UNIT 12: WORK STUDY

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12.1 LEARNING OBJECTIVES

After going through this unit, you must be able to:

- explain the basic concept of Work Study
- explain the foundation and components of Work Study
- describe the Time Study standards
- explain the basic concept of Work sampling

12.2 INTRODUCTION

In this unit, we are going to discuss the concept of Work Study, Method Study, Time Study, foundation and components of Work Study,

Time Study standards, and Work sampling. Proper implementation of these concepts can play an important role in the production of any goods or in the delivery of any service. In fact, these concepts can lead to effective production process or service delivery process.

12.3 WORK STUDY

Work Study deals with the techniques of method study and work measurement which is employed to ensure the best possible use of human, machine and material resources in carrying out a specified activity.

Objectives of Work Study: The objectives of Work Study are:

(i) Ensuring effective use of plant and equipment

(ii) Ensuring effective use of human effort

(iii) Ensuring effective evaluation of human work

12.3.1 Components of Work Stury

Work Study comprises of the following broad areas/ components:

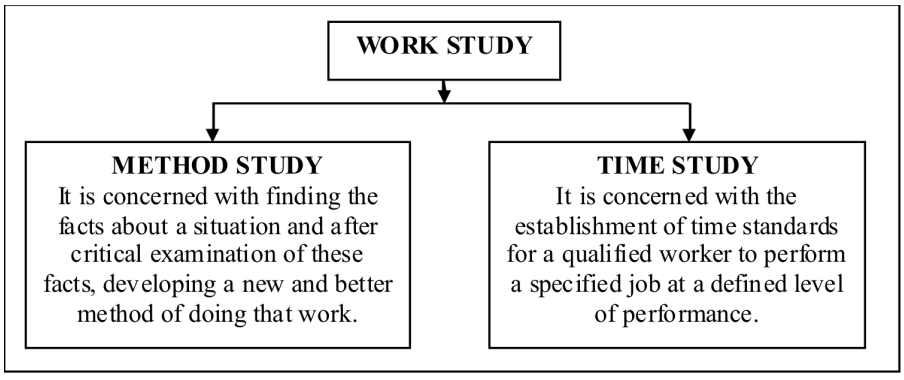


Figure 12.1: Broad areas of Work Study

Work Measurement: It is defined as the determination of the degree and quantity of labour in performing tasks.

The techniques of work measurement are as follows:

(i) Ignoring formal work measurement

(ii) Using historical data approach

(iii) Using the direct time study approach

(iv) Using the predetermined time study approach

(v) Using work sampling approach

(vi) Combination of approaches ii. and v.

12.3.2 Foundation of Work Study

Work study techniques may be employed to study processes or operations as well as for the study of people at work. Work consists of the basic work content plus content added as a result of:

(i) Defects in equipment

(ii) Shortages in knowledge and/or skill

(iii) Repair/ treatment/care methods used

(iv) Inefficient methods used

(v) Shortcomings in organizational or management, such as scheduling, resource allocation, location of supplies

(vi) Unproductive time management by workers

Work study examines work to identify the factors which contribute to the time required to perform the work. Work study is a systematic way to effect change and improve efficiency by applying the following steps (compare to the five steps of the scientific method listed previously):

(i) Observing the work being performed.

(ii) Identification of the factors contributing to performance time.

(iii) Reviewing work objectives and work constraints.

(iv) Formulating solutions and evaluate alternatives.

(v) Selecting the most efficient method of completing a work.

12.4 METHOD STUDY

Method Study is the systematic recording, analysis and critical examination of existing and proposed ways of doing a work and the development and application of easier and new production methods.

Areas of application of Method Study:

(i) Improved layout of office, working areas of factories

(ii) Improved design of plant and equipment

(iii) Improved use of materials, plant, equipment and manpower

(iv) Effective handling of materials

(v) Improved flow of work

(vi) Standardization of methods and procedures

(vii) Improved safety standards

(viii) Better working conditions

Steps in method Study:

(i) Selection of the work to be studied.

(ii) Recording all the relevant facts of the present (or proposed) methods by direct observation.

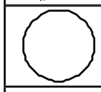
(iii) Examination of the facts critically in a sequence using special critical examination sheet.

(iv) Development of the best method in terms of practicality, economy and effectiveness under prevailing circumstances.

(v) Installation of that method as a standard practice.

(vi) Maintenance of that standard practice by regular routine check.

RECORDING TECHNIQUES		
Sr. No.	**Recording Technique**	**Information Recorded**
A	**Charts**	
	1) Outline process chart	Principle operations and inspection of the processes
	2) Flow process chart	Activities of men, material or equipment are analyzed into five events namely operations, transportation, inspection, delay and storage.
	3) Two handed process chart	Movement of the two hands or limbs of the operator.
	4) Multiple activity chart	Simultaneous/ interrelated activities of operators and/or machines on a common time scale.
	5) Simultaneous Motion Cycle (SIMO) Chart	Movement of body members of the operator, expressed in terms of *therbligs* on a common time scale.
B	**Diagrams and Models**	
	1) Flow Diagrams	Path of men, materials and equipments on a scale model
	2) String Diagram	Same as above except for the variations that it uses string to trace the path.
C	**Photographic Aids**	
	1) Cyclegraph	Movement of the hand obtained by exposing a photographic plate to the light emitted from the small bulbs attached to the operator's fingers.
	2) Chrono-cyclegraph	Modification of the cyclegraph in which recording is made using flash lights.

SYMBOLS USED IN PROCESS CHARTS		
Symbols	**Activity**	**Purpose for which it is used**
	Operation	It indicates the main steps in a process, method of procedure, usually the part, material or product concerned which is modified or changed during the operation.
	Transportation	It indicates movement of workers, materials or equipment from place to place.
	Inspection	It indicates any type of inspection, checks, measurement, and visual scrutiny for quality and/or quantity.
	Temporary Delay or storage	It indicates a delay in the sequence of the events.
	Storage	It indicates a controlled storage in which the material is received into or issued from the stores under some form of authorization or an item is retained for reference purposes.

Example 12.1: Process Chart related to manufacture of key ring:

Step A: Cutting key ring to the required shape and size from metal sheet

Step B: Making holes within the above key ring for fitting keys

Step C: Temporary storage for inspection of the exactness of the above cut key ring

Step D: Inspecting the exactness of the above cut key ring

Step E: Storage in warehouses

Step F: Final inspection before dispatch to distributors

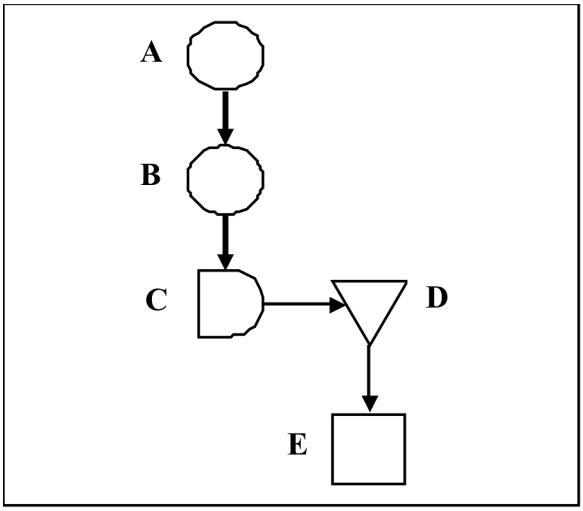


Figure 12.2: Process Chart related to manufacture of key ring

Principles of Motion Economy:

Principles of Motion Economy aim at the improvement of any method suing the ideas chosen from the alternatives thrown up during the critical examination phase of the method study. The following are the main principles of motion economy:

(i) Principles related to the use of the human body:

(a) The two hands should begin as well as complete their motion at the same time.

(b) The two hands should not be idle at the same time except during rest period.

(c) Motion of the arms should be made in the opposite and symmetrical directions and should be made simultaneously.

(d) Momentum should be employed to assist the worker,

wherever possible and it should be reduced to minimum if it must be overcome by muscular effort.

(e) Ballistic movements are faster, easier and more accurate than restricted or controlled movements.

(f) Rhythm is essential to the smooth and automatic performance of an operation and the work should be arranged to permit any easy and natural rhythm wherever possible.

(ii) Principles related to the arrangement of the work place:

(a) There should be definite and fixed for all tools and materials.

(b) Tools, materials and controls should be located close to the operator and directly in front of the operator.

(c) Gravity feed bins and containers should be used to deliver materials close to the pint of use.

(d) Drop deliveries should be used whenever possible.

(e) Materials and tools should be located to permit the best use of motions.

(f) The height of the workplace and the chair should preferable be arranged so that alternate sitting and standing at the workplace are easily possible.

(iii) Principles related to the design of tools and equipments:

(a) The hands should be relieved of all work that can be done more advantageously to a jig, a fixture or foot operated device.

(b) Two or more tools should be combined wherever possible.

(c) Tools and materials should be pre-positioned wherever possible.

(d) Where each finger performs some specific movements such as in typewriting, the load should be distributed in accordance with the inherent capacity of the finger.

(e) Handles such as those used on cranks and large screws should be designed to permit as much of the surface of the hand to come in contact with the handle as possible.

12.5 TIME STUDY

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

12.5.1 Time Study Standards

Time Study is of the following types:

(i) Direct Time Study: It is the work measurement that involves observing the job, determining the job cycle, stopwatch timing the job cycle and calculating a performance standard.

Steps in Direct Time Study:

(a) Selection of the job to be studied.

(b) Observing the time for an appropriate number of cycles.

(c) Determining the average cycle time (CT) = Total Time (?T) / No. of cycles

(d) Determining the normal time (NT) = CT (PR)

Where PR is the Performance Rating

Normal Time: It is average cycle time for a job adjusted by a worker rating to account for variations in normal performance.

(e) Determining the standard time (ST) = NT (AF)

Where AF is the Allowance Factor = 1 / (1 - % Allowance)

Allowance Fraction: It is the fraction of time lost on a job because of workers' personal needs, fatigue and other unavoidable delays; the remaining fraction of time is known as available fraction.

Standard Time: It is the ratio off normal time to the available fraction of time.

Example 12.2: In a company, a direct time study was done on a particular manufacturing operation. One industrial expert conducted the study and determined the cycle time (shown below). The expert engineer rated the worker 90%. The expert also used 12% allowance in the above case.

Cycle Time (min)	Number of times observed
12	2
14	1
15	1

From the above statement,

(a) Determine the normal time.

(b) Find the standard time.

Solution to Example 12.2: Given, for a company where a direct time study was done on a particular manufacturing operation by an industrial expert,

Performance Rating of the workers (PR) = 90% = 0.90

Allowance (A) = 12% = 0.12

Cycle Time (CT) =

Cycle Time (min)	Number of times observed
12	2
14	1
15	1

Let Average Cycle Time, Normal Time and Standard Time be indicated by ACT, NT and St respectively (all in minutes).

Calculation of the Average Cycle Time (ACT):

Cycle Time (min) *(a)*	Number of times observed *(b)*	*(a)* × *(b)*
12	2	24
14	1	14
15	1	15
Total (Σ CT)		**53**

Therefore, Average Cycle Time (ACT)

= ∑ CT / (Total Number of times observed)

= ∑ CT ÷ (Total Number of times observed)

= 53 ÷ (2 +1 + 1) = 13.25 minutes

(a) Normal time (NT) = ACT × PR = 13.25 × 0.90 = 11.93 minutes

(b) Standard time (ST) = $^{NT}/_{(1 - A)}$ = NT ÷ (1 - A) = 11.93 ÷ (1 - 0.12) = 13.56 minutes

(ii) Predetermined Time Study: It is a work measurement technique that involves observing or thinking through a job, recording the job elements, recording reestablished motion units and calculating performance standard. It involves study of basic or elemental motions of the human body called therbligs. They comprise 18 such elemental motions as follows:

Abbre-viation	Symbol	Name of symbol
Sh		SEARCH
F		FIND
St		SELECT
G		GRASP
TL		TRANSPORT LOADED
P		POSITION
A		ASSEMBLE
U		USE
DA		DISASSEMBLE

Abbre-viation	Symbol	Name of symbol
I		INSPECT
PP		PRE-POSITION
RL		RELEASE LOAD
TE		TRANSPORT EMPTY
R		REST FOR OVERCOMING FATIGUE
UD		UNAVOIDABLE DELAY
AD		AVOIDABLE DELAY
Pn		PLAN
H		HOLD

Figure 10.3: 18 basic or elemental motions of the human body called therbligs

(Source: http://thediagram.com/16_3/therbligs.jpg)

(iii) Work Sampling: It involves estimating the percentage of time that a worker spends on various tasks through random observations

used to record employee activity. It is explained below in section 10.6.

12.6 WORK SAMPLING

In work sampling, the standard time for a specified activity is determined by computing the proportion of time the worker spends on that activity. This may be done for finding the time standards of a worker on printing press where the single worker will be doing composing, proof reading, printing, cutting etc.

Steps in Work Sampling:

(i) Preliminary tasks

(a) Selection of the job to be studied

(b) Informing the workers about method study

(c) Preparing a detailed list of activities of the job

(ii) Deciding the total duration of observation

Total duration of observation = No. of hours/shifts × No. of shifts per day × No. of days

(iii) Determining the number of observations to be made, n* = (Z × p × q) / h2

Where, Z is the standard normal statistic given at a given confidence level

P is the value of sample proportion

q = (1 - p)

h is the half precision interval (half the width of the confidence level)

(iv) Preparing a tour schedule to take the specified number of observations over the specified time duration.

(v) Recording the performance rating of the workers and their activities as per schedule

(vi) Determining the acceptable number of units produced during that period

(vii) Computing the percentage of working on a given task using the formula

Percentage of working = (Frequency of performance of a task/ Total number of observations) × 100

(viii) Determining the normal time =

NT = (Total Time × % of working × PR) / No. of acceptable units produced

Where PR is the Performance Rating

(ix) Determining the standard time, ST = NT × AF = NT × (1 / (1 - % Allowance))

Where AF is the Allowance Factor = 1 / (1 - % Allowance)

Example 12.3: In a company, a work sample study conducted over the 70 hours of a week period. This study indicated the following data- The idle time was 10%, the performance rating was 92% and the total number of parts produced was 250, the allowance for this part is 15%. Calculate the standard time per unit.

Solution to Example 12.3: Given, for a company where a work sample study was conducted over the 70 hours of a week period,

Total Duration of work sample study in a week (DU) = 70 hours

Idle time (IT) = 10% = 0.10

Therefore, Percentage of working (P) = (1 - IT) = 0.90 = 90%

Total number of parts produced (TU) = 250 parts

Performance Rating (PR) = 92% = 0.92

Allowance (A) = 15% = 0.15

Therefore, Normal Time (NT)

= (DU × P × PR) / TU

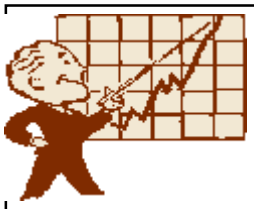
= (DU × P × PR) ÷ TU

= (70 × 0.90 × 0.92) ÷ 250 = 0.23 hours

Therefore, Standard time (ST)

= NT / (1 - A) = NT ÷ (1 - A)

= 0.23 ÷ (1 - 0.15) = 0.27 hours = 16.2 minutes



CHECK YOUR PROGRESS

Q 1: Which of the following is not an Objective of Work Study?

(a) Ensuring effective use of plant and equipment

(b) Ensuring effective use of human effort

(c) Ensuring effective evaluation of human work

(d) Supply Chain Management

Q 2: Which of the following is a step in Method Study?

(a) Selection (b) Manufactuing

(c) Salary payment (d) None of these

Q 3: In which of the following activities, the standard time for a specified activity is determined by computing the proportion of time the worker spends on that activity.

(a) Method study (b) Work sampling

(c) Time study (d) None of these

Q. 4: Which of the following activities is concerned with the establishment of time standards for a qualified worker to perform a specified job at a defined level of performance?

(a) Inventory control (b) Work sampling

(c) Time study (d) None of these



12.7 LET US SUM UP

Work Study deals with the techniques of method study and work measurement which is employed to ensure the best possible use of human, machine and material resources in carrying out a specified activity. The important points under Work Study discussed above are:

- Work Measurement is defined as the determination of the degree and quantity of labour in performing tasks.
- Method Study is the systematic recording, analysis and critical examination of existing and proposed ways of doing a work and the development and application of easier and new production methods.
- Time Study is concerned with the establishment of time standards for a qualified worker to perform a specified job at a defined level of performance.
- In work sampling, the standard time for a specified activity is determined by computing the proportion of time the worker spends on that activity.



12.8 FURTHER READINGS

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12.9 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No.1: (d) Supply Chain Management

Ans. to Q. No.2: (a) Selection

Ans. to Q. No.3: (b) Work sampling

Ans. to Q. No.4: (c) Time study



12.10 MODEL QUESTIONS

Q. 1) What is work sampling?

Q. 2) In a manufacturing company, a direct time study was done on a specific operation. One inexperienced industrial expert and one experienced industrial expert carried out the study simultaneously. They decided correctly on the cycle time (shown below) but their views on performance ratings of the worker differed. The experienced industrial engineer rated the worker 100% and the other engineer rated the worker 110%. They used 13% allowance:

Cycle Time (min)	Number of times observed
21	2
18	1
19	1
22	1

From the above statement,

(a) Calculate the standard time using the experienced industrial expert's performance rating of workers.

(b) Calculate the standard time using the workers' performance rating of the inexperienced industrial expert.

(c) According to you, which of the above standard time is more reliable?

Q. 3) A work sample study conducted over the 90 hours of a week period yielded the following data- The idle time was 15%, the performance rating was 87% and the total number of parts produced was 150, the allowance for this part is 11%. Determine the standard time per unit.

Q. 4) Draw the Process Chart related to manufacture of steel bangles:

Step 1: Cutting bangles to the required shape and size from steel sheet

Step 2: Making designs within the above bangles

Step 3: Temporary storage for inspection of the exactness of the above cut bangles

Step 4: Carrying out finishing operations in the above bangles

Step 5: Inspecting the quality of the above bangles

Step 6: Storage in warehouses

Step 7: Final inspection before dispatch to distributors

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