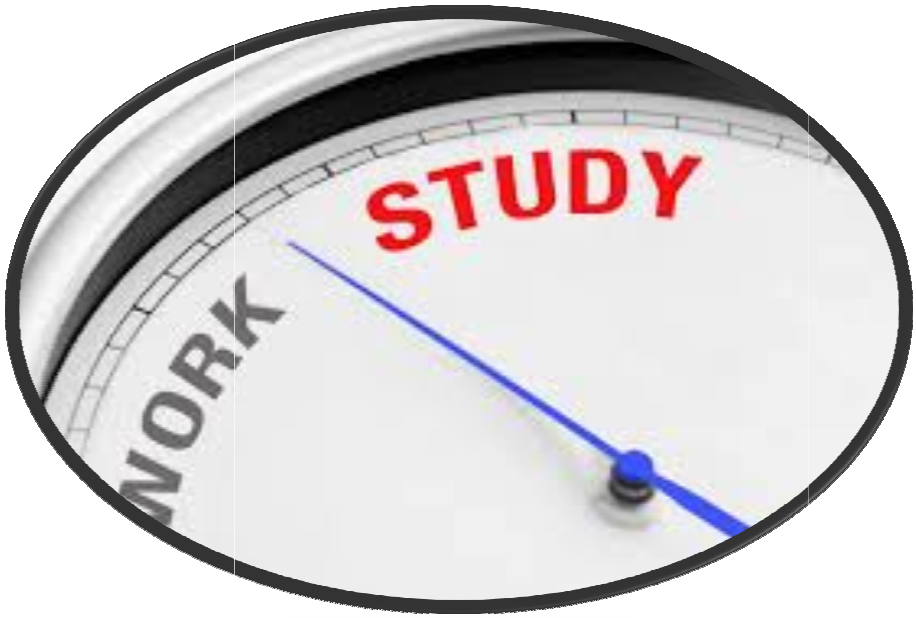


"WORK STUDY IS A MODERN DISCIPLINE TO ANALYZE AND EVALUATE ALL THE ASPECTS OF WORK SYSTEMS IN ORDER TO ENHANCE THE EFFECTIVENESS AND FUNCTIONAL EFFICIENCIES."

METHOD STUDY

INDEX

WORK STUDY - INTRODUCTION

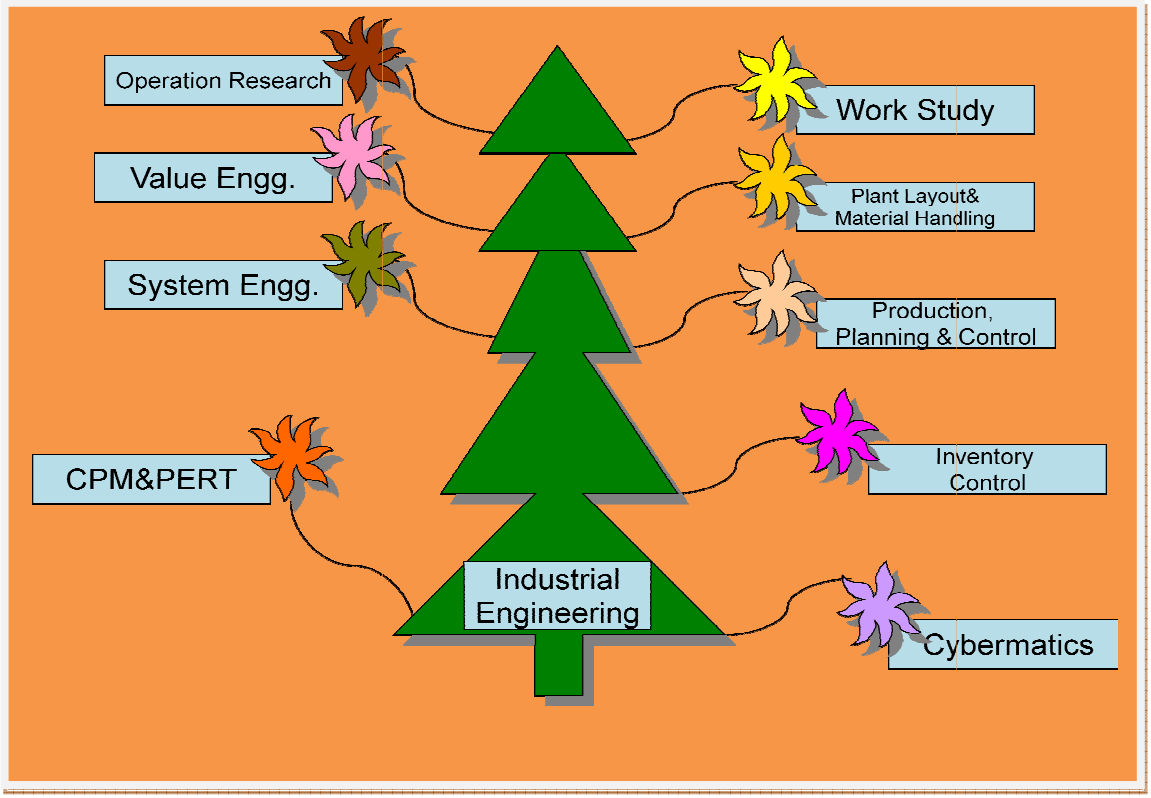


WORK STUDY-INTRODUCTION

WORK STUDY

CONCEPT:

In spite of technological and economical development the human element remains the most important resource in production management. There is only one "best method" to do a work. It is the responsibility of the manager to show and teach the best method to the workers to follow. This concept has developed as a separate discipline of knowledge called "Work Study". Work study is a branch of Industrial Engineering.



American Engineer Federick Winslow Taylor (1856-1915) published a book called "Scientific Management" in the year 1911. Hence he is known as "Father of Scientific Management". He put forth his ideas on "Scientific Management" and work measurement in 1881 and as a result Industrial Engineering came our as a formal technique in USA. Taylor also suggested that for increasing the production rate, the work of each person should be planned at least one day in advance and every person shall be allotted a definite work to complete by a given time using a pre-explained method.

F.W.Taylor started his carrier as Apprentice Machinist in Midvale Steel Works of Philadelphia. After working in different supervisory level, he becomes the Chief Engineer of the factory. He believes that "BEST MANAGEMENT IS A TRUE SCIENCE".

Other books published by F.W.Taylor are –

1. A piece rate system – 1895
2. A shop management – 1903
3. Art of cutting metals – 1906

F.W.Taylors' Scientific management philosophy is based on the following four principles.

1. Develop a scientific method for the human problem.
2. Select the worker to the particular task and train them soundly.
3. There should be co-operation between the worker and management.
4. There should be division of work and responsibility.

F.W.Taylor recommended "Fair days Wage for a Fair day's work".

He is also known as "Father of Time Study". F.B.GILBRETH (1868-1924) and Mrs. L.M. GILBRETH has used the method study techniques. F.B.GILBRETH has also known as "Father of Motion Study". He joined Whidden and Co., in 1885 at the age of 17 as a junior apprentice and took to brick-laying. He soon discovered that the person teaching him (i.e. instructor) used a certain set of motions while working slowly, another (set of motions) when working fast and a different set of motions while teaching to apprentices. Moreover, he found that no two brick layers adopted the same technique of brick lying. Gilbreth started studying the motions of different persons and tried to analyse them. Ultimately he got succeeded in reducing from 18 motions involved in laying each brick to five per brick only. According to Gilbreth the purpose of motion study is to discover and establish the scheme of least waste methods of labour. Gilbreth evolved the Principle of motion economy.

While concentrating on the economical motions for doing a job, Gilbreth felt the necessity of charting the activities to be analysed because a chart could provide the overall picture as well as the importance of everything involved.

He defined motion study "As the Science of eliminating wastefulness resulting from unnecessary, ill directed and inefficient motions".

He identified "Therbligs"- the fundamental motions involved in doing an activity.

WORK STUDY =

90 % PSYCHOLOGY

+

10 % TECHNIQUE

WORK STUDY DEFINITION:

Work Study has been defined in many ways. All of them however tend to convey the same meaning.

Work Study is an organised activity of increasing the productivity and quality with reduced cost within the organisation.

Work Study is a modern technique to analyse and evaluate all the aspects of work systems in order to enhance the effectiveness and functional efficiencies.

British Standard Institute defines "Work Study is the generic term for those techniques particularly method study and work measurement which are used in examination of human work in all its context and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvements".

According to ILO, Work Study is the term used to embrace the techniques of method study and work measurement which is employed to ensure best possible use of resources in carrying out a specific activity.

OBJECTIVE OF WORK STUDY

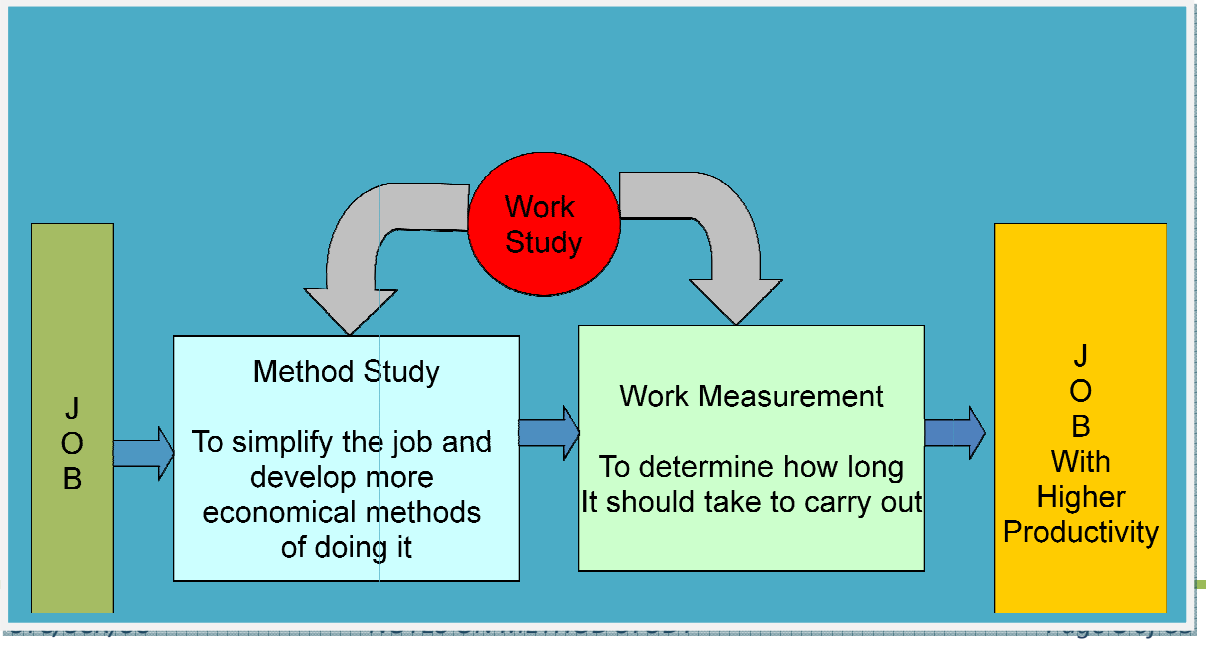
Work Study is "Organised Common Sense". It involves 10 % Technique and 90 % psychology.

Work Study is concerned with finding better ways of doing work and avoiding waste in all its forms. As such the objective of work study is to assist management to obtain the optimum use of the human and material resources available to the organisation for the accomplishment of the work for which, it is engaged. The emphasis is on optimum use.

Therefore, the objective has three aspects.

1. The most effective use of plant and equipment.
2. The most effective use of human effort.
3. The evaluation of human work to make it more convenient.

TECHNIQUES OF WORK STUDY



Work Study has two steps, viz the method study and work measurement. Both these techniques are distinct and interdependent.

METHOD STUDY

This is concerned with finding the true facts about doing a work and after a critical examination of these facts efforts are made to develop a new and better method of doing that work.

WORK MEASUREMENT

This is concerned with the establishment of time standards for a qualified worker to perform a specified job at a defined level of performance.

There are number of techniques to establish the work content of any specified activity. Some of these are given below.

(a) Time Study
(b) Analytical estimating
(c) Synthesis
(d) Production studies
(e) Activity sampling
(f) Predetermined Motion Time Standards (PMTS)

SCOPE OF WORK STUDY

There is a school of thought that work study is applicable only in the field of industry where processes are highly repetitive. This is not true. Since it is universal in its application, it does not matter whether the activities studied had occurred in industry, public services or in the armed forces. It is not confined to engineering activities of a repetitive nature.

PRINCIPLES OF WORK STUDY

There are three general principles that should be borne in mind while using work study.

1. It is an instrument of progressive management, where responsibility for its use must ultimately rest in exactly the same way as for any its value and the drive to apply it must come from the top.
2. Work Study is bound to affect the jobs of many people in the organisation; management must therefore make it quite clear to all concerned as to what it is trying to do and why.
3. Method Study must precede work measurement. Establish proper methods before any attempt is made to measure and set time standards for the various jobs concerned.

CHAPTER REVIEW:

1) Write about importance of work study in productivity.
2) What are the principles and objective aspects of work study?
3) How work study is defined as per BSI?

METHOD STUDY – CHAPTER 1

INTRODUCTION TO METHOD STUDY

1.0 Introduction

Method Study is the way in which work is done. Method study is essentially used for finding better ways of doing work. It is a technique for cost reduction. The philosophy of method study is that there is always a better way of doing a job and the tools of method study are designed to systematically arrive at this better way of doing a job.

Method Study, as defined it is a technique for improving the efficiency of every type of work, ranging from that of complete factories to the simplest manual movements used in mass production.

1.1 DEFINITION Work Study

A generic term for those techniques, particularly METHOD STUDY and WORK MEASUREMENT, which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement.

1.2 DEFINITION METHOD STUDY

The systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods, and reducing costs.

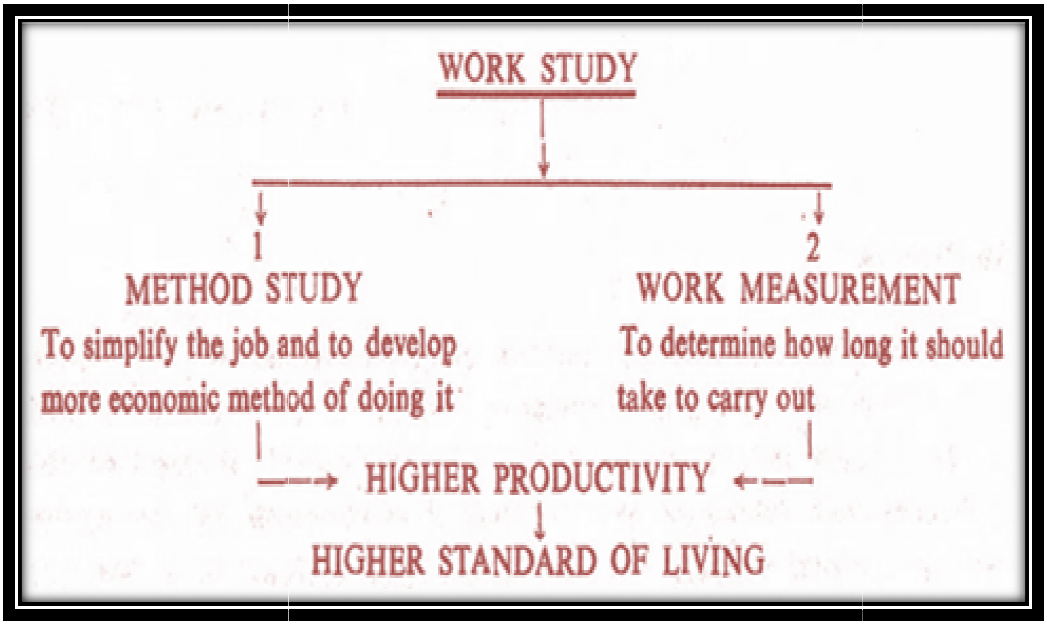
Work Measurement

The application of the techniques to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

The work study aims at improving the productivity through the systematic analysis of existing operations, processes, work methods and resources with a view to increasing their efficiency.

Work Study usually leads to higher productivity with no or little extra capital investment. It is evident that if a job or process is to be examined in order to improve the efficiency, both the method employed to perform the work and the time taken to complete it are significant. Therefore, work study consists of two distinct yet complementary techniques: Method Study, which is concerned with the education of the work content of a job or operation while work measurement is mostly concerned with the investigation and reduction of . any ineffective time associated with it, and for fixing up the standard time to be taken by the job after methods improvement has been carried out.

The relationship between Work study, Method study, Work measurement can be shown as in Figure.



1.3 Objectives of method study

1. The improvement of processes and procedures
2. The improvement of factory, shop and work place layout
3. The improvement of design of plant and equipment
4. The improvement in use of men, material & machinery and space / services
5. Economy in human effort and the reduction of unnecessary fatigue.
6. The development of a better physical working environment.
7. Improvements in quality of products.

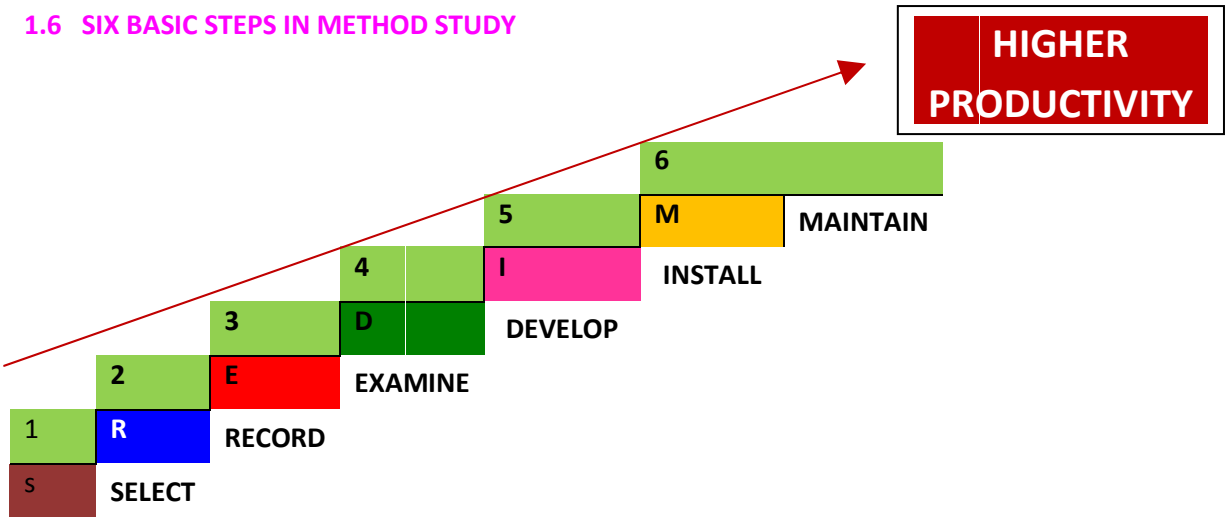
The distinction of method study is that it is a step-by-step procedure for improvements of methods of work, starting with the objectives, the selection of the activity to be studied; it proceeds to the collection and recording of the facts. The critical examination of the facts is the crux of the method study. This is followed by development of an improved method and the attainment of assured results in terms of greater output, cost savings and other benefit. This standard procedure, with flexibility of critical examination makes method study the most penetrating tool of investigation known to the Management.

1.5 PROCEDURE OF METHOD STUDY

Procedure of method study consists of the following six steps.

1. SELECT
2. RECORD
3. CRITICAL EXAMINATION
4. DEVELOP
5. INSTALL / IMPLEMENT
6. MAINTAIN

1.6 SIX BASIC STEPS IN METHOD STUDY



1.7 SELECT

Select the work to be studied and define the problem.

1.8 RECORD

All the relevant facts about the present method are recorded.

1.9 CRITICAL EXAMINATION

Critically examine those facts and ordered in sequence using the technique best suited.

1.10 DEVELOP

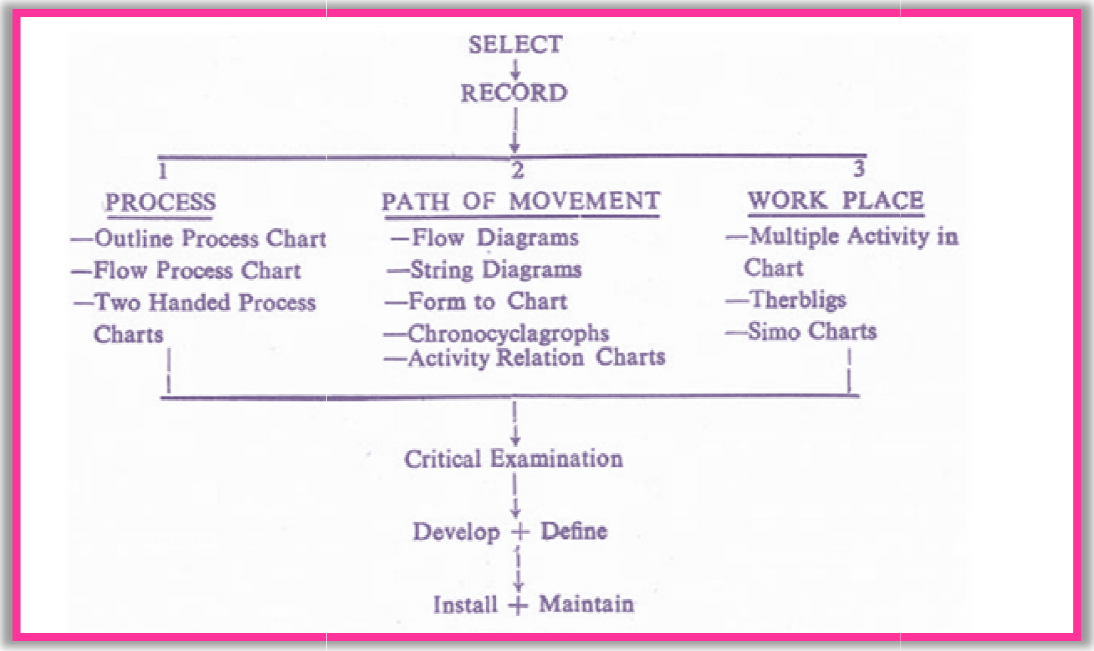
Develop most practical, economical and effective method having due regard to all contingent circumstance.

1.11 INSTALL OR IMPLEMENT

Implement the developed method as a standard practice.

1.12 MAINTAIN

Maintain the method by regular checks and review wherever necessary.



CHAPTER REVIEW:1)

1 Define method study, write the objectives.

2 what are the steps involved in method study?

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METHOD STUDY – CHAPTER 2

SELECTION OF JOBS

2. SELECTION OF JOBS

Almost any type of work of any magnitude is capable of study and improvement. The problem could be as big as the study of an organization, its structure, objectives, policies and products, or as small as an assembly or a clerical job. The scope for improvement and potential savings may be unlimited for some jobs and very much restricted for some other jobs. On the other hand, there may be certain jobs offering intangible and indirect benefits without any direct monetary gains. Thus the field of choice of method study is very wide and if method study is to be efficient, the subject of the study
should be carefully chosen. The selection should be a methodical process, rather than on an adhoc basis.

In certain cases the management may be very well aware of the problems and may themselves select the specific project to be studied. But it may also happen that the management only recognizes the problem in its broader perspective and may ask the work study practitioner to diagnose the specific problems and study those which are important and significant. In a situation where the real problem may be the one involving aspects of management, its policies and procedures, studying and improving small jobs do not bring about great benefits. Thus it is necessary to diagnose the problem, its causes and effects and select those which are of primary importance.

The first step, select, is obviously of great importance, for on it depends the success of the method improvement project. Great care in selecting projects for study is therefore necessary. Method study means a change for the better. Any change is normally resisted by people. This resistance may be from all levels right from the top. It is necessary to combine the employees and get their whole hearted co-operation if method study is to succeed. The effectiveness of method study can be proved by improving some unpopular jobs which are bard, unsafe, dirty or inconvenient from the point of view of employees.
Jobs where the scope for improvement is obvious need not necessarily be a profitable starting point for method study. That job under study should be viewed in perspective with the related components. Thus there are a number of factors involved in selecting a problem, and the considerations demanding attention may vary between different situations and organizations.

2.1 THREE CONSIDERATIONS FOR SELECTION OF JOBS

In the choice of a job to be studied, the following factors should be kept in mind.

1. Economic considerations

2. Technical consideration

3. Human reactions.

2.2 Economic Considerations

The economic importance of the job must be of such magnitude that it is worthwhile to begin a method, study of the job or to continue it. Bottlenec1cs in production, too much movement of materials in the operation, idle machines, idle operators and high costs of operations are the usual choices. The preferences should be given to the job with the greatest potential savings. No job should be selected for the method study, if it is expected to run only for a short time.

2.3 Technical Considerations

The availability of adequate technical knowledge is essential to carry out the study for example the productivity may be raised by a change in method of processing of jute but the change should not be made due to technical reasons. This calls for an advice of Jute specialist.

2.4 Human Reactions

In selecting a job human reactions should be given due consideration. The relation between management and the workers must not be strained. Unpopular and tiresome jobs should be studied with improved functions. The workers will eventually accept method study if the unpleasant features of these unpopular jobs is removed from them by the application of method study.

2.5 Field of Choice FOR SELECTION OF JOBS

As indicated earlier, since method study can be applied to almost any situation there is a very wide and varied field for selection of method study projects.

Cost of raw materials form a major portion of the total cost of the end product. In most of the Indian Industries about 60 to 70 per cent of the total cost is taken away by materials. Hence materials area offers very good scope for method study.

The following may be some of the subjects under materials:
1. Quality, Quantity or cost of raw materials
2. Substitution of cheaper or better materials
3. Reduction of waste or use of waste
4. Materials Handling
5. Control of Inventories
6. Marketing, Advertising or Selling etc

Method study may pertain to plant, equipment and machinery and may include

1. Design and modification of equipment
2. Machine utilisation
3. Maintenance of machines

4. Layout of plant and machinery, etc.

Method study may be applied to the process to eliminate, combine or simplify certain operations. Reduction of process or operational time, cutting down of delays, increased output, improved quality and similar factors may prompt method study investigation.

Apart from the above, human factors such as satisfaction, motivation, improved working conditions and safety consideration etc., offer conscionable scope for method study.

2.6 Need for Study

The need for improvement is not always apparent. However, following are some of the pointers which may indicate the area for study.

1. Operating costs-running higher than normal or gradually increasing.
2. High wastage, poor use of materials, machinery, labor, space and services.
3. Excessive movement and backtracking ions, handling of materials and men.
4. Existence of production bottlenecks.
5. Excessive overtime.
6. Excessive rejections and reworks.
7. Complaints about quality.
8. Complaints from workers-poor working condition of heavy job etc.
9. Increasing number of accidents-poor safety conditions.

2.7 Objective of the Study

Before undertaking a study it is necessary to decide the objective of the study. Although the alight of any method study is to effect improvements, the specific objectives of improvements should be clarified wherever possible. The objectives may be quite obvious, as in the case of increased output or reduced costs. But there may be other less obvious objectives like improved quality, improved safety, better working condition, etc. It is also possible that the study may have more than one objective. In certain cases it may be necessary to undertake a preliminary investigation in order to determine clearly the objective and also recognise the channels of improvement. A clear understanding of the objective is necessary to determine the method of investigation, the extent of detail, techniques to be adopted, and to assess the achievement of the objective.

2.8 Terms of Reference OF STUDY

After deciding the objective it is necessary to ascertain the limitations and the terms of reference of the study. There may be various conditions imposed on the conduct of the study by the management, within the framework of which the investigation will have to be carried out. Some of these terms of reference may be as follows:

(i) Capital expenditure for the implementation of the new method should not exceed Rs .....

(ii) Certain aspects of the manufacturing process should not be challenged.

(iii) The location of certain machinery will not be changed.

(iv) There should not be any labour retrenchment as a result of study.

(v) The study should be completed within.... months and so on.

2.9 Preparation of the Study

When the objective of the study has been defined and the terms of reference have been drawn up, the subsequent steps like deciding the personnel for conducting the study, getting managements approval and support and getting the participation from the workers can follow.

Method studies to be effective should have the full support and the active cooperation from the management, employees, trade unions and associations.

Co-operation would be obtained easily if everyone is kept properly informed, especially those who are likely to be affected. Before the commencement of the studies, a circular may be issued by the management to keep everyone concerned informed about the study. Such a circular may include the purpose and scope of the study, composition of the team, liaison and assistance required to be extended. This, apart from serving as information, will also provide an authorization for the team to obtain all necessary data and make the required investigation.

Finally, it may be worthwhile to make a time schedule in order to see that, the project is completed in time. Allocation of specific tasks to different members of the team and drawing up a programme of work will help in an organized conduct of the project.

2.10 SELECTION OF JOB IN RAILWAYS

FOLLOWING DEPARTMENTS / FIELDS MAY BE SELECTED FOR CONDUCTING WORK STUDY

S & T DEPT

COMMERCIAL DEPT

MECHANCAL DEPT

ELECTRICAL DEPT

CLERICAL STAFF etc.

CHAPTER REVIEW:

1) What are the 3 considerations for selection of job for work study?
2) Write the various points which neccecciates the need for work study.

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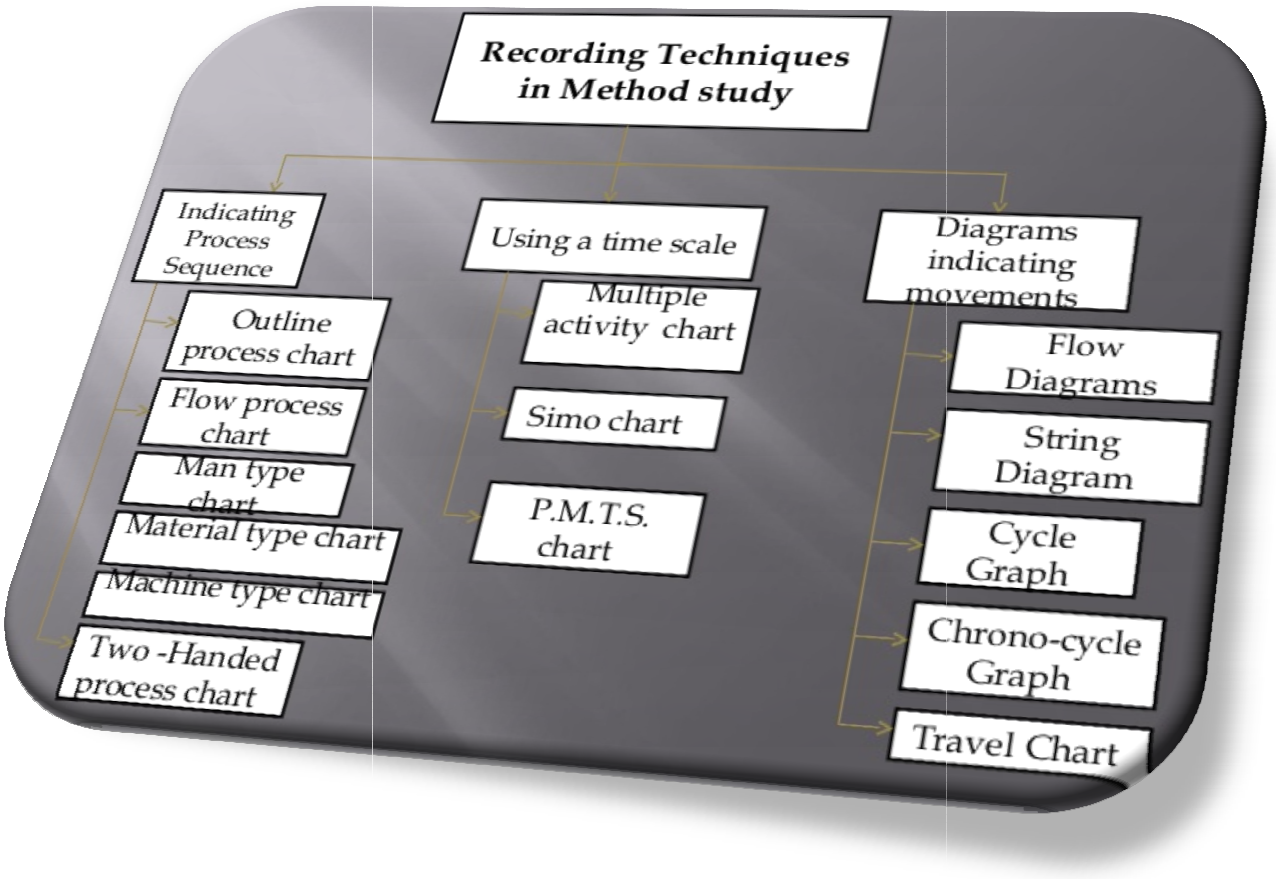
METHOD STUDY – CHAPTER 3



RECORDING TECHNIQUES

3.0 RECORDING

When the job has been selected for Method Study, the next step is to collect and record all the relevant data. The facts collected about the existing method are subsequently subjected to a thorough examination with a view to evolving improved methods. Hence, a clear and precise record is necessary, if method study is to be effective.

The success of method study depends on the accuracy with which the factors are recorded. The recorded facts should be clear, concise and complete to record detailed information clearly.

3.1 COMMON WAY RECORDING INFORMATION ANS ITS disadvantages

The common way of recording any information is to write it down. But writing down all the details of a complicated process in an industrial situation is not an easy task. Besides, reading through this information and visualising the same, is an equally tough job. In order to avoid these difficulties, certain graphical fords of representations are adopted.

3.2 NEED FOR PICTORIAL REPRESENTATION & ITS ADVANTAGES

In order to avoid the above difficulties, certain graphical fords of representations are adopted.

Advantages of such a form of recording are:

(i) It helps in presenting the necessary information in a precise and clear

manner and facilitates further analysis,

(ii) It is easily understandable and can be clearly visualised,

(iii) Often presentation of the existing method or procedure, in a graphic form

it self pin points obvious improvements.

3.3 NEED FOR COLLECTON OF the Background Information

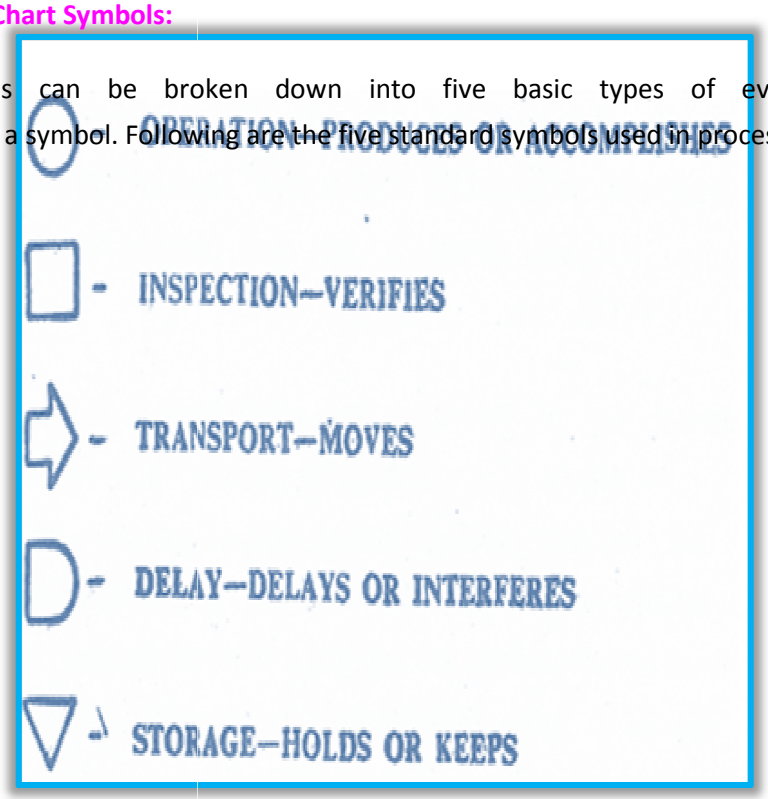
In order to become familiar with the job and the various inter-relationships, it would be worthwhile to collect a certain amount of background information about the situation under question. Such information may be in respect of organization structure, history of the jobs, the future trends, details with regard to the use of resources such as materials, labour, capital and equipment, etc. The type and details of background information required would depend upon the problem on hand. However, such information would be useful at the analysis stage.

3.4 NEED FOR Process Charts & DEFINITATION:

Charting is a method by which the nature and sequence of the activities involved in process are recorded. A process chart is a pictorial representation of the activities that occur in the work method or procedure, in which suitable symbols are used to represent the various activities. The construction and interpretation of process charts are simplified by the use of these symbols, which are so designated as to be easily distinguishable and to represent standard activities in a short hand form.

3.5 PROCESS Chart Symbols:

All activities can be broken down into five basic types of events and each is represented by a symbol. Following are the five standard symbols used in process charting.



(1)Operation-Occurs, when there is a change in the physical or chemical characteristics of an object or material. Assembling and disassembling, making ready for the activity or putting away after another activity are also classified as operation. Mental activities such as giving or receiving information or calculating, etc., are included in operation.

Example: Turning a rod on a lathe, joining two components by welding, posting in a ledger, a chemical reaction, dismantling of a steam pipe ..

(2) Inspection-Occurs when an object is checked for either quantity or quality.

Example: Checking by counting, dimensional check, visual inspection of welding, checks a letter.

(3) Transport- Occurs whenever there is any movement either by the material or the man.

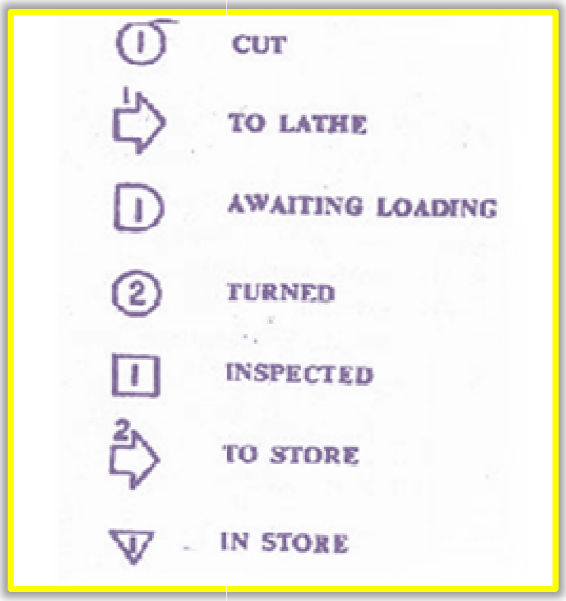
Example: Movement of material on a trolly, man walking.

(4) delay-Occurs when conditions do not permit the performance of the next activity immediately. Various delays and interruptions are denoted by this symbol.

Example: Material waiting near a machine for an operation and operator waiting for a tool near the tool crib.

(5) storage-Occurs when an object is kept and protected against unauthorised removal.

Example: Materials in tore, a letter in a file.



Some Principles and Conventions

The Process Chart is drawn by denoting the activities by relevant symbols and placing them one below the other according to sequence. These are joined by the vertical line. A brief description of the activity is given on the right of the symbol. Any other details such as distance, time, etc., can be given on the left of the symbol.

Subject of the Chart

The activities of only one subject can be recorded on each chart. The subject chosen need not be a single unit and may consist of a group of parts. It is useful to select one typical member or unit of each group; this plays an active part throughout the process. The activity charted should relate to the same subject, throughout the chart. The activities of men and materials should not be mixed up Scale of the Chart.

The degree of details charted will vary according to the requirement. Adequate amount of detail should be given without being elaborate. After depicting the broad details of the process, if

necessary, particular activity can be amplified further and a detailed chart can be drawn. The consistency must be maintained, with regard to the scale adopted as far as a particular chart is concerned.

Numbering the Activities

The symbols in a process chart are numbered to facilitate easy reference and comparison. The like symbols are numbered serially from beginning till end as shown in Fig.

3.5 COMBINED ACTIVITIES / SYMBOLS

Whenever two activities are performed simultaneously, they can be devoted by combined symbols.

For Example indicates a combined inspection and operation. The more predominant activity is denoted by the outer. The first number indicates the outer symbol and the symbol second the inner symbol.

Change of State

When there is a very significant changed in the subject charged during the process.

Rejects and Reprocessing

When the material is rejected, it is shown by taking out an arrow at the appropriate stage. If after inspection they are to be reworked it can be shown by taking and joining an arrow suitably.

Process Chart Symbols

Sym	Name	Action		Examples
	Operation	Adds Value		Saw, Cut, Paint, Solder, Package
	Transport	Moves Some Distance		Convey, Fork Truck, OTR Truck
	Inspect	Check For Defects		Visual Inspect, Dimension Inspect
	Delay	Temporary Delay/Hold		WIP Hold, Queue
	Storage	Formal Warehousing		Warehouse or Tracked Storage Location
	Handle	Transfer Or Sort		Re-Package, Transfer To Conveyor
	Decide	Make A Decision		Approve/Deny Purchase

3.6 Types of Recording Techniques

The recording techniques generally used are as follows,

(a) The Operation Process Chart

(b) The Outline Process Chart

(c) The Flow Process Chart (material)

(d) The Flow Process Chart (man)

(e) The Multiple Activity Chart

(f) The Two Handed Process Chart

(g) The Simultaneous Motion Cycle Chart (SIMO Chart)

(h) The Flow Diagram

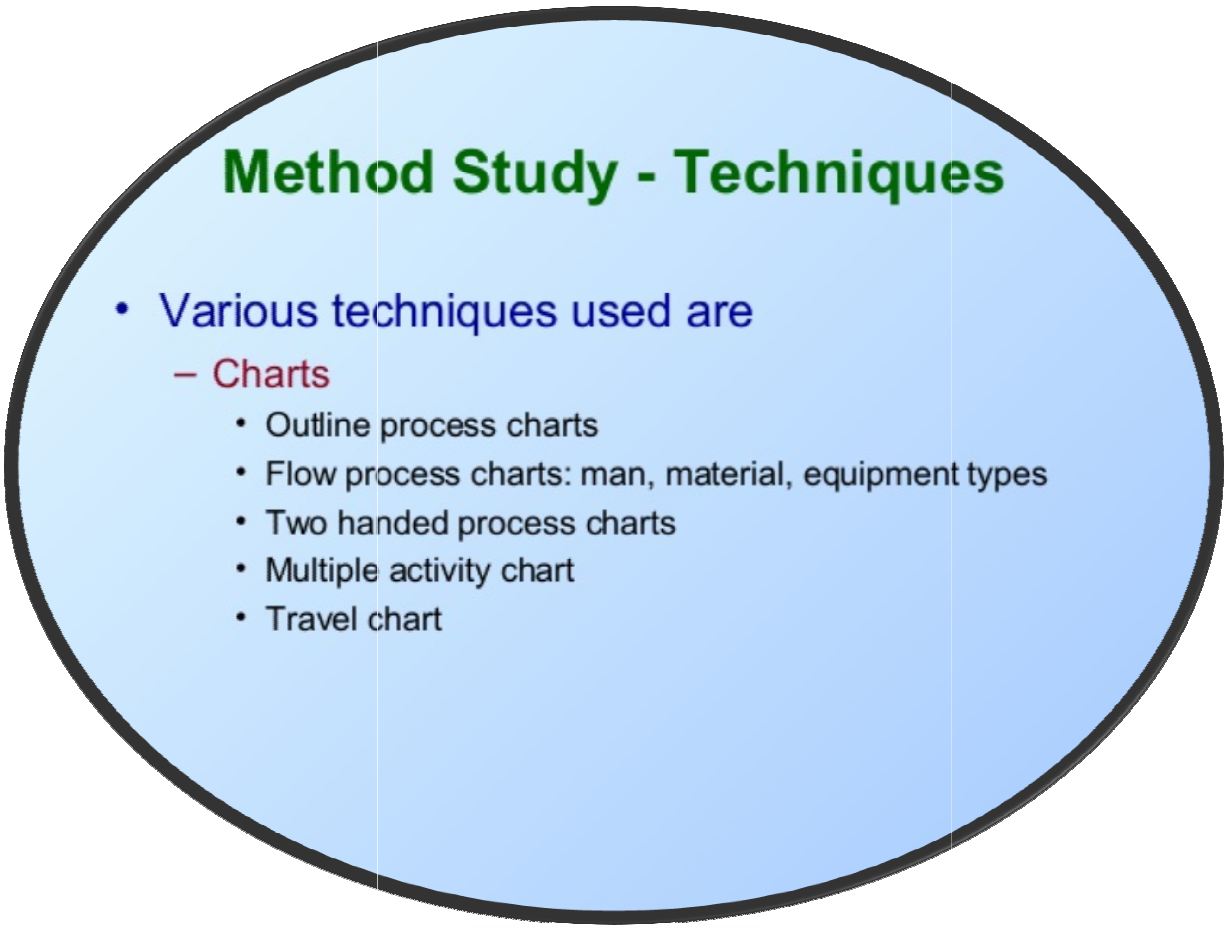
(i) The string diagram

(j) The travel chart

CHAPTER REVIEW:

1) what is need and advantages of pictorial representation ?
2) What are the different types of recording techniques used in method study?

METHOD STUDY – CHAPTER 4



CHARTS

4.0 Basic Information

In order to maintain the value of process charts and diagrams, for future reference and make them easily understandable and recognizable, the following information should be given as a heading;

(a) Name of the chart of diagram,
(b) Nature of process of job being recorded,
(c) Whether the present or proposed method is shown,
(d) Subject being recorded,
(e) A clear indication as to where the chart begins and where it ends,
(f) The time and distance scales used where applicable,
(g) The date of construction of the chart/diagram, reference number and name of the observer.

At the end of each chart a summary is prepared in a tabular form giving the total number of each activity, distance moved and the time taken. This also helps in comparing between the present and proposed methods

It should be remembered that these charts and diagrams are only a means to an end. They provide a graphic picture of the facts which facilitate further analysis. Thus these recording techniques can be adopted by the individual depending upon the situation to suit the purpose.

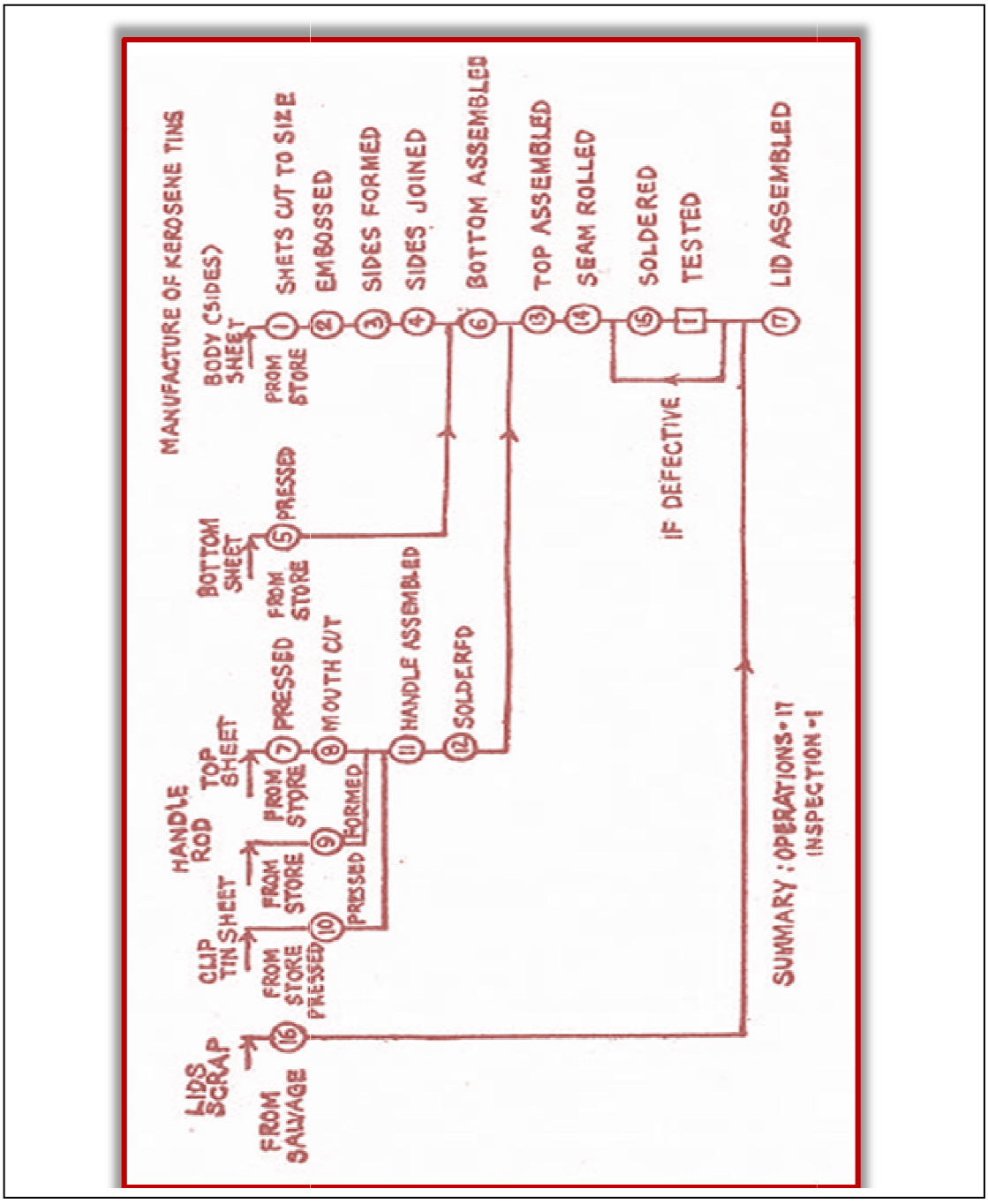
4.0 (a) The Operation Process Chart

At the initial stages it is valuable to get an overall view of the process. This will indicate how detailed further recording need to be. An operator process chart provides a bird's eye view of the whole process or activity. In an operations process chart all the operations and inspections involved are recorded. The chart does not indicate where the work takes place or who performs it. The delay, transport and storages are not indicated. But the entry points of materials are indicated.

"An operations Process Chart is a graphic representation of the sequence of all the operations and inspections involved in a process or procedure"

Such a chart will serve as a starting point for the critical examination. This is a very useful chart for initial analysis where the process is long and complicated; this chart provides an overall picture and gives adequate information for critical examination. This chart is particularly useful for recording maintenance and other indirect work.

An example of the operation process chart is given in Fig.

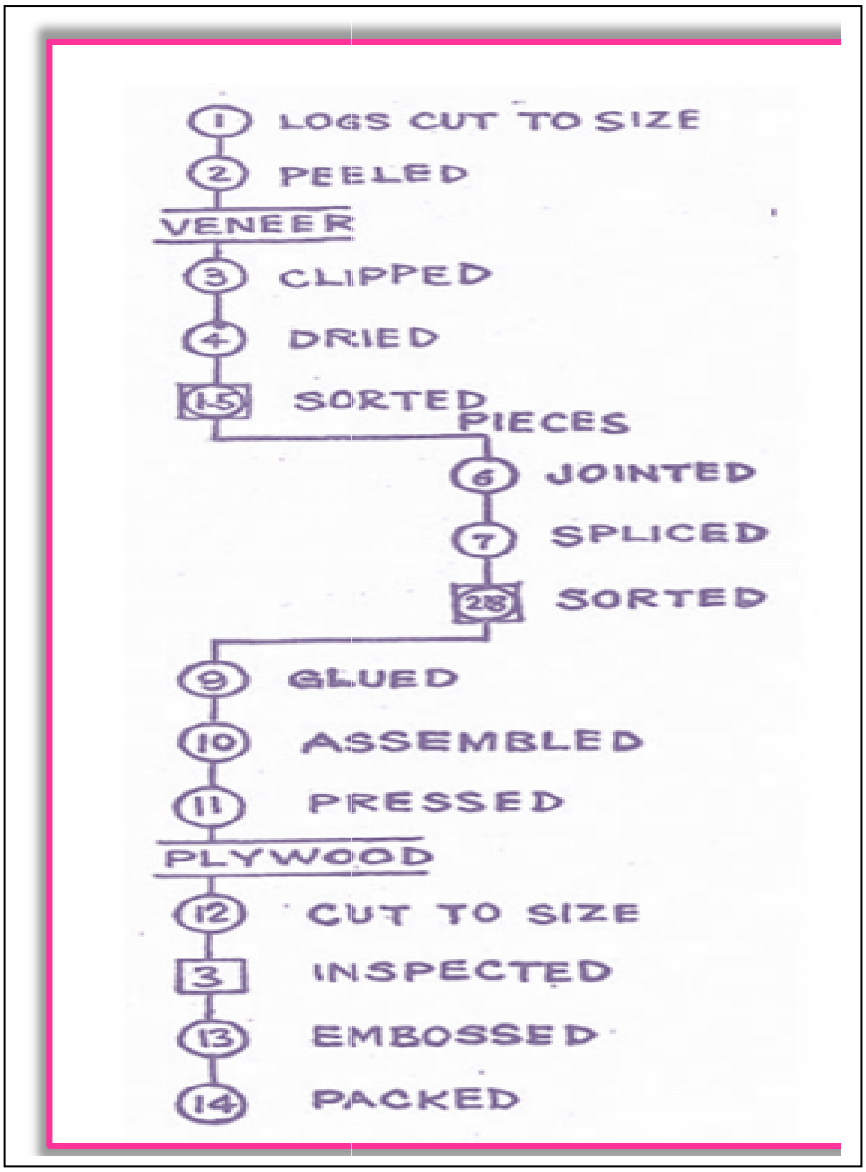


4.1 Outline Process Chart

"Sometimes as the initial stages of the study an overall view of the job under study can be obtained by recording only the key operations and inspections without going into all the operations and inspections and other activities like delays, movements and storages."

Such a chart is known as an Outline Process Chart. This chart is particularly useful for large projects for getting a broad outline. Further amplification and analysis can be gone into if necessary, through an operation process chart or a flow process chart.

An example of the outline process chart of plywood manufacture is given in Fig.



4.4 Flow Process Chart (Material)

When once an overall picture of the process has been obtained it may become necessary to go into a certain amount of detail. A flow process chart (material) is a detailed chart, indicating all the activities involved in a process.

"A flow process chart (material)), is a process chart setting out the sequence of the flow of a product or a procedure by recording all events under review in terms the material being processed, using the appropriate symbols"

In a flow process chart (material) the subject of the chart is material.

Since all the activities, operations, inspections, movements, delays and storages are recorded all the five symbols are used. The subject selected for recording should be one that provides continuity throughout the process. A suitable unit or a grouping of material should be selected.

A flow process chart (material) is more detailed than the operation process chart. All the factors contributing to the process must be recorded. Though the degree of detail would depend on the problem under consideration for method study, the chart should not be oversimplified.

In order to ensure that there is no confusion between material and operator while recording, the activity description given at the side of the symbol should be in passive voice. The distance and time values are also recorded whenever appropriate.

Since all the movements are recorded very clearly, the flow process chart along with the flow diagram is a very useful chart for analysing and improving layout and handling problems.

For recording and analysing a process a flow process chart (material) is a very useful chart. It gives a very clear account of events. This chart is also a useful medium for presenting new proposals to the management.

Fig. Gives an example of the flow process chart (material).

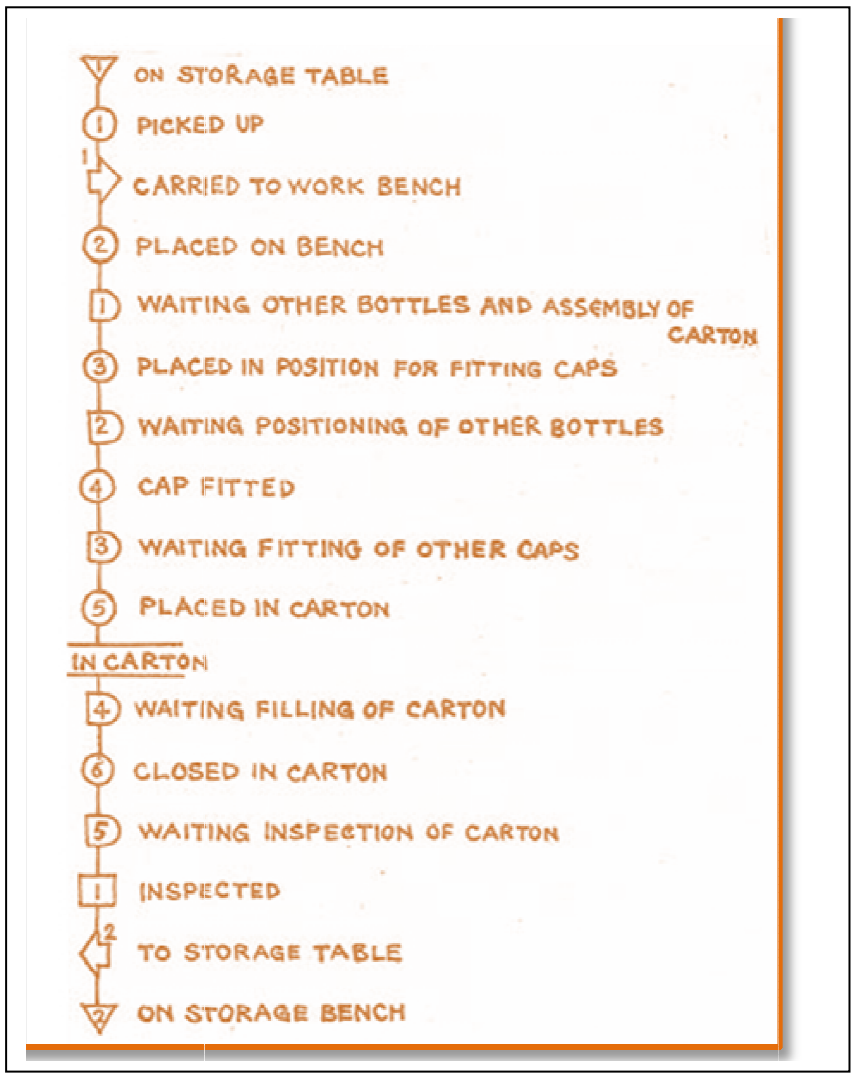
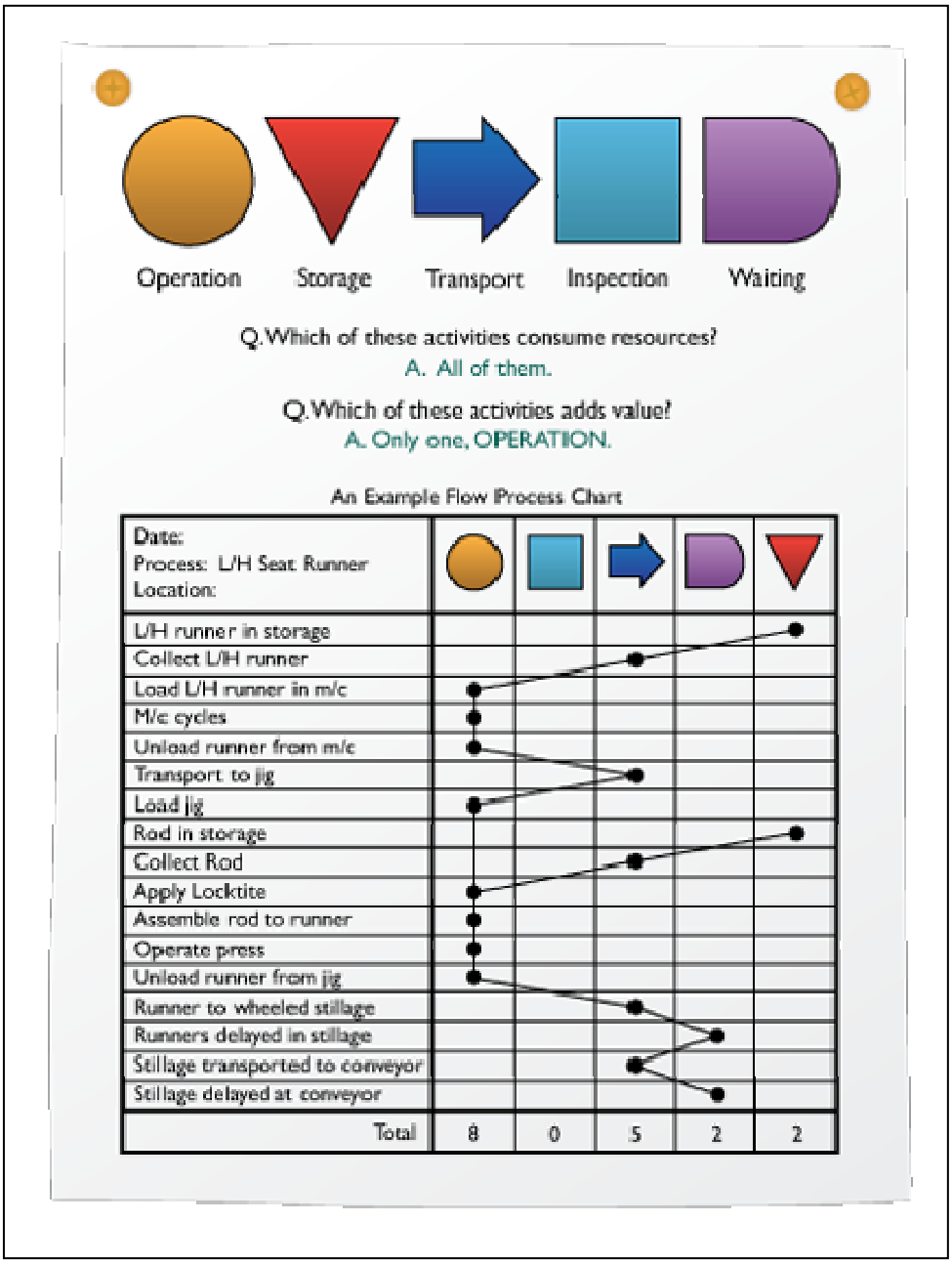


Fig. Gives an example of the flow process chart (material).



4.3 MAN TYPE FLOW Process Chart

There are various types of charts that are used to record the method depending on the degree of details required. The flow process chart (man) is One of the basic charts to record the method. It is used to record the work of Individual operators. It gives a graphic representation of all the activities performed by the operators in the sequence in which they occur.

"A flow process chart (man) is a chart setting out the sequence of the flow of a product or a procedure by recording all events under review in terms of the worker using the appropriate process chart symbols."

The term storage is not usually applicable to an operator and hence this symbol is not used. The subject of the chart will be an operator/worker per forming the job. The description of the activity is written in active voice to avoid confusion.

Flow process chart (man) is a useful recording technique to chart the method of performance rather than the process. When once the process has been examined and all possible improvements have been made, fun her analysis and improvements in methods would be necessary. Existing methods when clearly recorded through this chart would be helpful in developing new methods. This chart can also be used as an operating instruction for use by supervisors and workers.

4.6 Two Handed Process Chart

Jobs that are completed at a single work place often consist of a series of activities of the workers two hands and occasionally the other parts of the body. The two-handed process chart records the sequence of manual activities in such jobs in a graphical manner.

"The two-handed process chart is a process chart recording the work of the operator's hands (limbs) in relation to another."

A two-handed process chart is made up of two columns in which the activities of the left hand and right hand and the appropriate symbols are respectively recorded in sequence. The activities of the two hands are inter-related by aligning the symbols on the chart so that simultaneous movements by both hands appear opposite to each other. Additional columns can be designed to record the activities of the other parts of the body whenever necessary.

The two-handed process chart generally employs the same symbols as the other process charts. In practice only four of the five symbols are used to any extent "Inspection" is rarely used since "inspection" are a combination of hand movements and operations. Where the inspection is literally a matter of touch or feel this symbol can be used. The storage symbol implies "hold" instead of storage. The transport symbol represents movements of hands, the operation symbol, pick up, positioning, etc., and the delay symbol denotes the waiting of one hand for the completion of work by the other. There is no time scale on this chart and the exact duration of various activities is usually unknown.

Before embarking on a detailed study of this nature it is advisable to first justify activities by recording and examining them on a broad scale.

This chart is usually applicable only to the individual workplace and after, the broad methods have been decided and thus most suitable at the later stages of methods improvement.

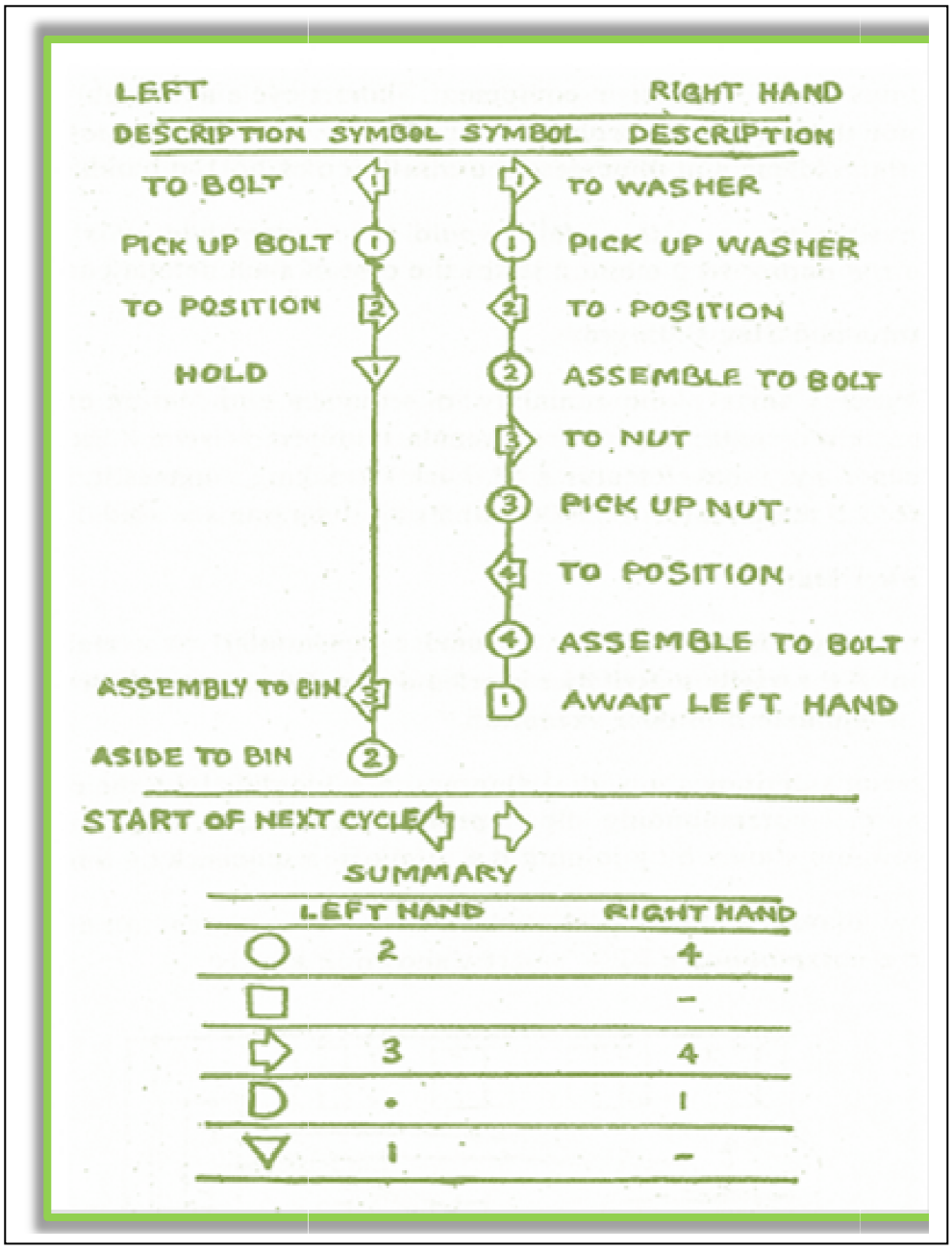
Work of a fairly short duration is suitable for recording on this type of chart.

Example: Two-handed Process Chart

Job : Assembling washer and nut to bolt

Chart Begins : Hands empty, materials in bins

Chart Ends : Completed assembly aside to bin



4.8 Multiple Activity Chart

There will be various situations wherein the combined and inter-related efforts of a group of workers and machines would be necessary for the performance of the job. The charts described so far can be used to record only one subject in any one particular chart. Whenever a process involves the co-ordination of various activities it may be required to study the relationship between these activities. Such an inter-relationship is provided by the multiple activity chart. A multiple activity chart is used to record the activities of one subject in relation to others.

"A Multiple activity chart is a form of process chart recording the related sequence of work of a number of operators and/or machines on common time scale."

Separate vertical bars are attached to each worker and/or machine to be charted. A time scale

is entered along side in a convenient place, usually on the left hand side. The activities are then plotted in sequence against the time scale within their own particular bar in the chart. Brief descriptions of the activities are also given along side. In getting the time for activities very fine accuracy may not be needed. But it may become necessary sometimes to obtain the time values by one of the work measurement techniques. The contract between working and non-working is brought out by suitable hatching of the respective boxes. A summary showing the times and percentage use of all the subjects is made at the end of the chart. Similar summary for the proposed method provides a comparison.

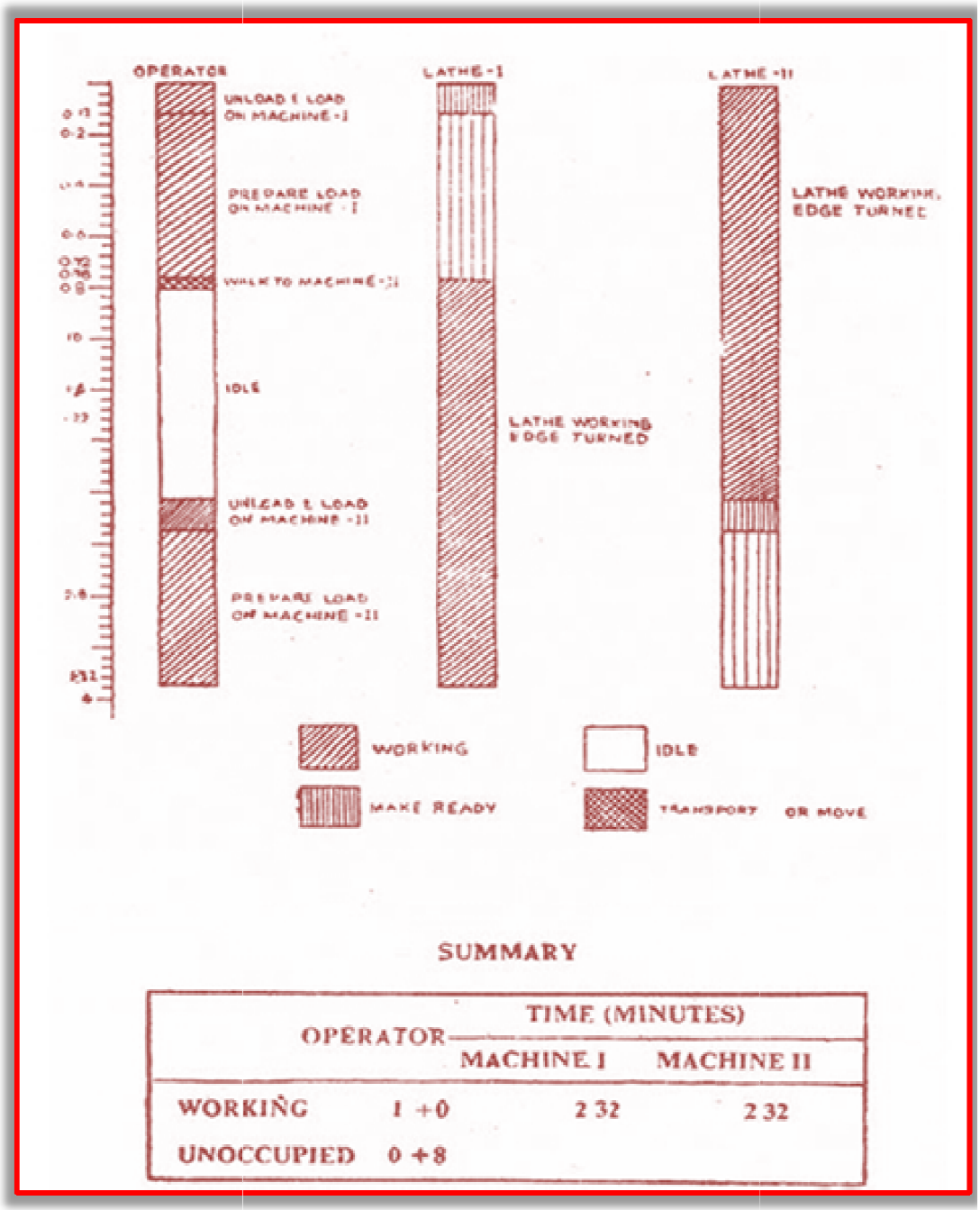
Multiple activity charts brings out the comparative utilisation of men and machines very clearly and helps to synchronies the various activities and improve the, situation. It is a useful tool for planning team work and determining the staffing pattern.

When the activities of the machines are recorded in relation to that of the operator, the chart is sometimes called as the man machine chart. This is only a special variant of the multiple activity charts.

Figure gives the multiple activity charts of one operator operating two machines.

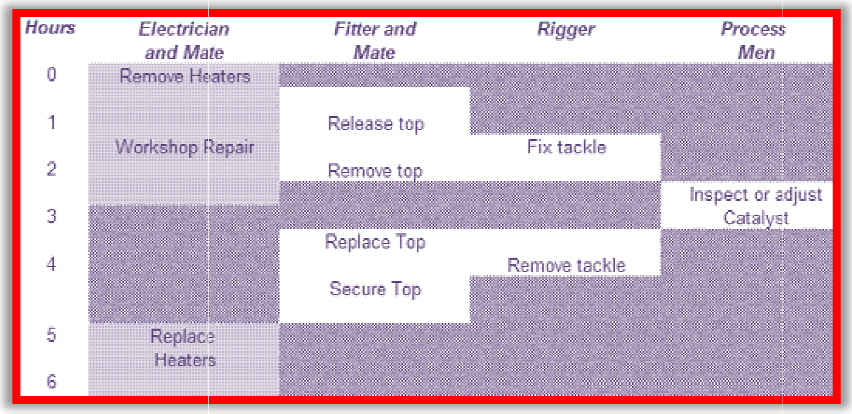
The multiple activity charts shows up clearly the periods of ineffective time and by rearrangement of work it becomes possible to eliminate or reduce the ineffective time. This chart is useful for maintenance work in order to reduce the down time of equipment. It also helps to determine the number of workers for a group job and the number of machines that can be looked after by an operator. This chart is useful to analyse and obtain optimum utilisation of men and machines.

Job	: Turn Edge-present method
Subject of Chart	: Operator, Lathe I, Lathe II
Chart Begins	: Operator near Machine I-unloading & loading
Chart Ends	: Operator near Machine II



SUMMARY

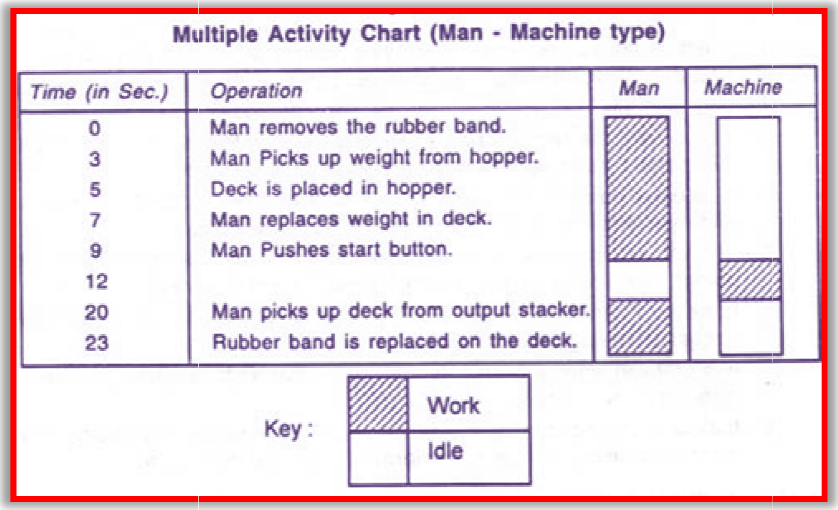
OPERATOR	TIME (MINUTES)	
	MACHINE I	MACHINE II
WORKING 1 +0	2 32	2 32
UNOCCUPIED 0 +8		



multiple activity chart

4.9 MAN MACHINE CHART

WHEN ONE OPERATOR IS WORKING ON ONE MACHINE



Multiple Activity Chart (Man - Machine type)

Time (in Sec.)	Operation	Man	Machine
0	Man removes the rubber band.		
3	Man Picks up weight from hopper.		
5	Deck is placed in hopper.		
7	Man replaces weight in deck.		
9	Man Pushes start button.		
12			
20	Man picks up deck from output stacker.		
23	Rubber band is replaced on the deck.		

Key : Work, Idle

4.10 MAN MULTI MACHINE CHART

WHEN A SINGLE OPERATOR IS WORKING ON A NUMBER OF MACHINES

4.11 MULTI MAN CHART

WHEN GROUP WORKERS WORKING ON MACHINE

4.12 MULTI MAN MACHINE CHART

WHEN A GROUP OF OPERATORS WORKING ON A COMMON CENTRAL MACHINE

CHAPTER REVIEW:

Mention the difference between out line process chart and flow process chart.

Draw a flow chart for the activity of changing brake blocks of a coach.

Write about multiple activity chart and two handed process chart.

REVISED TRAINING MODULE FOR THE ADVANCED WORK STUDY COURSE

METHOD STUDY – CHAPTER 5

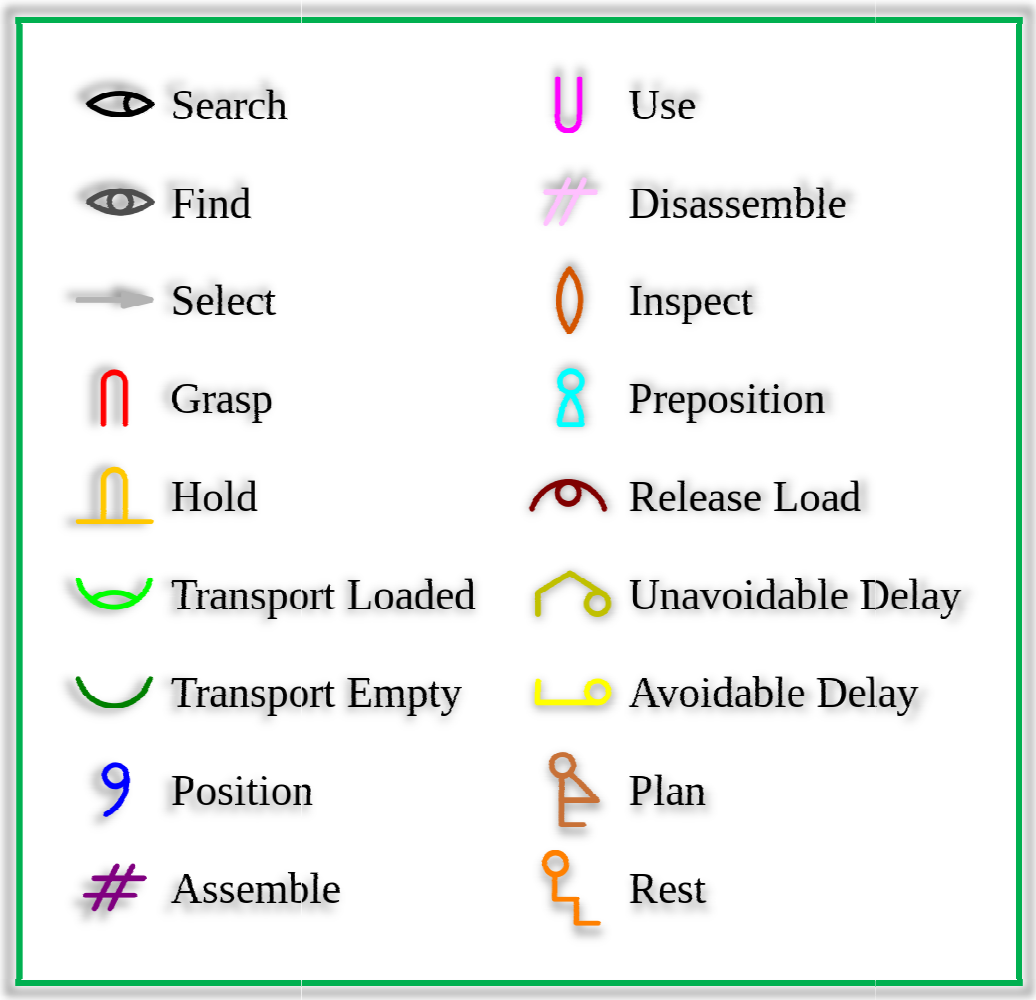
ANALYSIS OF MOTION

5.1 & 5.2 The Simultaneous Motion Cycle Chart (Simo-Chart)

The SIMO Chart is a, refinement over the two-handed process chart. In this chart the activities the two hands (or other parts of the workers, body) in relation to each other, during an operation are recorded against a time scale. The activities recorded are in terms of "Therbligs"; which are very fine basic human motions. Such a chart can be prepared only with the help of photographic aids, involving expensive equipment. Short cycle and highly repetitive jobs are suited for this type of recording. By an analysis it will be possible to identify and remove the idleness and increase the utilisation of both the hands.

An investigation in this detail would be worthwhile only if the expected savings from the improved method justifies the cost of such detailed analysis.

THERBLIGS


Search
Find
Select
Grasp
Hold
Transport Loaded
Transport Empty
Position
Assemble
Use
Disassemble
Inspect
Preposition
Release Load
Unavoidable Delay
Avoidable Delay
Plan
Rest

SIMO CHART

OPERATOR: Ken Reisch
DATE: May 21,
OPERATION: Assembly
PART: Lace Finger
METHOD: Proposed
CHART BY: Joseph Riley

TIME SCALE (wmks)	ELEMENT TIME	LEFT-HAND DESCRIPTION	SYMBOL	MOTION CLASS	SYMBOL	RIGHT-HAND DESCRIPTION	ELEMENT TIME	TIME SCALE (wmks)
4548	12	Reach for finger	RE		RE	Reach for finger	12	4548
4560	19	Grasp finger	G		G	Grasp finger	19	4560
4579	31	Move finger	M		M	Move finger	31	4579
4610	75	Position and release finger	P RL		P RL	Position and release finger	75	4610
4685	15	Reach for clamp	RE		RE	Reach for clamp	15	4685
4700	15	Grasp clamp	G		G	Grasp clamp	15	4700
4715								4715
7541	12	Grasp assembly	G		G	Grasp assembly	12	7541
	18	Move and release assembly	M RL		M RL	Move and release assembly	18	
7559								7559

SUMMARY

%	TIME	LEFT-HAND SUMMARY	SYM.	RIGHT-HAND SUMMARY	TIME	%
8.56	249	Reach	RE	Reach	245	8.4
7.49	218	Grasp	G	Grasp	221	7.6
12.16	354	Move	M	Move	413	14.2
30.47	887	Position	P	Position	1124	38.6
39.33	1145	Use	U	Use	876	30.1
1.03	30	Idle	I	Idle	0	0.0
96	28	Release	RL	Release	32	1.1
100.0	2911	TOTALS			2911	100.0

Source: Benjamin W. Niebel, *Motion and Time Study*, 8th ed. (Burr Ridge, IL: Richard D. Irwin, 1988), p. 229. © 1988 by Richard D. Irwin, Inc. Reprinted by permission.

5.4 & 5.5 Photographic Aids

Still and cine photography is employed to record and analyse the operations and procedures. There are different types of analysis such as memo-motion and micro-motion studies, cyclographs and chrono-cyclegraphs. All these are very expensive methods involving special photographic equipment. Photographic aids for analysis will be useful for detailed investigation of very short duration, highly repetitive and high speed operations.

5.6 NEED FOR PATH MOVEMENT RECORDING

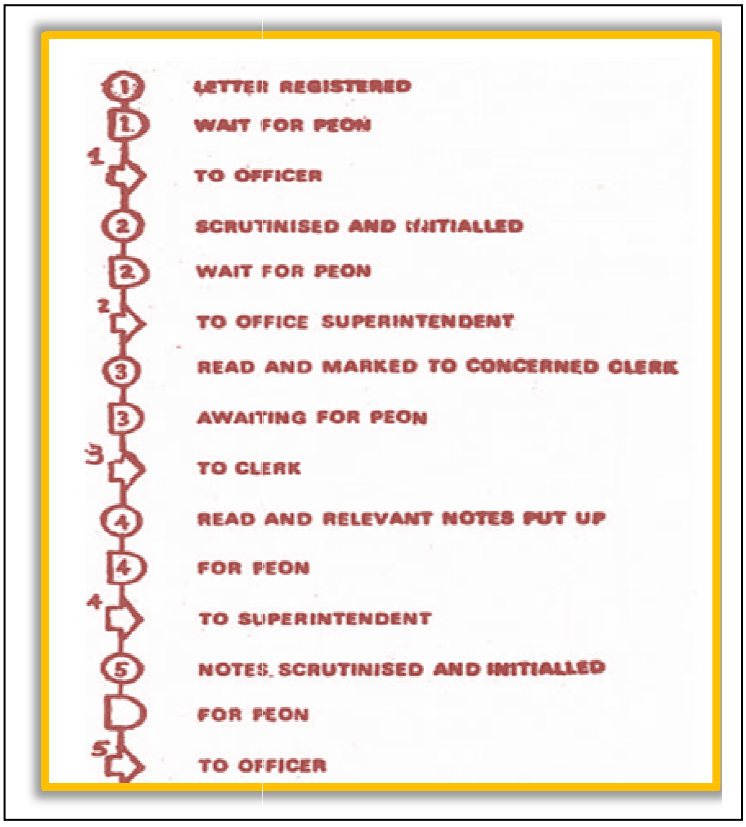
The Process Charts show mainly sequence and nature of activities, the information given regarding the movements involved is, very little. The pattern of movements may have features like back-tracking, congestion, long distances, etc. To record these features the flow and string diagrams are used.

5.7 The Flow Diagram

"A flow diagram is a drawing or a model substantially to scale, which shows the location of the various activities carried out and tube routes followed by workers, materials or equipment in their execution."

The various activities on the diagram are identified by their numbered symbols from the corresponding flow process chart either man or material. The routes followed are shown by joining the symbols in sequence by a line.

A flow diagram showing the movement of a paper in an office is given in Fig.



5.8 String Diagram

"The string diagram is a scale plan or model on which at bread is used to trace and measure the pat of worker, materials of equipment during a specified sequence of events."

When there is too much of movement involved then, a flow diagram may become incomprehensible. In such cases, string diagram is used.

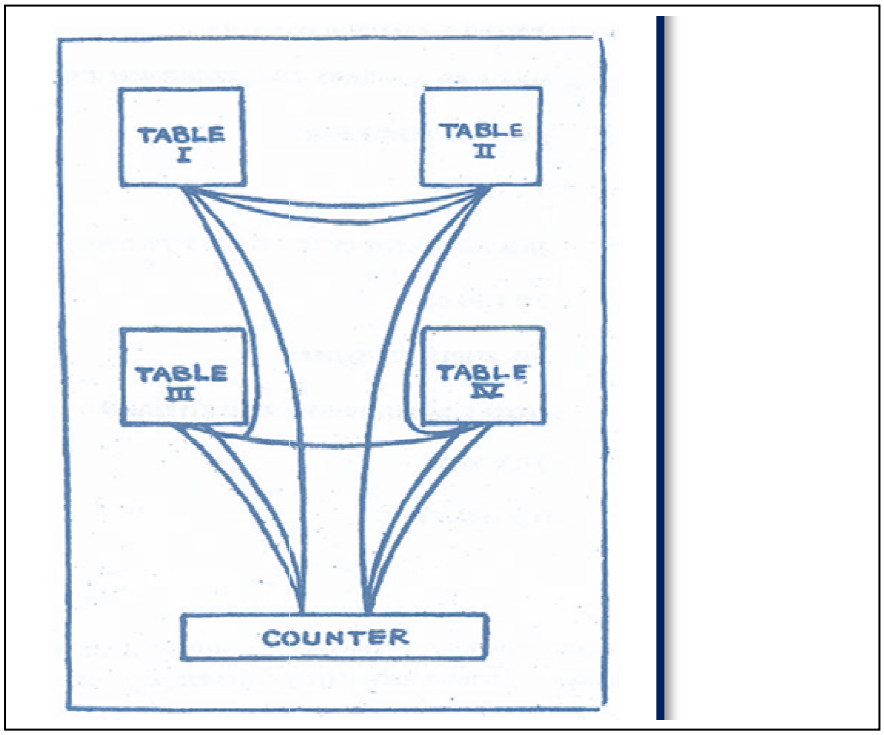
The scale layout is fixed to a board and plans, are driven into the board to mark the location of various activities and also at points where the direction of move changes. A thread is then wound round the pins following the various activities in sequence. The distance covered can be calculated by measuring the length of the thread used.

These diagrams are particularly useful when, considering problems of plant layout and design. Proposed improvements can be effectively demonstrated bold, to management and workers.

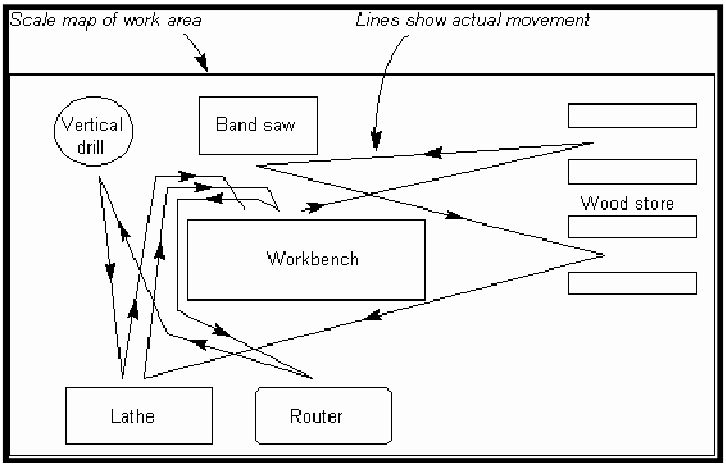
Features like back-tracking, excessive movement and congestion are clearly shown hips to take steps to improve the situation.

String diagrams are particularly useful to study the movement of workers in circumstances like, one man attending several machines, processes involving involvement of the worker from one place to another, etc.

Figure represents a string diagram of a bearer serving refreshments in a canteen.



example: string diagram



5.9 Travel Chart

The string diagrams take rather a long time to construct and when a great many movements along complex paths are involved the diagram may end up looking like a forbidding maze of criss-crossing lines when the movement patterns are complex, the Travel Chart is a quicker and more manageable recording technique.

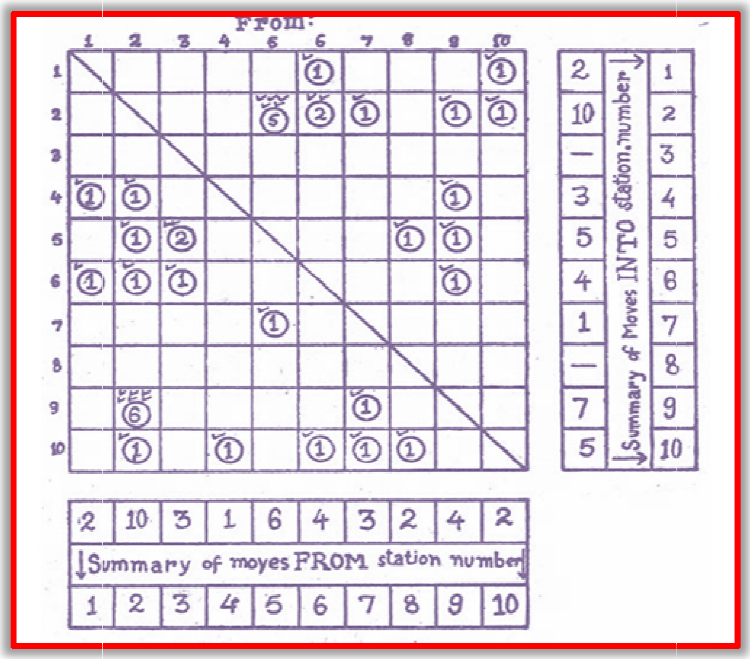
"A Travel chart is a tabular record for presenting quantitative data about the movement of worker, materials or equipments between any numbers of places over any given period of time."

The figure shows a typical travel chart.

The travel chart is always a Square, having within it smaller squares. Each small square represents a work station. If for example there are 10 work stations then the travel chart will have 10 x 10 = 100 small squares. The squares from left to right along the top of the chart represent the places 'from where' movement takes place. Those down the left hand edge represent the stations 'to which' the movement is made. For example, consider a movement from station 2 to station 9, to record this, the study man enters the travel chart at the square numbered 2 along the top of the chart, runs his pencil down vertically through all the squares underneath this one until it reaches the square which is horizontally opposite the station marked 9 on the left hand edge. This is the terminal square, and he will mark in that square to indicate his journey from station 2 to station 9. All journeys are recorded in the same way.

The travel chart can also be made to indicate the weight/material moved per trip. This is a particularly useful technique for plant layout and materials handling analysis studies.

EXAmple 1: travel chart



exmple 2 : travel chart

TO / FROM	Gds rec	Store	Mill	Drill	Assy	Pack	Total
Gds rec		24			12		36
Store			8	4	4		16
Mill				10	6		16
Drill					10		
Assy						14	
Pack							

CHAPTER REVIEW:

1) How many symbols are used in Simo cahrt ?what are they?
2) How path movement recording is done? write about one method.

METHOD STUDY – CHAPTER 6

CRITICAL EXAMINATION

When the details of the existing method have been recorded through a, suitable process chart, the next step in the study procedure is to examine all the facts. Critical Examination of the recorded, data is the crux of method study. It is at this stage that the possible alternatives for each activity are evolved for later development. Each activity is questioned and challenged thoroughly with a view to improving the situation. Critical Examination consists of a well designed questioning pattern in an impartial and objective manner.

Recording-A Prerequisite for Examination

The facts of the method study problem under consideration recorded in the form of a process chart forms the basis for critical examination. Process chart to be used, depends on the type of problem being examined. In many cases, it may be useful to draw an outline process chart which will give the summary of the whole situation and may form the basis for critical examination without further, recording. In case, any more details are required, then the operations and inspections recorded in the outline process chart which ate complex can still be amplified and these are then made the subject of further charts. A first order outline process chart depicting the prior and after activities of the situation under review will help to get a proper perspective of the various processes involved and their elation to each other. In many cases a critical examination of the connected activities will give a lead to the solution of the problem under consideration. Sometimes stepping outside the terms of reference and questioning the activity of the department or organization itself might bring about fruitful results. To illustrate suppose the problem for method study is grinding operation of milling cutters in a factory manufacturing various types of tool cutters And to start with, if the total activity of the department, i.e., 0 milling cutters produced, is subjected to critical examination, it might reveal certain information which may be of immense value to the management, though the investigation called for is only on a small portions of this process. Examination of the operation under review may then follow.

6.1 Classification of Activities

Before starting the examination it is necessary to decide which activity should be examined first. It is found that maximum improvements are obtaining by examining the operations and inspections first. Any changes effected in the operations and inspections will either automatically eliminate the connected transports, storages and delays by modify them. Even among the operations certain priorities can be fixed by for examination in their order if importance. For this purpose operations may be classified into:

(i) Key Operations: Which represent actual performance of work on the material or machine and may involve change in physical or chemical characteristics of the material.

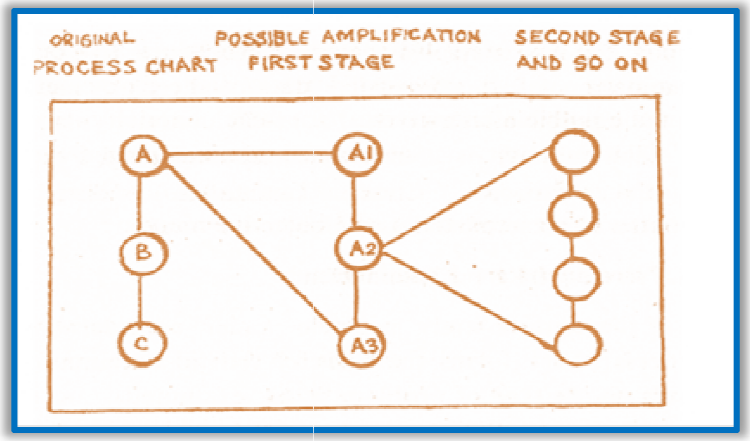
(ii) Make/Ready Operations: Which are concerned with preparation of material or equipment and keep them, ready for next activity.

(iii) Put Away Operations: Which are concerned with the clearing up or disposal after the operation

or inspection.

In a turning operation on a lathe, the actual turning operation will be the "key operation", loading will be a "make ready" and Unloading will be a "put away" operation.

What the key operation is, depends very much on the subject of the study “key operation may on amplification divide itself into several "keys". Similarly, a make 'ready or a put away operation may be sub-divided again into make ready, key and put away operations. Inspections fire always treated as key operations. Operations are examined first before proceeding with the examination of other activities. When any of the key operations are eliminated or modified, the connect make ready and put away operations automatically get eliminated or changed. After examining the key operation, the remaining make ready and put away operations and the transports, delays and storages may be examined.



6.2 CRITICAL Examination---- Approach

The success of any method study depends on the thoroughness with which the Work Study man conducts the critical examination and his ability to dig out information and elicit answer to all questions from appropriate sources. No information is to be overlooked as unimportant till he is satisfied that it is so. While answering the questions true reasons must be unearthed. Often it happens that the answers to the same question obtained from different sources vary in their context. Answers should be accepted only when they are proved to be correct. The facts should be examined with an unbiased and impartial mind. It will always be better to start the examination with a blank but open mind devoid of any preconceived ideas, as they tend to influence the investigation. Bright ideas and hunches which start troubling the Work Study man when he is halfway through the critical examination should be jotted down as and when they occur and should be reserved for consideration to the appropriate place in the investigation lest the examiner should be influenced by them and may be led to answer questions in such a way as to fit in with these ideas and hunches. Evaluation and development of new methods should start only after a systematic examination of the existing method.

6.3 CRITICAL EXAMINATION---- Procedure

The essence of critical examination technique lies in that all the details of every activity are examined in isolation with others to establish the facts to the present method and the reasoning behind them. All the possible alternatives then recorded and among these the most effective one is selected. The questions are so designed that the answers to the first set of questions give an indication of the facts and the reasons behind them and the answers to the second set suggests all possible alternatives and the means of improvements. The questions allege the purpose, place, sequence, person and means and thus make the examination exhaustive, and the method study effective.

One of the essential qualities that a Work Study man should possess is the challenging or the questioning attitude. While doing a method study he does question the activities but most of the time mentally and not in any ordered sequence, and hence the chances of some details being overlooked are more. The strongest feature of the critical examination technique is the systematic and thorough approach given and in addition the pointers provided for each question which if followed properly, leaves no activity of the process unchallenged and also makes the examination simple and quick at the same time making the methods improvement effective.

6.4 FIVE GOVERNING CONSIDERATION-PURPOSE, PLACE, SEQUENCE, PERSON AND MEANS.

PRIMARY AND SECONDARY QUESTIONS IN CRITICAL EXAMINATION

The answer to the question 'What is achieved?' should be simple and specific and should dearly indicate the achievement of the particular operation rather than the means, which is answered by how is it achieved? While answering the question why? The true reasons must be found out by consultation with the persons connected. And thus it becomes necessary that everyone in the organization should co-operate and much depends on the approach of the Work Study man and his knack to elicit information.

The answer to the question 'What else could be achieved? is never blank, since the answers to this question bring out the different alternatives and suggest means of improvement, this should be carefully answered. In order to get as many alternatives as possible certain pointers are given such as,

(I) Non-achievement or don't achieve

(2) Avoid the need for the achievement

(3) Modify (more or less)

(4) Invert

(5) Compromise.

All these should be answered.

Some of the answers might be meaningless in particular situations. But it is worthwhile to note down all the answers and while recording the implications of each of these, those that are not relevant may be discarded. The alternatives particularly suited are divided into long term and short term and are recorded in order of preference in the What should be?

The question 'How is it achieved?' is answered under four main titles:

(I) Materials employed

(2) Equipment employed

(3) Operators' method, posture and environment

(4) Operating conditions including safety precautions.

Reasons for each are investigated and all conceivable alternatives for each are considered:

1. The best suited alternative for each is selected in isolation and then combined with others to produce the best, safest and cheapest method.

2. Most of the major improvements are obtained by answering the questions, What and How? The remaining three questions, When, Where and Who? are fairly simple to answer.

3. Sequence and frequency are the two items to be considered while answering When? The detailed position: and the distances from previous and subsequent activities are required for Where? The question Who achieves it ? is -answered by recording the (a) Number of Operators, (b) Grade, (c) Employment Status, (d) Designation or Name, (e) Wage Scale and Incentive Scheme if appropriate. All possible alternatives for each of the above are considered.

While answering these questions the imagination should be allowed to run without minding the cost, time, and practicability of any other factor Ideas, which appear ludicrous and silly, should also be given a serious thought as these may in turn emerge other ideas. It is in evolving these ideas that the skill and mental ability of a Work Study man are put to test. The best alternatives are chosen after a careful consideration of economics and feasibility of all the alternatives listed. The sequence to be followed in asking these questions may vary according to the situation exam med. But invariably the purpose is the first to be considered and thereafter, sequence, place and person may follow.

The first attractive solution that comes up should be accepted without going into the details of all the other practical solutions. The improvements that could be effected with no capital expenditure are considered carefully and compared with other expensive methods. The return on capital expenditure could be used as convenient criteria for comparison of alternative methods. Though the terms of reference limit the scope of suggestions, those falling outside the terms may

also be recommended 'if they are valuable for future consideration by management. In certain cases it may be worthwhile to get the terms of reference suitably changed if, necessary, by consultation with the management, in order to widen the scope for improvements.

Maximum benefit is obtained by eliminating the activity altogether. But this is not possible always in which case modification or combination of the activities or simplification of the means of performance should be resorted to.

It is found by experience that the critical examination to be effective, two persons should work together at least hale tackling the secondary questions, since this reinforces the chances for getting as many ideals as possible. Use of critical examination sheets to record the answers will be extremely helpful to ensure that no aspect of the problem is forgotten or overlooked and will also serve as a record for future reference.

The technique of critical examination on the above lines envisages a thorough questioning on all the aspects of each activity and helps to evolve different alternatives out of which effective lines of improvements could be decided and an improved method could be developed.

6.5 CRITICAL EXAMINATION PATTERNS FOR DEVELOPING NEW METHOD

CRITICAL EXAMINATION—GUIDE SHEET

	Facts	*Alternatives*	*Selection for Development*
What is achieved ? Consider the element in isolation (Bear in mind the subjects of the chart) *Note* : What is achieved NOT how it is accomplished or why ?	WHY ? Reasons given may not be valid. True reasons must be uncovered.	What ELSE could be achieved ? The answer to this section is never 'nothing'. Three main alternatives which must always be considered are :— (a) Non-achievement. (b) Part achievement. (c) Avoid the necessity for the achievement. Each of these can be explained.	What SHOULD be achieved? Helpful to divide into short and long term. Under long term can go suggestions for future research, customer education etc. The aim is elimination or if this is not practicable, modification. The economics of the situation must be borne in mind throughout.
How is it achieved ? Information should be tabulated as simply as possible under these main headings with all relevant details. (a) Materials Employed (b) Equipment Employed (c) Operator's Method, Posture & Environment (d) Operating Safety precautions.	WHY THAT WAY ? Reasons should be investigated for each of the tabulated items under each heading.	HOW ELSE could it be achieved ? Consider all conceivable alternatives for each main heading (a) Eliminate (b) Substitute. (c) Modify. (d) Compromise. (e) Combine.	How SHOULD it be achieved ? Each heading should be considered first in isolation and selection made of the most appropriate items, bearing in mind the economics. The selected items should then be knitted together to produce the best, safest and cheapest method.

Contd.

WHEN is it achieved ? (a) What are the previous and subsequent activities and what are the time factors involved ? (b) What is the frequency ?	WHY THEN ? What determines (a) The sequence. (b) The frequency.	When ELSE could it be achieved ? All conceivable alternatives should be considered. (a) Combine. (b) Rearrange.	When SHOULD it be achieved ? Bear in mind the economics.
Where is it achieved ? Since the fundamental questions have been cleared at the selection stage, only the detailed position within the factory, plant or area is required. Where appropriate give reference to location and subsequent activity. *Note* : Remember the three dimensions.	WHY THERE ? What governs the location today and what were the original reasons ?	Where ELSE could it be achieved ? All conceivable alternatives should be considered. (a) Relocate. (b) Modify.	Where SHOULD it be achieved ? Answer may be in relation to some other activity. Consider limitations and cost of building design and services (steam, air) etc.
WHO achieves it ? (a) Number of operators. (b) Grade, e.g., unskilled male. (c) Employment, e.g., day worker. (d) Designation or name. (e) Wage scale and incentive scheme if appropriate.	WHY THAT PERSON ? Reason for each heading.	WHO ELSE could achieve it ? All conceivable alternatives should be considered. (a) Substitute. (b) Modify. (c) Confine.	Who SHOULD achieve it ? It may not be possible to select the individual without Work Measurement and recommendations as to wage scale and incentives will usually be made at the development stage.

7. DEVELOPING NEW METHOD

7.1 PROCEDURE FOR DEVELOPING NEW METHOD:

Various alternatives would have been evolved for each activity during the examination stage and depending on the implications, some of the alternatives be chosen for development. Under each governing considerations like purpose, means, sequence, place and person there may be any number of suitable alternatives generated. In developing the new method the economics and productivity of these suggestions when the job is viewed as a whole must be determined. The activities are examined in isolation at the critical examination stage: during development the alternatives thus obtained are considered in relation to each other and a complete new method is evolved. However, if development takes place as the examination proceeds it would simplify the procedure of development. Certain key operations and inspections in the existing method which are found to be essential may form the framework around which the improved method could be built up. Sometimes work measurement may be necessary to choose between alternative methods or to determine the manpower allocation.

Invariably the 'purpose' is the first governing factor of an activity that is examined. Various alternatives are generated when the question "How else could it be achieved" is answered. Each of these alternatives is evaluated for its advantages and disadvantages and an order of merit is prepared. The next governing factor for examination may be 'means'. The alternatives generated under 'means' would be in the text of the best alternative under purpose. If this is found to be not feasible the next best alternative as per the preference is selected and so on. This procedure is continued till all the governing factors have been covered.

At this stage the type of solution required should be considered. This may be (I) a simple and inexpensive improvement leading to a quick, and perhaps partial, solution to the problem: (2) a long-term solution entailing some capital expenditure and yielding a good return or (3) phased improvements, to be carried out in stages.

Each of the developed methods would have to be again evaluated and the best chosen for implementation. In determining the best method, economic consideration such as, cost of implementation and expected savings, feasibility acceptance and reaction of employees would all have to be taken into account.

It will also be worthwhile to classify each alternative into short-term and long-term, so that depending upon the resultant benefits, the management an decide whether to accept, for example, a short-term plan with less capital expenditure and larger saving or a long-term plan with comparatively high expenditure and larger saving

A short term proposal is one which takes reasonably short period, about two to three months for implementation. A long-term alternative may take a much longer time which may be due to certain reasons such as the need for research and development, customer education, change in

management policy, or modification of governmental regulation.

It is necessary to seek advice and help from everyone concerned during the development of new methods. They may provide useful information and also the acceptance and implementation of the new method becomes a very much easier task.

It may sometimes be necessary to tryout these new methods in order to determine the practicability and to assess potential savings from the new method.

8.0 INSTALL

An important aspect of standard procedure of method study is that the responsibility of the person who carries out the study does not cease at the development stage but extends to 'install' i.e. the introduction of new method, and to 'maintain', i.e. to insure, by periodic checks, that it continues to operate as planned. Therefore, he must 'define' the now method and make a proposal

for approval of higher management. It is essential! that during the earlier stages of selection, recording, examining and development the involvement of concerned workers, managers and supervisors, etc is achieved.

A report is prepared giving in detail the proposed method, and expected benefits from the new method. The report should clearly show the anticipated savings and the cost of installing and operating the new method. This information provides a clear picture to the higher management to evaluate the proposals. After the report has been submitted through proper channels and discussed alterations if any ate noted and the agreed method is recorded.

8.1 WRITTEN STANDARD PRACTICE & ITS PURPOSES

The written standard practice should give a clear description of

(1) the diagram of work place layout and if possible, the sketches of special tools, jigs or fixtures

(2) the tools and equipments to be used,

(3) general operating conditions

(4) a description of new method.

The details of description of new method will depend on the nature of the job and the volume of production. If a job involves several workers for several months in a year, then the detailed instructions can be written, some of the description sheets may run into several pages also.

The 'operating instruction sheet' serves many important purposes, like:

(1) It records the improved method for future reference.

(2) It can be used for explaining the new method to operatives, supervisors or managers and thus helps in installation and maintenance of the method.

(3) It serves as a training aid for new operatives and supervisors.

(4) It forms the basis for works measurement for or for further studies, if need be.

(5) When all detailed preparations have been made and a successful rehearsal

held the actual installation can take place.

Installing the New Method

Installation will require the active support of all concerned and it is by no means a simple job. Adequate preparation is necessary before the changes can be introduced. Throughout the course of the study, the opportunity should have been taken to establish good working relationships at all levels to gain acceptance of the change by management supervision and workers and to create a sense of participation from all regarding the changes. The work of installation is necessarily a cooperative affair.

8.2 TWO STAGES OF INSTALL

The installation can be made into two stages:

(I) Preparation and

(2) Installation.

Preparation may include various stages like

(1) Planning-drawing up of a general programme for installation.

(2) Arrangements the necessary detailed arrangements regarding materials, tools, equipment, selection and training of workers etc.

(3) Rehearsal the new method may be given a trial run. When all detailed preparations have been made and a successful rehearsal been held, the actual installation can take place.

If any changes are proposed where workers get affected then it is advisable to keep their representatives informed and involved from the earliest possible stage of the study. The 'resistance to change' is likely to be faced in many cases when it comes to installation of new methods. The whole hearted co-operation at any level will only come as the result of commence and trust. The method study man must convince the management that he knows what he is doing. He must have the respect of supervisors and technicians, and they must realise that he is not there to displace them or show them up, but as a specialist at
their disposal to help them. Finally, he must be able to win the confidence of the workers that he is not going to hum them. The method study man must make certain that every one understands clearly that he cannot give executive decisions and that the instructions concerning the introduction and application of new methods must come from appropriate level in the management.

9. MAINTAIN AND REVIEW

9.0 Maintaining the New Method

It is important that once a method is installed it should be maintained in its specified form. Therefore when the new method is operating detailed supervision is necessary until managements are satisfied that the scheme is operating satisfactorily. Unless the new method is observed for some

time after installation the expected results may not be reused. Changes may creep in which lead to a less of efficiency and external conditions may alter. On the other hand some changes may improve efficiency and will show up in operation. Therefore, during the 'maintain' period reviews are carried out at the necessary frequency in order to see that the planned results are achieved and if possible improved.

PRODUCTIVITY

"Productivity implies development to find better, cheaper, easier, quicker and safer means of doing a job, manufacturing a product or providing a service"

10.0 PRODUCTION AND PRODUCTIVITY

Production is any process or procedures developed to transform a set of input elements like men, materials, capital, information and energy into a specified set of output elements like finished products and services in proper quantity and quality, thus achieving the objectives of an enterprise. The essence of production is the creation of goods, may be by the transformation of raw material or by assembling so many small parts (as in coach building factory). The word production merely implies “OUTPUT”.

To increase output management can apply the following techniques.

(a) Increasing the raw materials

(b) Increasing the number of shifts

(c) Increasing the number of machines

(d)Increasing the man power

Thus output can be increase by increasing inputs (men, materials, machinery / equipments etc.,) The concept of Work Study is not merely increasing production, but is mainly applied to achieve more productivity. Therefore it can be said that Work Study (Method Study and Work Measurement) is applied for achieving more productivity.

PRODUCTIVITY

Productivity may be defined as follows:

"PRODUCTIVITY IS THE RATIO OF OUTPUT TO INPUT"

Goods and services reflect the GNP and hence our standard of living. We can improve our standard of living only if we minimize the use of real resources and cut down wastes. Productivity may therefore be defined as the ratio of what we generate in the way of goods and services from what we put in as real resources.

PRODUCTIVITY is first time used by Mr.Quesnay in his article in the year 1766. In 1883, Littre defined productivity as "Faulty to produce". In 1950, Organisation for European Economic Co-operation (OEEC) defines productivity as the quotient obtained by dividing the output by one of the factors of production.

In 1962, Mr.Faricant defined, "the productivity means always the ratio of output to input."

In 1976, Mr.Siagal defined the productivity as the family of ratios of output to input.

In 1979, Mr. Sumanth defined " Total Productivity means the ratio of tangible output to tangible input."

Mr.Peter Drucker defines the productivity as a balance between all the factors of production that would give the greatest output for a smallest effort.

Mr.P.R.K.Menon defines productivity as "Productivity implies development of an attitude of mind and constant urge to find better, cheaper, easier, quicker and safer means of doing a jo9b, manufacturing a product and providing a service."

In other words,

$$\text{PRODUCTIVITY} = \frac{\text{Output obtained from an undertaking}}{\text{Input of resources used to produce this o/p}}$$

Productivity means producing more with same resources (with or without little addition to input)

Or

Producing same output with fewer resources.

Productivity improves the standard of living of the people. Productivity is important to increase the economic level of the nation.

To increase productivity it is necessary to

- Increase the output obtained from the same amount of resources.
- Decrease the amount of resources used for a given output of goods and services.

Productivity is often thought to be the same as that of increased production. In reality, it is very different. One can increase production by using more machinery, by using larger quantities of new material. But if the utilization of extra resources does not lower the price of what is being manufactured, there is no ultimate gain.

Therefore the aim work study should be to obtain a greater output with the same resources; the same output in the lesser resources or if possible, greater output with less resources.

10.2 PURPOSE TO INCREASE PRODUCTIVITY

It is only through the increase in productivity that

1. A worker gets higher real wages.
2. A share holder has an increase in the purchasing power of his dividends.
3. A customer pays lower price for an article.
4. A customer pays lower price for an article.
5. A higher standard of living is attained.
6. Nation's economy is strengthened.

Increased Productivity serves the following purposes,

a. FOR MANAGEMENT:
   1. To produce good earnings (profit).
   2. To clear the debts or loans.
   3. To sell more and
   4. To stand better in the market.

b. FOR WORKERS
   1. Higher wages
   2. Better working conditions
   3. Higher standard of living
   4. Job security and satisfaction.

PRODUCTIVITY INDEX OR PERFORMANCE INDEX

The average productivity index of a department or of a plant would be the total or of a plant would be the total standard times or standard hours produced by all employees divided by the actual hours worked multiplied by 100.

10.3 STRATEGIES OF INCREASING PRODUCTIVITY

To ensure the most effective utilization of resources, Russel Currie, the father of modern Work Study, developed six strategies which can be classified as follows.

1. Improve basic processes by research and development ! In the long
2. Improve the existing production line by providing better plant and building ! Term, it will equipment ! require capital

3. Improve and simplify the product, reduce the varieties and standardise the range ! Intermediate stage may require capital.

4. Improve the method of operating and existing material resources. ! Require little or no capital investment.

5. Improve the planning of work and the use of manpower. ! Require little or no capital investment.

6. Increase the effectiveness of all employees. ! Require little or no capital investment.

The actual significance and the order of importance of these strategies will vary according to the individual situation of each organisation.

PRODUCTIVITY BY MEN

It can be achieved by concentrating on the performance of workers. More can be achieved by deputing right person for the right job, by providing training to workers and reducing idle man hours.

PRODUCTIVITY BY MACHINES

It can be achieved by utilising the services to trained and experienced operators to handle the machines. So that more can be manufactured with the same machine by concentrating on its proper maintenance and attending to its defects and breakdown immediately and also by reducing machine idle hours.

PRODUCTIVITY OF MATERIALS

Productivity can be achieved by procuring good quality raw materials by redesigning the job, and using skilled workers for a job thereby wastages can be reduced.

DIFFERENCE BETWEEN PRODUCTION AND PRODUCTIVITY

PRODUCTION	PRODUCTIVITY
1. Means output of goods for Services	1. Means efficient utilisation of resources
2. It can be increased by increasing material man power, m/c etc.	2. It can be achieved by reduced wastages of Material, manpower and m/c hours.
3. Cost of the product will remain with the increase of production alone	3.Cost of the product will come down with increase in productivity
4. It does not have effect the impact of standard of living	4.It certainly improves standard of living.
5. It changes the raw material Into finished product	5.It is the ratio between output to input

11. PLANT LAYOUT

Plant Layout and Materials Handling offer very good scope for improvements and cost reduction. While developing improved methods it is necessary to give a careful consideration to the layout and handling aspects. A poor layout involving excessive movement of materials and men and improper utilisation of space can considerably increase the manufacturing costs besides being unsafe.

Some of the advantages of an improved layout and a handling system are:

(a) Increased production
(b) Savings in time and cost
(c) Reduced materials inventory
(d) Economy in space
(e) Better working conditions, increased safety and greater job satisfaction
(f) Improvement in quality and reduced damages to materials

Plant layout and materials handling are very much linked together. A good layout takes all the aspects of materials movement and vice versa.

Some of the aspects of plant layout and materials handling with particular reference to an industry are briefly discussed in this chapter.

Plant Layout

Plant layout can be considered as the physical arrangement of industrial facilities.

These facilities include

(a) buildings, (b) equipment, (c) workplaces, (d) shortage points,(e) offices, and (f) employee facilities.

11.1 The fundamental objectives of a good layout are that

(i) it should integrate all the factors affecting a layout and should be a

best compromise

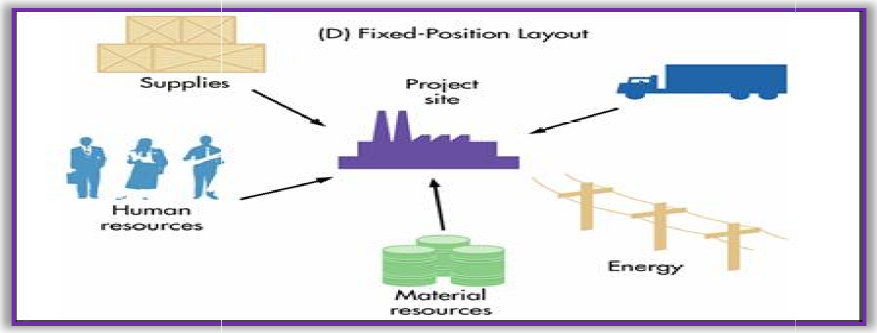
(ii) it should involve minimum movement of materials
(iii) there should be a continuous flow of work
(iv) the space should be effectively utilised
(v) it should ensure satisfaction and safety for employees
(vi) it should be flexible to accommodate changes.

There are basically three types of layouts which are described as under

1. Fixed Position Layout

A fixed position layout is one where the material or major component remains in a fixed place. All tools, machinery, men and other pieces of materials are brought to it and the product is built up into its final shape at the same location. Manufactures of a ship, construction of a building are some of the examples.

Such a layout would be adoptable when the material forming or treating involves only hand tools and small machines or when only a few pieces are made or moving the major component or material is expensive.



2. Process Layout

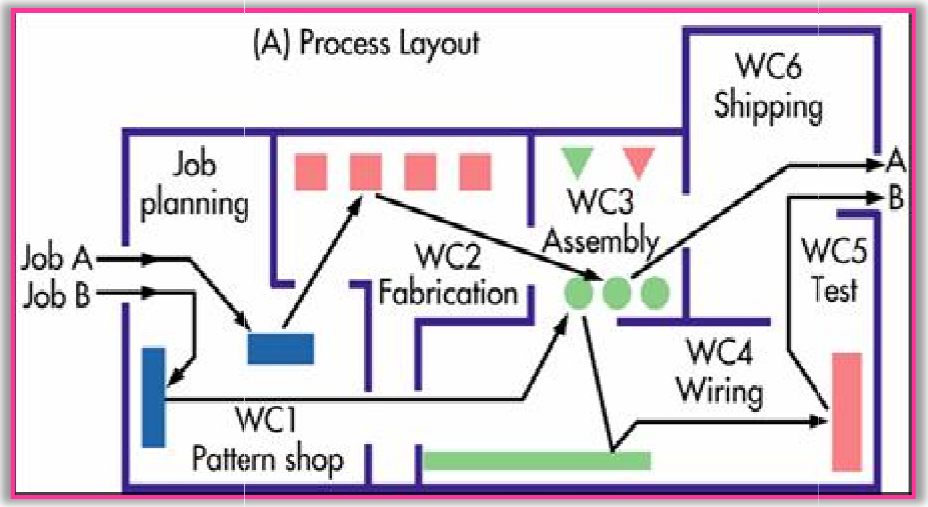
In a process layout all machines or process of the same type are grouped together.

EXAMPLE 1

Milling machines				Drilling machines				Broaching machines			
1		2		1		2		1		2	
3		4		3		4		3		4	
Lathe Machines				Shaper machines				Heat treatment section			
1		2		1		2		1		2	

	3		4			3		4			3		4	

EXMAPLE 2



The advantages of a process layout are

(i) Better machine utilization,

(ii) Adoptable to a variety of products and frequent changes in sequence of operations and

(iii) Easier to maintain continuity of production in cases of machine break-downs and absenteeism.

The disadvantages of a process layout are

(i) involves more materials handling,

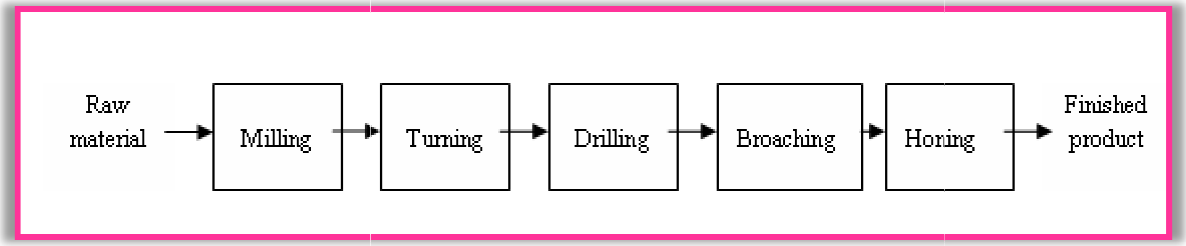
(ii) occupies more floor space and

(iii) higher in-process inventory.

A process layout can be used in those situations where the machinery is highly expensive, a variety of products are made, or intermittent or small demand for the product.

3. Product Layout

In a product layout the arrangement of machinery is according to the sequence of operations of the product.

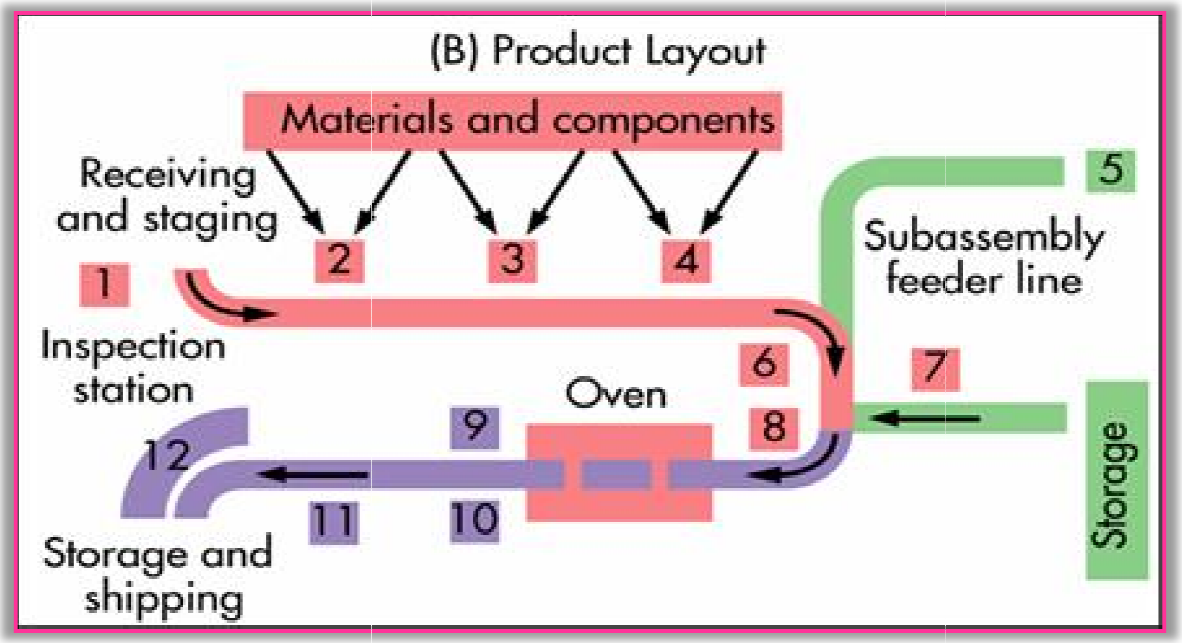


Advantages of such a layout are

(i) less material, handling, (ii) less in-process inventories and (iii) reduced congestion and less floor space is occupied. Manufacturing costs are low at high volume of production but the costs will be very high at lower volumes of production. The capital investment on machines may be quite high and all operation times need to be balanced. A breakdown on any one machine in the line may hold up the complete production time.

A product layout will be economical when the volume of production is large, when the product design is standardised and when the demand is fairly steady.

Most of the layouts in practice area combination of the above. It may be worthwhile to have a product type of layout for some of the components and others may have a process layout depending on the various factors as discussed above.



11.8 Aids for Improving Layout

The Flow Process Chart, Flow Diagram. Travel Charts and String Diagram are all very useful aids for charting the existing methods and movements and for developing improved layouts.

Travel chart is a recording technique which will be very helpful for recording quantitative data about the movement of materials, men and equipment between different locations in a particular period of time. While the flow process chart and flow diagram indicate the direction and distance the travel chart gives the frequency of movements.

In addition, templates and scale models are also used to determine the most suitable location of shops, facilities and equipment, for arriving at the best layout.

12. Material Handling

A material handling for long has been considered as an activity of lifting, shifting and placing of any material regardless of size, form and weight. However, with the growing complexities of the production operations, a need has been felt to integrate the materials handling function with the production operation and control production control functions. The function of production control in any enterprise is to optimise the production within the limitations imposed by manufacturing and marketing conditions. It determines factors like what is to be done, where it is to be done, how it is to be done and when it is to be done. Whereas materials which are to be moved as per the schedules of manufacturing and production control. The procedures, actions and evaluations used in controlling the movement of materials create a strong link between the functions of materials handling, production operations and production control. Realisation of this integrated systems approach offers a great opportunity for the reduction in production delays and costs in the industry. Materials Handling is, therefore, now being considered as Preparation, Placing and Positioning of materials to facilitate their movement or storage. It relates to every aspect of product except the actual processing".

12.1 DEFINATION OF MATERIAL HANDLING

The American Society of Mechanical Engineers (ASME) has approved the following definition: "Materials Handling is the art and science involving the moving, packaging and storing of substance in any form." A few other representative definitions mentioned elsewhere are:

*Materials handling is the creation of time and place utility in a material.
*Materials handling IS the lifting, shifting and placing of materials, which effect savings in money time and place.

Materials Movement Management

The growing complexities of the production processes, the increasing competitive practices within the industry and in the country, coupled with the rising cost of labour has led to increased awareness in managers and engineers about the application of materials handling techniques to cut down the unit cost of production and to increase the productivity in the enterprises. There are a number of success stories, but the desired situation is yet to be obtained. It can be inferred that past approaches to materials handling have frequently led to lessening the magnitude of the problem rather than completely solving the same. Even now idle lying handling equipments or machines waiting for handling equipments are very common sight in our industries, especially in engineering and construction units. This can possibly be attributed to the fact that the approach to materials handling, though sometimes claimed to be systems oriented, has mostly been fragmented are ultimately, equipment-oriented.

Growing number of materials handling equipment manufacturers in India, easy availability of the equipment, flexibility in usage, and intensive sales campaign have resulted in the undesirable tendency to confuse the materials handling system with the use of mechanical aids to the handling. Of course, in many a situation the mechanisation can be useful and increase the efficiency of the system but a quick jumping in this direction takes away the opportunity for a logical and a procedural analysis. The central point of focus then becomes, "How to handle" which leads to "What type of equipment should be used" and this often, results in purchase of some adhoc equipment which suits the budget only or is being used in similar conditions elsewhere. Whereas the concern should be on "Systematic Movement Analysis" and "Management Requirement Analysis" wherein "Handling Analysis" forms only a part of the exercise.

"Materials Movement Management" thus, is a broader concept covering the analysis, integration, coordination of Production Management System, Materials Management, Materials Handling, Facility Planning and Plant Engineering into an interlinked framework with a view to achieving optimum cost of movement and storage of materials to meet the production and delivery schedules of the company."

The approach based on Materials Movement Management focuses attention on the four aspects viz. material, moves, methods and management.

The basic analysis should therefore, be as follows:

METHOD
MATERIAL
MOVES

What materials are to be moved and why?

Where and when the materials are to be moved and why?

How the material is to be moved.

MANAGEMENT

What is the cost of movement?
What are the Systems implications?
What is the efficiency of the systems?

13. PRINCIPLES OF MATERIAL HANDLING

13.0 Some Principles

Some of the major principles in the design of an efficient system of materials handling are:

(a) Reduce handling to a minimum

As far as possible materials should always move towards completion, over, the shortest distance without back-tracking. Often materials move back and forth over large distances unnecessarily. A large amount of handling can be eliminated by planning the location of operations so that one operation finishes right where the next begins. The flow of product should receive top priority in planning of layout.

(b) Avoid re-handling

It may not be possible to eliminate re-handling completely, nevertheless re-handling is a wasteful and costly operation. Re-handling can be reduced by (i) not keeping anything on floor, (ii) avoiding transfers from floor to container or vice versa or from container to container and (iii) avoiding mixing of materials.

(c) Combine handling with other operations

Many times handling may be, made a productive activity by combining with other operations, such as production, inspection, and storage. In process industries, materials undergo physical and chemical changes while in movement, handling devices may be used as live storages or materials may be sorted and inspected while they are being handled.

(d) Ensure safety in handling

Safety is a key word in handling. A large percentage of industrial accidents are attributed to poor handling practices. Even more costly in terms of money in the damage to equipment and products due to improper handling methods. A good handling system should ensure safety to walkers and materials. Manual handling of heavy objects materials scattered on floor or projecting into aisles are but a few causes of accidents. Keeping gangways and aisles clear is one of the primary precautions against accidents in handling.

(e) Handle materials in unit loads

It is easier and quicker to move a number of materials at a unit rather than piece by piece. Modern material handling devices are designed to take advantage of unutilised loads.

(f) Use gravity where possible and mechanical means if necessary

The simplest and cheapest way to handle materials is by using gravity.

Often chutes and inclined boards can conveniently used to transport materials quickly to the point of use about much investment on costly handling equipment. Where it is not possible to use gravity for various practical reasons, some mechanical means should be considered. Lifting and carrying of heavy materials mechanical1y saves time and reduces fatigue of workers.

(g) Select proper handling equipment

There are as many types of handling equipment available today as the number of materials to be handled. And any single equipment may not solve all handling problems. It is therefore, necessary to choose the equipment suitable for the job under consideration. The equipment selection needs to be done carefully so that there is an efficient coordination of all handling, resulting in overal1 economy. Use of standardized equipment facilitates maintenance and repair.

Another important factor in the selection of equipment is flexibility.

Industrial activity is subject to constant changes and handling equipment should provide for this change. In other words, the equipment selected. should be capable of a variety of uses and applications.

(h) Reduce terminal time of equipment

The advantage of mechanical and power equipment would be lost if they are made to wait during loading and unloading this may take considerable amount of time. By reducing this waiting time the handling equipment could be released for more productive work. There are various mechanical devices like trailers; tipping arrangements, cranes and hoist attachments, to quicken loading and unloading operations.

(i) Buy equipment for overall savings

In selecting equipment savings in overall handling cost must be the guiding principle rather than the first costs of equipment. Arriving at handling costs is a difficult problem but a fairly accurate estimate can be obtained by determining the handling elements and applying work measurement.

In India labour is still comparatively less costly and a longer period may have to be allowed for amortizing the handling equipment. All direct and indirect savings are to be taken into consideration while deciding on handling equipment.

(j) Use labour consistent with handling methods

Manual handling could be done by unskilled labour, whereas mechanical

handling may. require semi-skilled or skilled workers. Proper allocation of skills helps in overall economy. As far as possible direct production operators should not be used for handling operations. It is preferable to have a separate gang of material handlers to ensure proper utilization of production workers.

(k) Train workers and maintain equipment

Careful operation and proper upkeep are essential for getting the maximum out of the handling equipment. Careful selection and training of employees in principles, operation and safety rules and planned maintenance of equipment are 'worthwhile investments in the long run.

13.1 EFFICIENT MATERIAL HANDLING

Use of right method to provide right amount of right material at the right time in the right sequence, right position, right condition and at right cost

14. TYPES OF MATERIAL HANDLING EQUIPMENT

14.1 TYPES OF MATERIAL HANDLING EQUIPMENTS

The material handling equipments are classified under 5 categories.

1.CONVEYORS

Used to move the material between two fixed stations either continuously or intermittently.

CONVEYOR

ROLLER TYPE — 1.POWER, 2.GRAVITY

WHEEL TYPE

BUCKET TYPE

SCREW TYPE — 1.BELT, 2.CHAIN

2.INDUSTRIAL TRUCKS AND TROLLEYS

Moving materials in a shop floor in a flexible manner.

INDUSTRIAL MOVEMENTS

TROLLIES | MOTOR TRUCKS | FORK LIFTS | PLATFORM TRUCK

3.CRANES AND HOISTS

Moving the material on over head space without disturbing workers.

Examples : - Jib cranes, Bridge cranes, Circular cranes

Hoists : Chain hoists, Electric hoists, Pneumatic hoists

4.CONTAINERS

a. DEAD CONTAINER : Contains material but not moved.

B .LIVE CONTAINER : Contains material and can be moved.

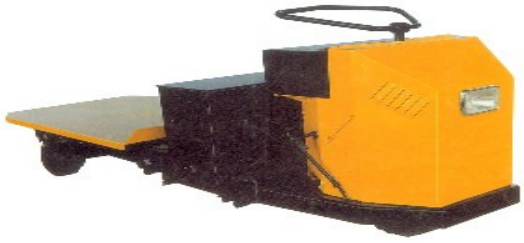
E.g. Power trucks, wagons etc.

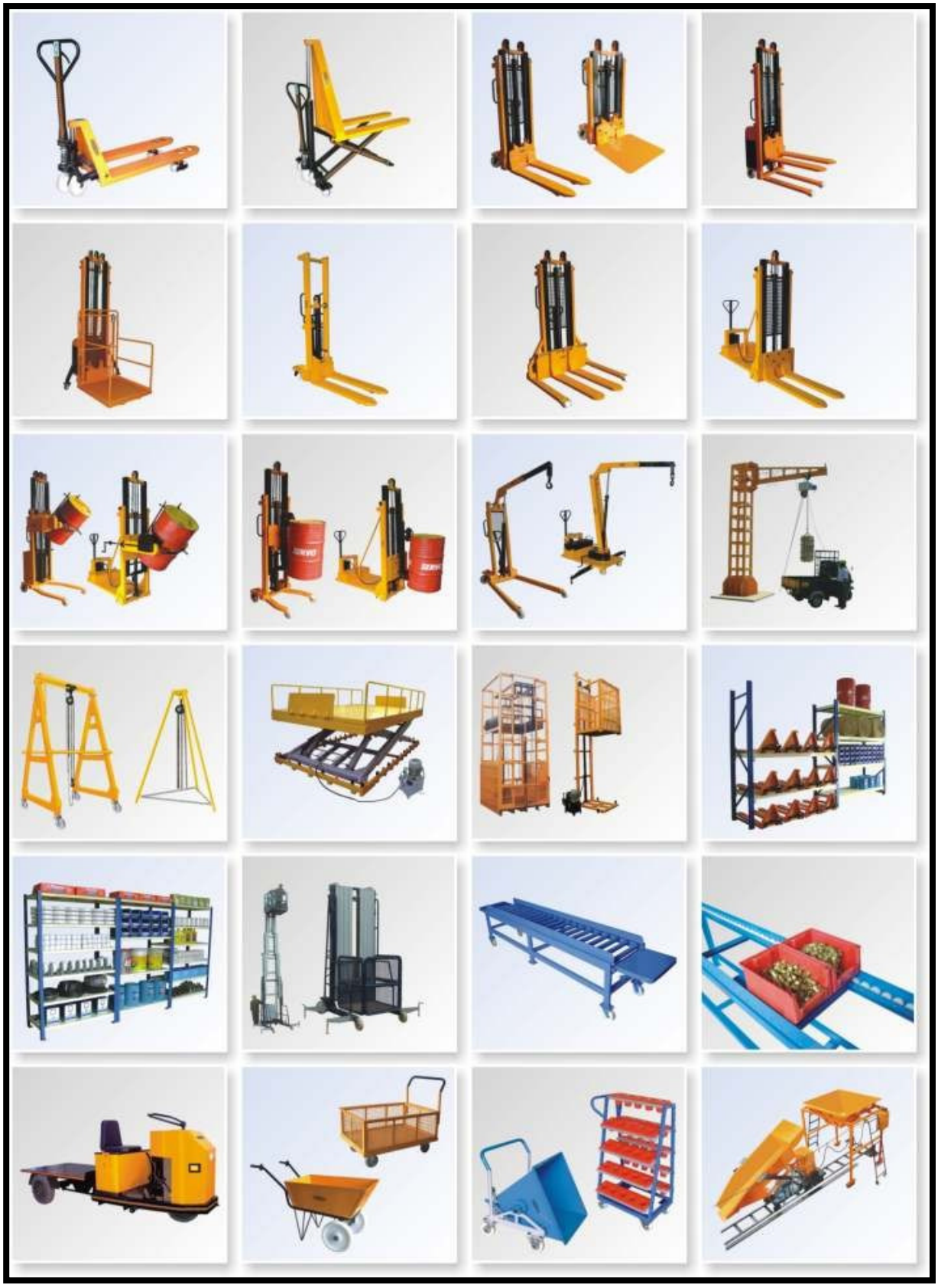
5.ROBOT

Performs the operation and also move material from one place to another for material handlings. It can also perform the operation where men cannot perform the job due to hostile conditions.







15. STATISTICS

15.0 Basic Statistics

Mean, Mode, Median, and Standard Deviation

The Mean, Mode, and Median

The sample mean is the average and is computed as the sum of all the observed outcomes from the sample divided by the total number of events. We use x as the symbol for the sample mean. In math terms,

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x$$

where n is the sample size and the x correspond to the observed valued.

The mode of a set of data is the number with the highest frequency, one that occurs maximum number of times.

One problem with using the mean, is that it often does not depict the typical outcome. If there is one outcome that is very far from the rest of the data, then the mean will be strongly affected by this outcome. Such an outcome is called an outlier. An alternative measure is the median. The median is the middle score. If we have an even number of events we take the average of the two middles. The median is better for describing the typical value. It is often used for income and home prices.

Variance and Standard deviation

The mean, mode, median, and trimmed mean do a nice job in telling where the center of the data set is, but often we are interested in more. For example, a pharmaceutical engineer develops a new drug that regulates iron in the blood. Suppose she finds out that the average sugar content after taking the medication is the optimal level. This does not mean that the drug is effective. There is a possibility that half of the patients have dangerously low sugar content while the other half has dangerously high content. Instead of the drug being an effective regulator, it is a deadly poison. What the pharmacist needs is a measure of how far the data is spread apart. This is what the variance and standard deviation do. First we show the formulas for these measurements. Then we will go through the steps on how to use the formulas.

We define the variance to be

and the standard deviation to be

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x-\bar{x})^2$$

Variance and Standard Deviation: Step by Step

1. Calculate the mean, x.
2. Write a table that subtracts the mean from each observed value.
3. Square each of the differences.
4. Add this column.
5. Divide by n -1 where n is the number of items in the sample This is the variance.
6. To get the standard deviation we take the square root of the variance.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x-\bar{x})^2}$$

15.1 COLLECTION OF DATA, PRESENTATION

DeFInitions

Statistics: Techniques used to collect, organize, analyse and interpret data.

Example: Collect data on height, age, number of years in university education, distance from home, approximate time to get to school, gender, hometown.

Data: can be quantitative, expressed numerically, or qualitative.

Descriptive Statistics: Techniques used to summarize and describe data.

Inferential Statistics: Techniques used to make decisions about statistical populations based only on sample observation.

Sample statistic: measured characteristic of a sample.

Population parameter: measured characteristic of a statistical population.

Discrete variable: The values of the discrete variable can be listed. The values are usually generated by counting.

Examples: the number of cars arriving at a crossing, the number of defective items in a lot, age, number of years in university education.

Continuous variable: The values of the continuous variable can take any value in an interval. They are generated usually by measuring.

Examples: The height of students in a specified school, the temperature at a fixed point, time to get to school, distance from home.

Obtaining data: by direct observation, or by setting up a statistical experiment where there is control over some of the factors that may influence the variable studied.
Examples:
Observation: measuring temperature.
Statistical Experiment: the effect of a drug checked by giving the drug to one group and placebo to the other group.

Random Sampling: Type of sampling where every member of the population is equally likely to be chosen for inclusion in the sample.

Example: We number students in the class. Using a table of random numbers or computer choose a simple random sample of students.

A sample obtained through random sampling is representative of the population, therefore it is the best for inferences.

What is Data Collection?

Data Collection helps your team to assess the health of your process. To do so, you must identify the key quality characteristics you will measure, how you will measure them, and what you will do with the data you collect. What exactly is a key quality characteristic? It is a characteristic of the product or
service produced by a process that customers have determined is important to them. Key quality characteristics are such things as the speed of delivery of a service, the finish on a set of stainless steel shelves, the precision with which an electronic component is calibrated, or the effectiveness of an administrative response to a tasking by higher authority. Every product or service has multiple key quality characteristics. When you are selecting processes to improve, you need to find out the processes, or process steps, that produce the characteristics your customers perceive as important to product quality.

Data Collection is nothing more than planning for and obtaining useful information on key quality characteristics produced by your process. However, simply collecting data does not ensure that you will obtain relevant or specific enough data to tell you what is occurring in your process.

What Is Data Collection?
Data Collection is obtaining useful information.
The issue is not: How do we collect data?
It is: How do we obtain useful data?

Why Collect Data?
To establish a factual basis for making decisions
I think the problem is . . .
Becomes
The data indicate the problem is . . .

Making a Data Collection Plan
Why do we want the data?
What purpose will they serve?
Formulate your change statement:
If . . . then . . .

Making a Data Collection Plan
Where will we collect the data?
- Refer to the process Flowchart
- Identify steps where you expect changes
- Take data at those steps and at the end of the process

What type of data will we collect?
Attribute data: Presence or absence of a characteristic
Variables data: Specific measurement

Who will collect the data?
Workers who perform the process steps
Properly trained
Provided with resources

How do we collect the right data?
Small sample sizes
Collect frequently
Dependent on availability of data, cost, consequences

Data Collection Problems
Failure to establish Operational Definitions
-When and how often to collect data
-How to collect data
-Units of measurement
- Criteria for defects
-Handling of multiple defects

Adding bias to the collection process
-Slowdown or speedup
- Fear
-Errors in procedures
-Missing data

Uses for Checksheets
Record data for further analysis
Provide historical record
Introduce Data Collection methods

Types of Checksheets
-Tabular Format
-Location Format
-Graphic Format

Making a Useful Checksheet
-Tailored for specific purpose
-Workers help develop form
-Columns labeled clearly
-User-friendly format

PRIMARY DATA

Primary data are those which are collected for the first time and are always given in the form of raw materials and originals in character. These types of data need the application of statistics methods for the purpose of analysis and interpretation. While secondary data are those which have already been collected by someone and have gone thought the statistical machines. They are usually refined of the raw materials when statistical methods are applied on primary their shape and become secondary data.

Methods of Collection of Primary Data:

The primary data are collected by the following methods.

1. Direct personal investigation.
2. indirect personal investigation
3. Investigation thought questionnaire.
4. investigation through questionnaire in the charge if enumerator
5. Investigation through local's reports.

COLLECTION OF SECONDARY DATA

The secondary data are those which have already been collected by someone other than the investigator himself, and as such the problems associated with the original collection of data do not arise here. The secondary data can be collected directly either form published or unpublished sources.

The following are the sources of published at from which secondary data can be collected.

1. Official publications, i.e. the publication of the central statistical office, Karachi ,Ministry of Finance , Ministry of Food, Agriculture, Lahore, Industry, etc… the provincial statistical Bureau, etc.

2. Semi-Official publications , etc., the publication issued by the state Bank of Pakistan Railway Board , Board of Economic Enquiry , District councils, Municipalities, Central Cotton Committee, etc

3. Publication of trade-association, chambers of commerce, co-operative societies, and unions.

4. Research publication, submitted by research workers, economists, University bureaus,and other institutions.

5. Technical or trade journals.

15.2 ANALYSING, INTERPRETATION OF DATA

TABULATION & GRAPHS

Tables
After collected, the data is often grouped into classes.

Example: use the collected data to prepare classes, record the number of items in each class (frequencies), divide each frequency with the total (relative frequency), and prepare the corresponding tables.

Frequency Distribution Table: contains the classes, frequencies, shows the frequency distribution.

Relative Frequency Distribution Table: contains the classes, relative frequencies, shows the relative frequency distribution.

Remark: Each data value has to be in exactly one class.
Usually there are 5 to 20 per class.

Graphs
Display frequency, relative frequency tables graphically.

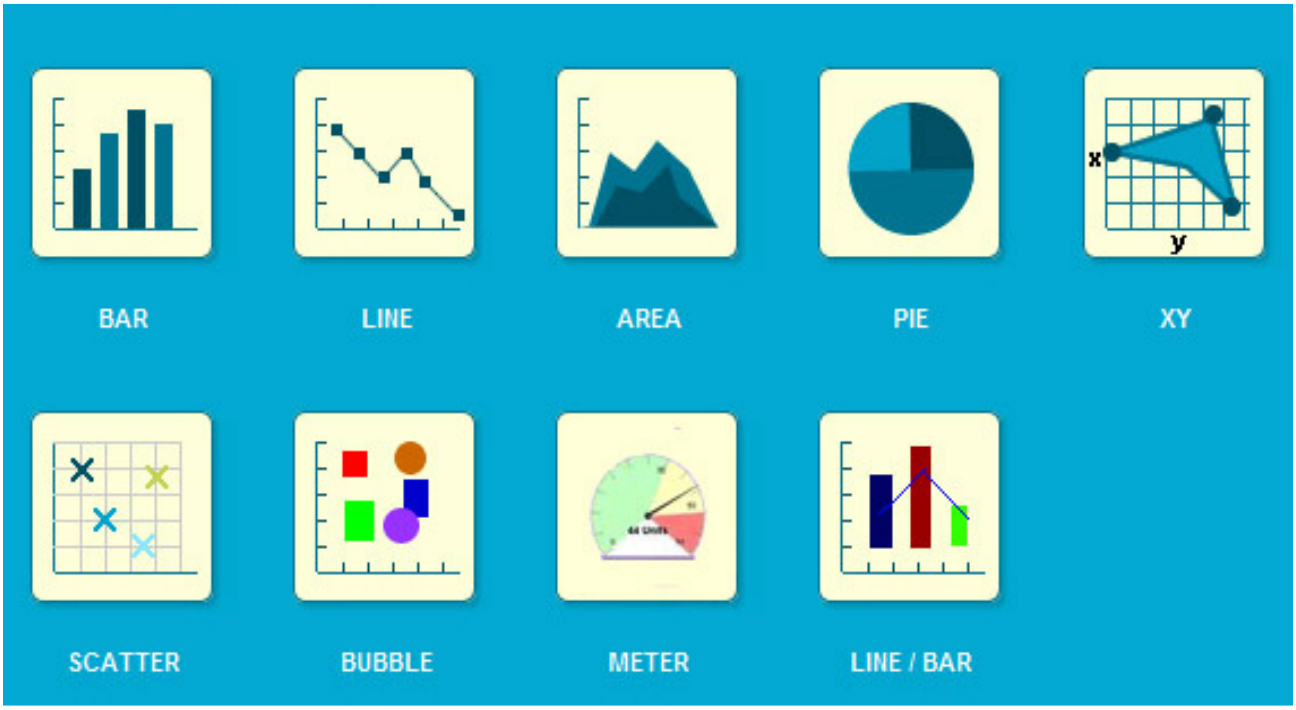
Histogram: Bar graph of a frequency (relative frequency) distribution.
Frequency polygon: line graph of the frequency distribution, connecting the points determined by the midpoint and frequency of a class.

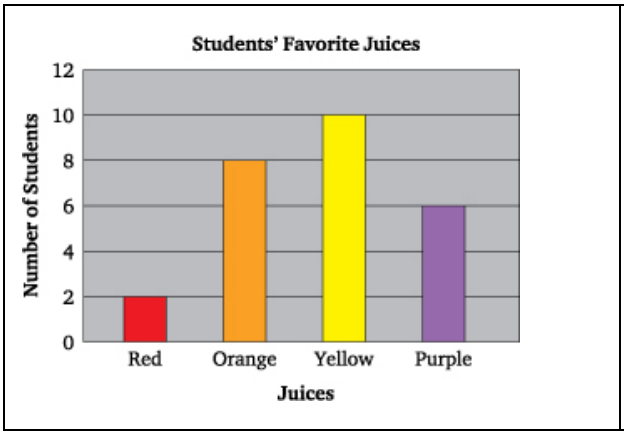
Cumulative frequency distribution: identifies the cumulative number of observations below the upper limit of the classes.
Ogive: Line graph of the cumulative frequency distribution.
Ogive curve: Smoothed ogive.

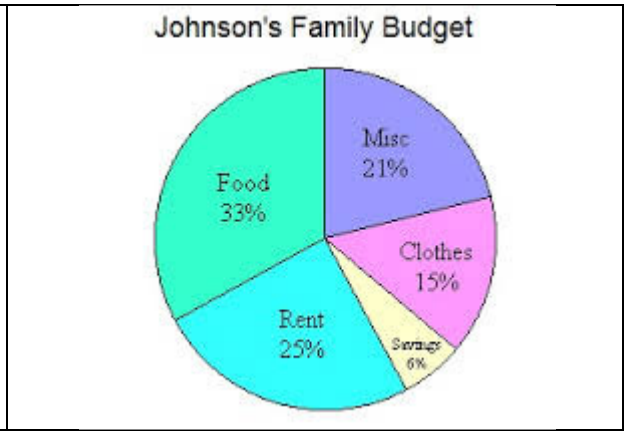
Shape of Graphs

The shape of frequency curves can be:
Symmetrical: skewness measure is zero.
Positively skewed: nonsymmetrical with the tail to the right, the skewness measure is positive.
Negatively skewed: nonsymmetrical with the tail to the left, the skewness measure is negative.

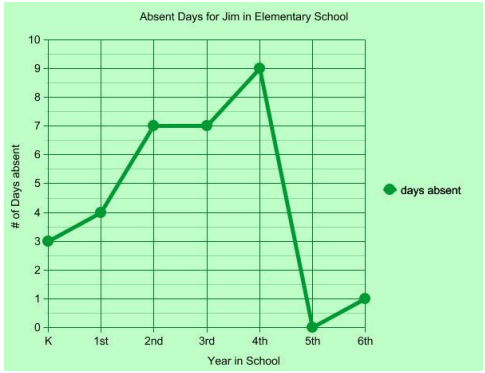
TYPES OF GRAPHS








Product Y
$12,000
$23,000
$21,000
$30,000
17,000
$30,000


Absent Days for Jim in Elementary School
# of Days absent
0
1
2
3
4
5
6
7
8
9
10
K
1st
2nd
3rd
4th
5th
6th
Year in School
days absent