7

WORK DESIGN

Introduction

Work is the basic source of our livelihood. It also nourishes the human personality. We regard work differently at different points of time. Our attitude towards work changes from time to time, and is different from culture to culture. Perhaps these days in advanced societies, work has lost the central position it used to occupy in human life, thanks to other cultural, social, aesthetic and leisure pursuits. In India, however, work still is in the centre-stage, and, there is talk of making the right to work a fundamental constitutional right. Work systems set boundaries to what must be managed. Work systems result from people-machines interface or technical competence and equipment interface. This interface is in an organizational context to achieve certain objectives. **Work Design** is the study and design of a work system in an organizational context. Work to begin with, was considered in technological terms. Social scientists later modified the concept in favour of a behavioural angle. Technologically, work is viewed as tools, techniques and methods used for production of finished goods. The economic concept of work is associated with wages and employment. Work design seeks to increase productivity by seeking better and less expensive ways to perform the functions/tasks. Benefits of improved productivity are available to employees, managers, shareholders, consumers and people at large.

We assume in a production unit work exists and so do the work problems originating at individual work stations. The man-material-machine combination is the focus of any work problem. This is a part of the entire organisation/work system. Work system is sub-system of a larger super system. Work systems mostly are open, and there are actions-reactions in them, depending upon the values associated with the work systems. Moreover, there is the work method which is important for Work Design. Work design is a systematic investigation of desired and present work systems to get the ideal work systems and methods.

Assumptions of Work Design

(1) Work systems try to improve productivity and effectiveness.

(2) Work systems are in the three states — design, betterment, improvement.

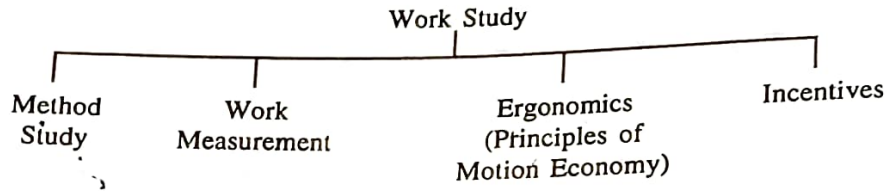
(3) Work design considers all aspects of the work system.

(4) Work design integrates abilities and talents.

Work design goes beyond a set of techniques, since work systems need continuous monitoring. A system is a collection of parts that form a whole. The objectives could be increased productivity and higher effectiveness. Work study is one of the techniques of enhancing productivity. Work study should be applied properly with due support from employees and management to enhance productivity. Work study guides us about how the jobs should be done and how long they should take.

Work Study Approach

Work study can be diagrammatically presented as follows:



Work Study is defined as a technique that embraces method study and work measurement which are employed to ensure the best possible use of human and material resources in carrying out the specified activity.

The main objective of WS is to improve productivity of men, machines and materials.

Method Study is the systematic recording and critical examination of existing and proposed ways of doing work as to develop/apply easier/more effective methods and to reduce costs. It investigates how jobs are done and how the method of doing them can be improved.

Work Measurement is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance. It tries to estimate how long jobs should take once the method is decided.

Both the above concepts — Method Study and Work Measurement — are closely linked. The former intends to reduce the work-content, and the latter establishes time standards on the basis of work-content as determined by the former. Generally, a method study precedes work measurement. In some instances, time standards do indicate occurrence of ineffective time in work sampling for corrective action in anticipation of method study. Time study also enables comparison of alternative methods.

Basic Work Study Procedure

WS consists of eight basic steps, some of which are common to both method study (MS) and work measurement (WM).

Sr. No.	Basic Step	MS	WM
1.	Select	✔	✔
2.	Record	✔	✔
3.	Examine	✔	✔
4.	Develop	✔	—
5.	Measure	—	✔
6.	Define	—	✔
7.	Install	✔	—
8.	Maintain	✔	—

Thus, Method Study (MS) has six steps:

(1) SELECT the job to be studied.

(2) RECORD how it is performed right now.

(3) EXAMINE the existing method critically.

(4) DEVELOP an improved method

(5) INSTALL the improved method

(6) MAINTAIN it in practice.

The acronym SREDIM will help you to remember the steps.

To conduct MS, we should have conducive human relations climate, top-management support, supervisory co-operation. WS, if properly applied, tends to improve industrial relations. WS should not be conducted amidst an atmosphere of distrust. Skilled seniors may resist changes. WS results may render some workers redundant, leading to retrenchment/redeployment/ transfer. In developing countries, this causes the greatest anxiety. In the long run, however, the technique benefits all. WS is to be conducted by a properly qualified person, who can win confidence of both the supervisiors and the workers. He should be able to deal with people. WS results are to be applied with tact.

Let us now examine MS, focusing our attention on those steps which improve effectiveness and productivity. We shall postpone the discussion of technicalities like physical environment, therbligs, motion economy etc. to a subsequent chapter.

METHOD STUDY

Diagrammatically, the Method Study (MS) procedure is illustrated hereunder:

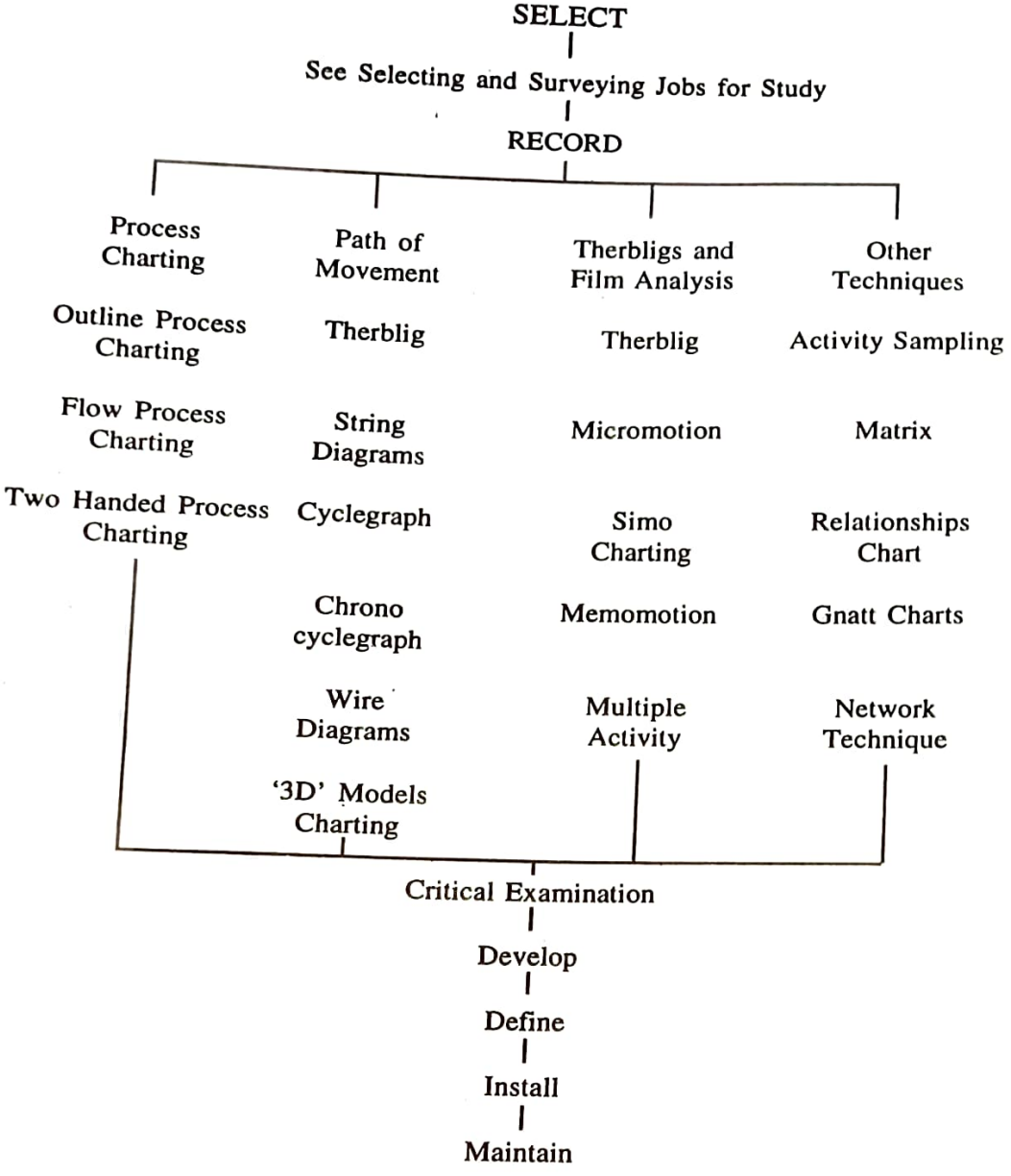


Fig. 7.1 Guide to Method Study Procedure

Introduction

There is always an improvement possible in a process.

Method study involves the breakdown of an operation into its component elements and the elements are analysed.

The method study men should have

(1) The desire and the determination to produce results

(2) The ability to produce results.

(3) An understanding of the human factors involved.

Factors to be considered while having Method Study

(*i*) Economic considerations

(*ii*) Technical considerations

(*iii*) Human reactions.

Analytically, method study involves basic procedure of SELECT — RECORD — EXAMINE — DEVELOP — INSTALL — MAINTAIN, sequence.

— The merit of the basic procedure is that, whatever be the job or its size, it can be approached and dealt with on a common pattern.

— The RECORD step is an important step and should be carried out with accuracy, because further study depends on the recorded data. If the recorded step is inaccurate, the whole process of critical examination and developed method may fail.

— The critical examination is the Heart of the method study procedure.

Examination makes a systematic analysis of the purpose, place, sequence, person and means involved at every stage of the operation.

The following questions are considered for the examination step:

(*i*)	(*a*) What (is achieved)?	(*b*) Why (is it necessary)?
(*ii*)	(*a*) How (is it done)?	(*b*) Why (that ways)?
(*iii*)	(*a*) Where (is it done)?	(*b*) Why (there)?
(*iv*)	(*a*) When (is it done)?	(*b*) Why (then)?
(*v*)	(*a*) By whom (is it done)?	(*b*) Why (that person)?

The answer to the question why? leads to the consideration of other alternatives.

In this way methods will be adopted that are completely assured to be not only economically sound and technically correct, but are based on sound physiological and psychological principles and above all make a positive contribution to the value of the produce.

Method Study Objectives

The first step in carrying out a work study is the method study of the work under consideration.

Definition

Method Study is the systematic recording, analysis, and critical examination of the methods and movements involved in the performance of existing or proposed ways of doing work, as a means of developing easier and more productive methods.

Method study is essentially concerned with finding better ways of doing things, and it contributes to improved efficiency by getting rid of unnecessary work, avoidable delays and other forms of waste. **This is achieved through:**

(*a*) Improved layout and design of factory, plant and work place, (*b*) Improved working procedures, (*c*) Improved use of material, plant and equipment and manpower, (*d*) Improved working environment, (*c*) Improved design or specification of the end product.

The techniques of method study aim at doing three things:

(1) To reveal and analyse the true facts concerning the situation, (2) To examine those facts critically, (3) To develop from the examination of the facts the best answer possible under the circumstances.

[The value of methods study is due to the flexibility with which the technique may be used in different situations].

Basic Procedure

There is a simple framework for application in any circumstances.

SELECT: The work to be studied.

RECORD: All the relevant facts of the present (or proposed) method.

EXAMINE: Those facts critically and in sequence systematically.

DEVELOP: The most practical, economic and effective method having due regard to all contingent circumstances.

INSTALL: That method as standard practice.

MAINTAIN: That standard practice by regular routine checks.

The Function of Method Study

Method study does not replace the ability to make the best use of available information; the inventive genius or the organising ability necessary to develop new methods. What the analytical approach of method study does, by its carefully planned sequence of analysis, **is to show where change is likely to be most effective by highlighting unnecessary activities and showing where improvements are possible.**

In this way thoughts are directed into channels likely to be profitable, and any inherent flair for improvements the members of the work study team may possess stands the best chance of finding full expression. **Thus, method study enables the ordinary man to improve methods and at the same time avoid the dangers of taking 'short cuts'.**

(1) Selecting Jobs for Study

Cost is the usual basis for the selection of operations, sections or departments likely to benefit from method study. **The following defects in an organisation indicate where method study is likely to bring worthwhile savings:**

(1) Poor use of materials, labour or machine capacity, resulting in high scrap and reprocessing costs.

(2) Bad layout or operation planning, resulting in unnecessary movement of materials.

(3) Existence of bottlenecks. Work begins to pile up.

(4) Inconsistencies in quality.

(5) Highly fatiguing work.

(6) Employees' complaints about their work without logical reasons. Labour discontent.

(7) Workload is unevenly distributed. Some workers are over-burdened, and get excessive over-time and some are under-loaded with a lot of spare time.

(8) Areas of high accident rate.

(9) Bad quality of work.

The question is whether a change is likely to achieve the following results sufficiently to make the cost of the study worth while:

(1) Increase production and reduce costs.

(2) Maintain it with less labour, materials or equipment.

(3) Improve quality without additional labour or equipment.

(4) Improve safety conditions.

(5) Improve standards of cleanliness and house-keeping.

(6) Reduce scrap.

When all these matters have been weighed up in the light of the economic importance of a task and its expected life, the manager should be able to select the work to be investigated.

The manager should also list the objectives for the study in order of priority. (Danger of going too far and carrying the study to uneconomic limits must be avoided).

Both in selecting objectives on the larger scale [e.g. a whole company or plant] and in choosing the economically appropriate methods, mathematical techniques like "Operational Research" are used hand in hand with method study.

Once a job is selected for method study, we have to make an official record of:

(*i*) The name of the job to be investigated.

(*ii*) Objectives of this investigation.

(*iii*) Accountability for this investigation.

(*iv*) Resources available for this investigation.

(*v*) Person authorising the investigation.

Having selected the job and getting it approved for method study, we should communicate this to all concerned outlining the logic behind the study. Method Study becomes successful if everyone involved extends to it the necessary co-operation.

(2) The Need for Records

In order that the activities selected for investigations may be visualised in the entirety, with a view to improving them by subsequent critical analysis, it is essential to have means of placing on record all the necessary facts of the existing method.

A record is also essential if a before-and-after comparison is to be made to assess the effectiveness of the investigation and the subsequent installation of the new method.

It is tedious and costly to jot down every small detail about a particular job. It is, therefore, convenient to use charts and phonographic or electronic methods of recording.

Recording Techniques

According to the nature of the job being studied, and the purpose for which the record is required, the technique chosen will fall into the following categories.

(1) Charts (for process and time records)

(2) Diagrams and models (for path of movement records)

Charts

Charts are often used to record the facts due to their simplicity and economy.

(1) Outline process chart	—	principal operations and inspections.
(2) Flow process chart	—	activities of men, materials or equipment.
(3) Two handed process chart	—	activities of worker's two hands.
(4) Multiple activity chart	—	activities of men and/or machine on a common time scale.
(5) Simultaneous motion cycle (simo) chart	—	activities of a worker's hands, legs and other body movements on a common time scale.
(6) Travel chart	—	movements of materials between departments.

Diagrams & Models

(1) Flow and string diagrams	—	path of movement of men, materials or equipment.
(2) Two and three dimensional models	—	layout of work-place or plant.
(3) Cycle graphs and Chrono cycle graphs	—	high speed, short cycle operations.

Whatever type of chart or diagram is prepared, great care should be taken to ensure that the information it portrays is easily understood and recognised. **The following information should always be provided:**

(1) An adequate description of all the activities or movements entailed in the method.

(2) Whether the present or proposed method is shown.

(3) The specific reference to where activities begin and end.

(4) The time and distance scales used, where applicable.

(5) An explanation of any abbreviations or special devices.

(6) The date of construction of the chart or diagram.

Process Charting

The job or process under investigation often consists of a number of activities. It is with a view to listing them conveniently, we use symbols as a short-hand.

The modern system of process charting is an adaptation of one of Gilbreth's later developments in motion study technique. Originally Gilbreth used a large number of symbols, 'as a device for visualising a procedure as a means of improving it.' Later, in 1947, the American Society of Mechanical Engineers reduced the number of symbols and standardised the technique to its present form. The British definitions are as follows:

Process Charts: Charts in which a sequence of events is portrayed diagrammatically by means of a set of process chart symbols to help a person to visualise a process as a

means of examining and improving it. We can devise our own symbols. However, we follow standardised symbols developed by A.S.M.E. since 1947.

Process Chart Symbols

Symbols used for recording the nature of events.

Operation		Indicates the main steps in the process, method, or procedure. Usually the part, material, or product concerned is modified or changed during the operation.
Transport		Indicates the movement of workers, materials or equipment from place to place.
Permanent		Indicates a controlled storage in which material is received into or issued from a stores under some form of authorization, or an item is retained for reference purposes.
Temporary Storage or Delay		Indicates a delay in the sequence of events, for example, work waiting between consecutive operations, or any object laid aside temporarily without record until required.
Inspection		Indicates an inspection for quality and/or a check for quantity. (This covers measuring, weighing or looking for some aspect of quality).
Combined		Combined activity occurs simultaneously. Various combinations are possible.
Activity		Combined activities can be shown by superimposing their respective symbols so that the outer symbol represents the major activity.

Types of Process Charts

Outline Process Chart (Operation Process Chart): It give the bird's eye-view of the whole process by recording in sequence only the main **operations** and **inspections**. It, therefore, **uses only operations and inspection symbols.**

Fig 7.2 gives an example of outline process chart.

Specify

(1) Type of chart.

(2) Job concerned and whether it is the present or proposed method.

(3) Date of study and name of observer.

(4) Where chart begins and ends.

Include

(5) Adequate and accurate description of all activities on the right-hand side of the symbol concerned.

(6) Number each activity for identification purposes by placing the numeral within the symbol. The convention for doing this is implied by the chart.

(*a*) Each class of symbol is numbered in its own sequence.

(*b*) Numbering begins on the main line of activities which is always placed on the right-hand side of the chart.

(c) The numbering sequence continues until there is a junction with a subsidiary line, when it jumps to the top of this subsidiary and proceeds downwards from there. The same convention is applied when meeting all other junctions. When combined symbols are used, the first number applies to the outer symbol.

Reconditioning of Brake Shoes: Outline Process Chart

Method: Present — Location:

Charted by: Name of the observer — *Chart begins:* Inspection Pit

Date — *Chart Ends:* Road test

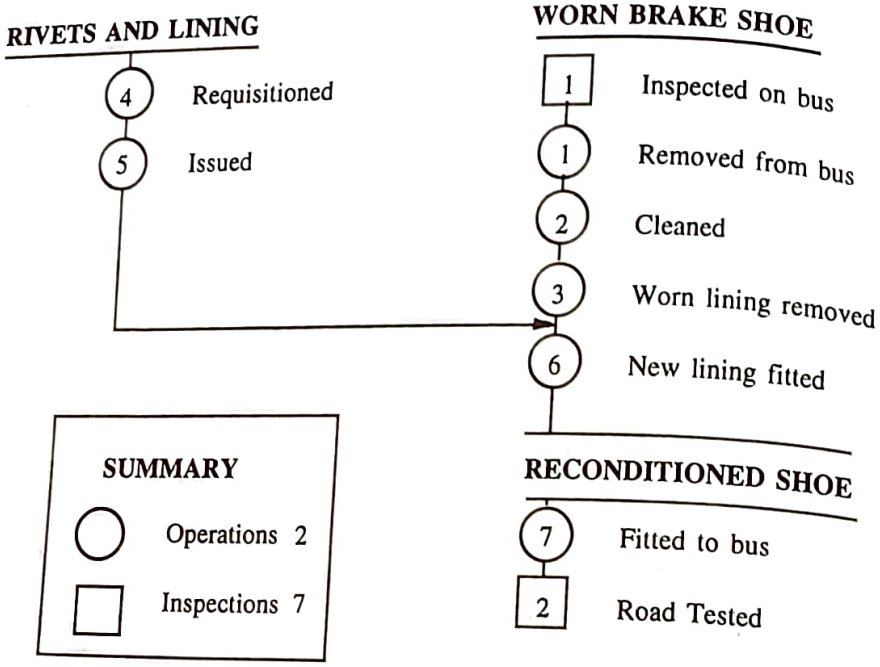


Fig. 7.2 Outline Process Chart

(7) Date concerning time, distance, weight, or quantity are shown on the left-hand side of the symbol it refers to.

(8) A summary of activities is shown at the bottom left-hand side of the chart.

(9) Use the same scale of breakdown in the analysis of activities so that the comparison of present and proposed methods will not be distorted by appearances.

(10) Neatness and clarity in the layout of the chart helps to simplify the process of critical examination.

The outline process chart gives an overall view of a process, from which it can be decided whether a further and more detailed record is needed. It is a graphic representation of the points at which materials are introduced into a process, and of the sequence of all operations and inspections associated with the process.

The chart does not show where work takes place, or who performs it, and since it is concerned only with operations and inspections, only two of the five recording symbols are used.

In the design stage, where it is increasingly the practice to use work study, outline process charts are often used to assist in the layout of plant, and in the design of the product or the machinery for making that product. The charts can be made to record the basic data, which can then be subjected to the complete method study procedure while still on the drawing board. Features in the design of a product which are wasteful of materials or labour can often be eliminated and it is frequently the case that expensive equipment, which otherwise might have been bought, proves unnecessary in the light of the investigation.

Construction of the Chart

A start is made by drawing an arrow to show the entry of the main materials, writing above the line a description of the component, and below the line a description of the condition.

As each operation inspection takes place, the symbol is entered and numbered in sequence, with a brief description to the right and if required, a note of the time taken on the left.

During an assembly process, the major process is charted towards the right hand side of the chart and subsidiary process on to its left. These are joined to each other and to the main trunk at the place of entry of the materials or sub-assembly.

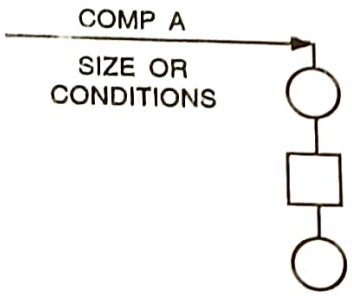


Fig. 7.3

Flow Process Chart

The flow process chart is an **amplification** of the outline process chart, in which it shows transports, delays and storage as well as operations and inspections. It gives a detailed picture of the process by showing all the activities in sequence. It can express the process in terms of the events as they affect the material being processed, or it can express the process in terms of the activities of the man or the use of certain types of equipment.

Flow process charts recording simultaneous activities of two or more subjects can be presented alongside each other on the same sheet of paper to indicate more clearly their interdependence.

It is essential however, that only the activities of the particular subject to which it refers, either man, materials or equipment, are recorded on any single chart.

Construction of the Chart

The conventions used in the construction of the chart and the method of construction are the same as for the outline process chart, except that all five symbols are used. It is usual for distance to be recorded on the left of the symbol for transport in the same way

as time can be recorded against operations. The total distance can then be entered at the root of chart.

Amplifying the Chart

The value of a flow process chart as record may be increased by making full use of coloring and hatching in order to show up some particular aspect of a process. The transport symbol may be used to show movement in one direction or another by altering the way it faces.

When a particular activity extends over a large area covering different work places, a clear understanding of what is done at each is obtained if they are separated on the chart. The movement between the sections concerned is also brought out.

Types of Flow Process Charts

(i) Material or Product type records what happens to material or product.

(ii) Man type which records what the worker does.

(iii) Equipment type which records show how the equipment is used.

The following diagram illustrates Material type of Flow Process chart:

Sr. No.	*Activity*	○	□	▽	D	⇨	*Remarks*
1.	There is casting in foundry store						
2.	It travels to cutting machine						Material handing equipment (trolley) used for 25 mtrs.
3.	Cutting machine setting: Wait						
4.	Risers cut						
5.	Wait for trolley						Trolley used for 20 mtrs.
6.	Travels to machine shop						
7.	Inspection before machinery						
	Summary						

Fig. 7.4 Flow Process Chart (Material)

Mostly flow process charts are either man/material/equipment type, but there are some combined flow process charts making use of three resources – man, material and equipment.

One more process chart is used in Organisation and Methods (O & M) called **Form Process Chart** which graphically represents the flow of paper-work form. The focus is on one or more forms. It shows operations, movement, storage, inspection, verification and disposal of all forms charted, and information flow between these forms.

Two-Handed Process Chart

Work confined to a single work-place often consists of the use of hands and arms only, and the two handed process chart gives a **synchronized** and graphical representation of the sequence of manual activities of the worker. Recording is made by the ordinary symbols with **omission of the inspection symbol**, since inspection will be shown as movements of the hands. They can be labelled as inspection by bracketing such movements and writing the word in. The ∇ symbol implies **HOLD instead** of **storage.**

A two-handed process chart is made up of two columns in which are recorded the symbols representing the activities of the left hand and the right hand respectively. They are inter-related by aligning the symbols on the chart so that simultaneous movements by both hands appear opposite each other. A brief description of the activities represented by the symbols should be inserted.

Movements of the two feet can be recorded by making two additional columns.

The use of two-handed process charts is limited by the comparatively broad meaning of the symbols and the fact that neither, paths of movement, nor detailed movements of hands and arms are shown. They do, however, help to assess whether the expense of the detailed micromotion analysis is justified.

Two Hand Process Chart – Operations Only

Where only an overall picture of the activities at the work place is required, the activities of the hands will be described solely in terms of operations.

Two Handed Process Chart in Full Detail

If more detail is required for the study, then the symbols for transport and delay and hold will also be used.

The two handed process chart is given below: (See Fig. 7.5)

Two-Handed (LH – RH) Process Chart
Job: Dismantling of 15 ampere electric plug,

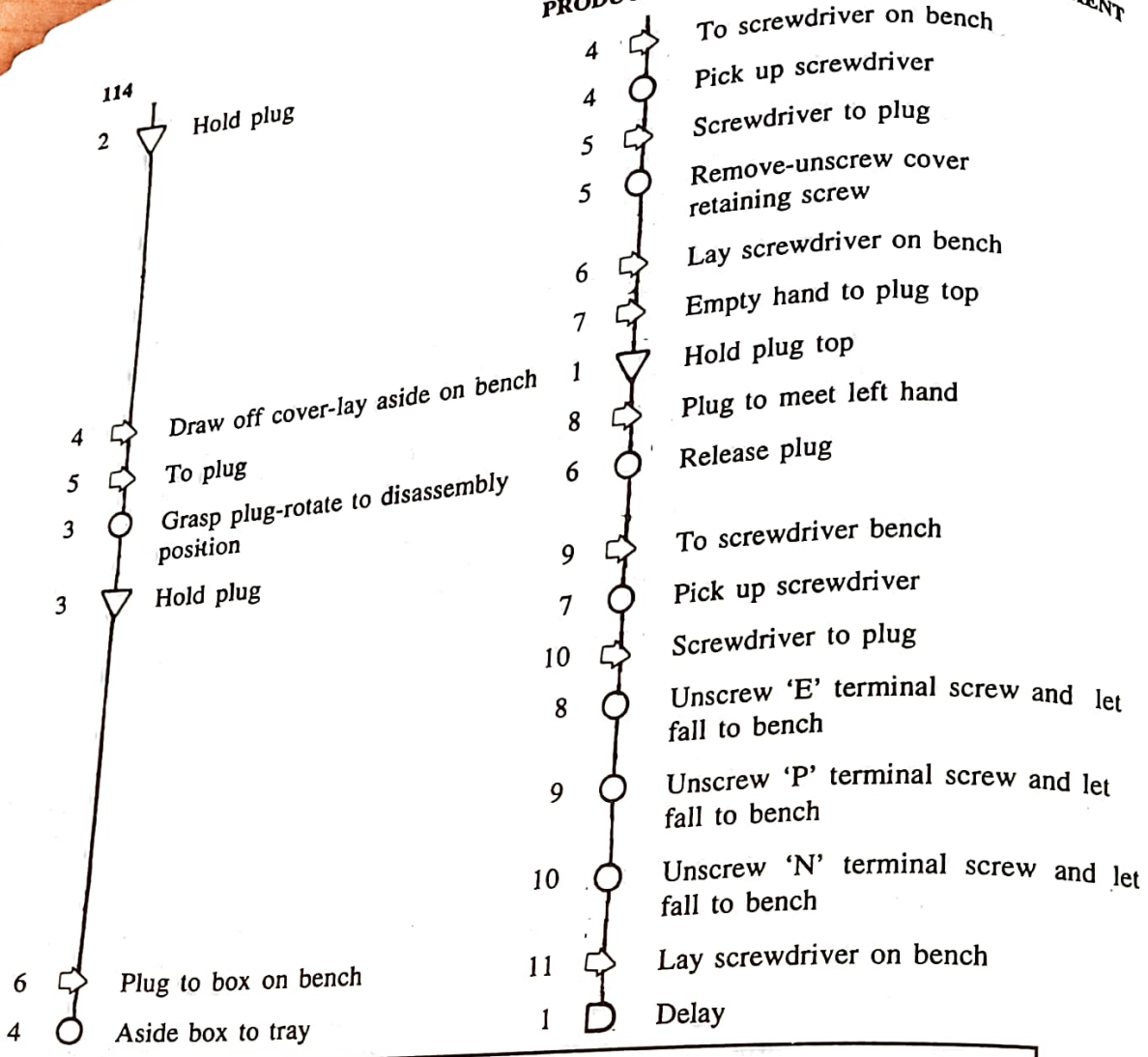
Chart Begins: Hands empty plug top in carton

Chart Ends: Hands empty plug top dismantled

Details of present method

Charted by . . . . . .
Date . . . . . .

	Left Hand	*Right Hand*
1	Delay	
1	To meet right hand	To carton on bench
1	Grasp carton	Pick up carton
1	Hold carton	To meet left hand
2	Draw off carton and toss aside	
3	To meet plug at right hand	Open lid and grasp plug
2	Grasp plug-rotate to disassembly position	Plug to left hand
		Release plug



SUMMARY			
LEFT HAND		RIGHT HAND	
Operation	4	Operation	10
Transport	6	Transport	11
Inspection	0	Inspection	0
Delay	1	Delay	1
Hold	3	Hold	1

Fig. 7.5 Two-Handed Process Chart

In the two-handed process chart, however, the symbols are used in a slightly different
way.

is used to represent **HOLD**. For example, the left hand might hold an electric plug while the right hand manipulates a screwdriver to tighten a screw. Thus, the activity of the left hand would be described by the **HOLD** symbol.

the delay symbol is used to show that a particular hand is idle at a certain time.

The conventions peculiar to this type of chart are implied by Fig. 7.5 Exact identification of the symbol with the action it represents is essential, and if the observer desires, a sketch plan of the work place layout can be included at the top of the chart to make the analysis of motions more meaningful. The chart itself shows a column of symbols for the left and right hand respectively. These symbols are positioned so that the simultaneous motions of the left and right hands are indicated by parallel symbols. Thus, in Fig. 7.5 operation 2 (L.H) is carried out at the same time as operation 3 (R.H.)

Constructing the chart usually starts by plotting the activities of the hand that does the most work. Then, the observer turns his attention to putting the symbols for the other hand in their right places. Mostly the movements being recorded are small and fast, so it is preferable, with this type of chart, to start at the top, with the earliest activity and work downwards. Another example of two-handed process chart follows.

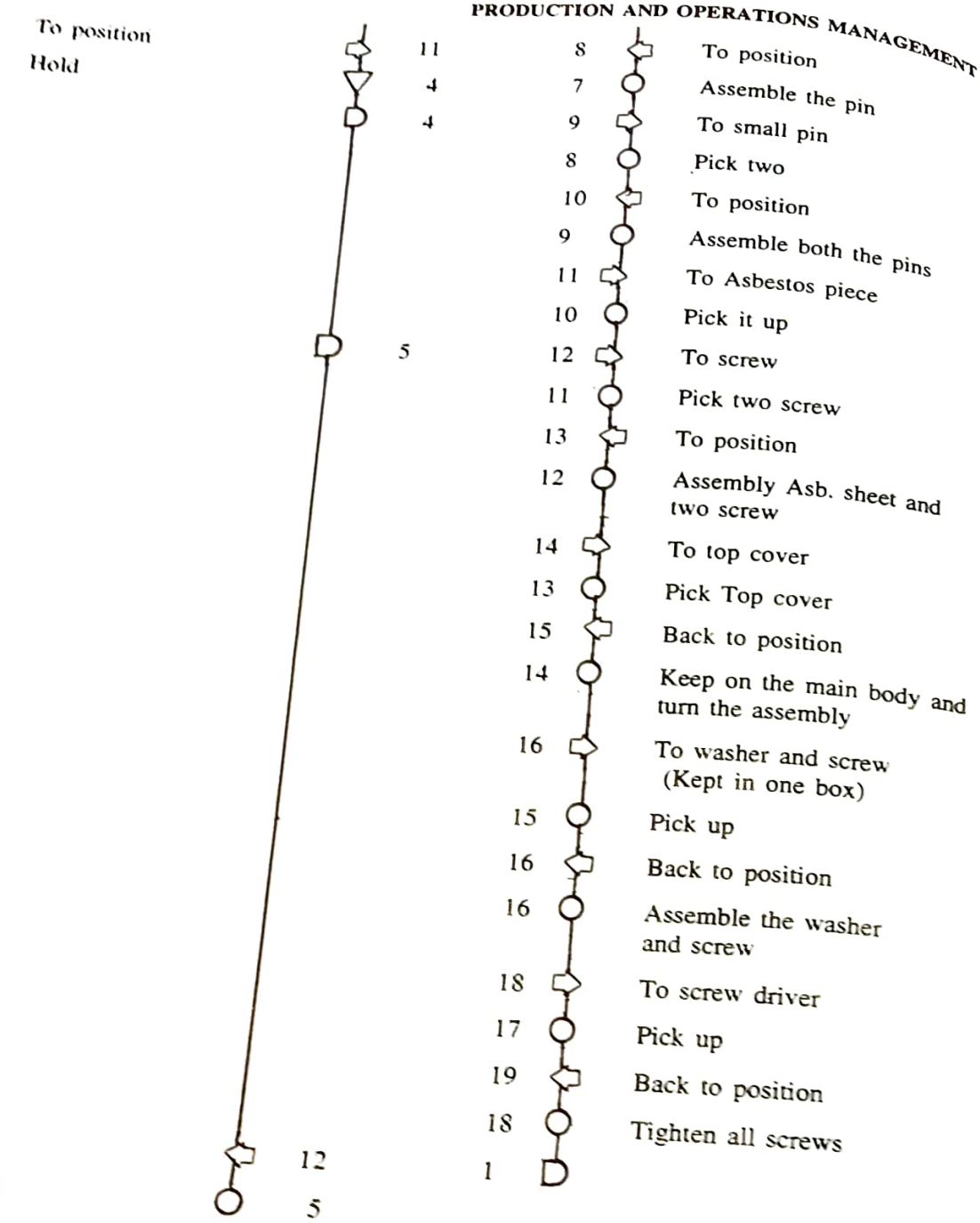
TWO-HANDED PROCESS CHART

Job: Assembly of 3 Pin Electrical Plug

Chart begins: Hands empty: Material in boxes

Chart ends: Completed assembly aside to box.

LH			RH
To large pin	1	1	To screw
Pick up large pin	1	1	Pick up screw
To position	2	2	To position
Hold	1	2	Assemble the screw
To box	3		
Delay	1		
To position	4		
To small pin	5	3	To screw
Pick up small pin	2	3	Pick up screw
To position	6	4	To position
Hold	2	4	Assemble the screw
To box	7		
Delay	2		
To position	9	6	To position
To main body	10	7	To assemble large pin screw
Pick the main body	4	6	Pick the assembled large pin and screw



L.H

Operation	=	5
Transport	=	12
Hold	=	4
Delay	=	5

R.H

Operation	=	18
Transport	=	19
Hold	=	0
Delay	=	1

Fig. 7.6 Two Handed Process Chart