

# A Primer on Work Study and Related Concepts

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*The most important resource in production is the human resource*

## **Work Study (Time and Motion Study)**

According to the ILO Hand Book, it is a term used to embrace the techniques of method study and work measurement, which are employed to ensure the best possible use of human and material resources in carrying out a specified activity.

Work study consists of as already mentioned in the above definition of two steps –

Method study (motion study)

Work measurement (time study)

According to the British Standards Institute, *work study* is a generic term for those techniques, particularly *method study* and *work measurement*, which are used in examination of human work in all its contexts and which lead systematically to the investigation of all factors which affect the efficiency and economy of the situation being renewed, in order to effect improvement.

## **What is Work Study?**

- ✓ Organized common sense
- ✓ 10% technique and 90% psychology

## **Objectives of Work Study**

To assist the management to obtain the optimum use of the human and material resources available to the organization for the accomplishment of the work for which, it is engaged.

## **How to Optimize?**

- ✓ Effective use of plant and equipment
- ✓ Effective use of human effort
- ✓ Evaluation of human work to make it more convenient

## **Principles of Work Study**

- ✓ Being an instrument of progressive management responsibility for its use, the conviction of its value and the drive to apply it must come from the top echelons of the management.
- ✓ As it is bound to affect the jobs of many people in the organization, these people must be made aware of the objectives and the need of the exercise.
- ✓ Method study must precede work measurement

The two steps of work study are very much distinct in spite of being interdependent. *Method study* is the process wherein existing and proposed ways of doing a work are systematically examined so as to develop and apply better methods of doing the same. *Work measurement* is the technique of establishment of time standards for a qualified worker to perform a specific job at a defined level of performance.

## **Areas of Application of Method study**

- ✓ Improved layout of office, working areas of factories
- ✓ Improved design of plant and equipments
- ✓ Improved use of materials, plant, equipments and manpower
- ✓ Most effective handling of materials
- ✓ Improved flow of work
- ✓ Standardization of methods and procedures
- ✓ Improved safety standards
- ✓ Better working conditions

### **Steps in Method Study (SREDIM)**

1. **Select** – Select the work to be studied. It involves taking account of economic, technical and human considerations.
2. **Record** – Record all the relevant facts of the present (or proposed) method by direct observation.
3. **Examine** – Examine the facts critically in sequence, using special critical examination sheets.
4. **Develop** – Develop the best method, i.e., the most practical, economic and effective method, under prevailing circumstances.
5. **Install** – Install that method as standard practice.
6. **Maintain** – Maintain that standard practice by regular routine checks.

### **SELECTING**

*Economic considerations –*

- ✓ Cost
- ✓ Worth the effort and capability of paying for itself

*Focus of economic considerations –*

- ✓ Whether economically sound or not?

*Technical considerations –*

- ✓ Availability of necessary equipment, facilities and technical knowledge for production

*Focus of technical considerations –*

- ✓ Production process and infrastructure

*Human considerations –*

- ✓ Mental and emotional reactions of men and their inherent resistance to change

*Focus of human considerations –*

- ✓ Worker involvement

### **RECORDING**

It is the phase of *data* collection. Data is relevant facts pertaining to the existing method which are collected and recorded to carry out the investigation. The place where this data is entered is called a record. Recording techniques depend on the type and nature of the data. The broad techniques are

- ✓ *Charts* – for process and time records
- ✓ *Diagrams and models* – for path of movement of men or materials (not mutually exclusive)
- ✓ *Photographic aids*

*Charts*

1. *Outline process charts* – Principal operations and inspections of the processes.
2. *Flow process charts* – Activities of men, material or equipment are analyzed into five events of operation, inspection, transport, storage and delay.
3. *Two handed process charts* – Movements of two hands or limbs of the operator.
4. *Multiple activity charts* – Simultaneous / interrelated activities of operators and / or machines, on a common time scale.
5. *Simultaneous motion cycle* – Movement of body parts of the operator, expressed in terms of micro-motions (therbligs) – 18 of them on a common time scale.

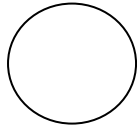
*Diagrams and Models*

1. *Flow diagram* – Path of men, materials and equipments on a scale model.
2. *String diagram* – Same as above except for the variation that it uses a string to trace the path.
3. *Two and three dimensional diagrams, models and templates* – Planning of layout of work place or plant.

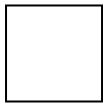
*Photographic Aids*

1. *Cyclograph* – Movement of hand obtained by exposing a photographic plate to the light emitted from small bulbs attached to the operator’s fingers.
2. *Chrono-cyclographs* – A modification of the cyclograph, where the record is made by using flash lights.

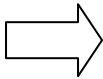
*Symbols for recording*



1. Operation – Main step in a process, method or procedure. Usually, the part, material or product is modified or changed during the operation.



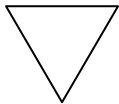
2. Inspection – Indicates any type of inspection check, measurement, visual scrutiny for quality and / or quantity.



3. Transport – Indicates movement of workers, material or equipment from place to place.



4. Temporary storage or delay – Indicates a delay in the sequence of events.

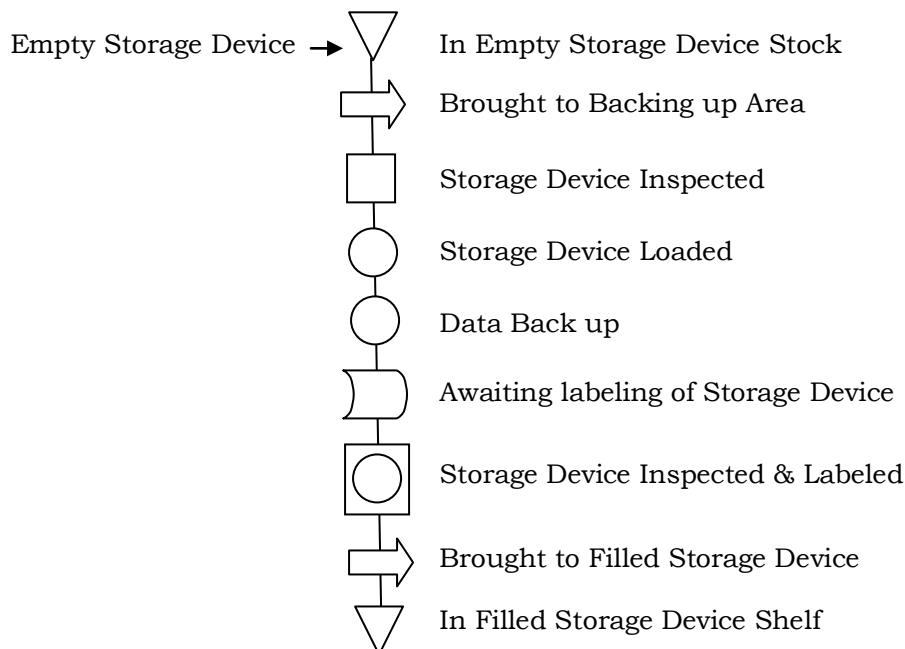


5. Storage – Indicates controlled storage in which materials is received into or issued from stores under some form of authorization or an item is retained for reference purposes.

*Flow process chart*

Product analysis / Man analysis

Activity : Backing up data on storage devices  
 Chart Begins : Empty storage device in stock  
 Chart Ends : Filled storage device in storage shelf  
 Method : Proposed  
 Charted By : Atibax



## **EXAMINING**

*What is done?*

- Critical examination of existing method / proposed method is done.

*Purpose?*

- ✓ If unnecessary, eliminate the activity altogether
- ✓ Combine activities, if feasible
- ✓ Change sequence of activities so that work or delay is reduced
- ✓ Simplify the activity to reduce the work content or the time consumed

*Principles*

- Examine facts without any bias
- Avoid hasty judgments / conclusions
- Do not consider new method until all undesirable features of existing method have been exposed by examination

*How to be done?*

- Questions
  - ? Primary (What is to be done?)
  - ? Secondary (What else can be done?)
  - ? Alternatives (What should be done?)
- Critical examination sheet

## **DEVELOPING**

- ① Draw a framework of an improved method by arranging in sequence the essential 'do' operations.
- ① Fill up ancillary work in a way as efficient as possible
- ① Try out *mock ups* of the new method (make dry runs)
- ① Draw up improved method in process chart form
- ① Submit

## **INSTALLING**

- ① Two phases
- ① Preparation
- ① Plan (Who? How?)
- ① Arrange (check, Training, Advise)
- ① Rehearse
- ① Installation

Note: There should be minimum disruption of normal work.

## **MAINTAINING**

*Objective*

- ✓ To make allowances for changes

*Why?*

- ✓ Good reasons
- ✓ Result of suggestion schemes
- ✓ Minor innovations introduced by workers / supervisors

## **Important Terms in Work Measurement**

**Standard performance** – Optimum rate of output achieved by a qualified worker as an average per working day/shift, due allowance being made for the necessary time required for rest.

**Qualified worker** – One who has the necessary physical attributes, intelligence and education, and has acquired the necessary skill and knowledge to carry out the work in hand to the satisfactory standards of safety, quantity and quality.

**Element** – A distinctive part of a specialized job selected for convenience by observation, measurement and analysis. There are eight types of elements – repetitive, occasional, constant, variable, manual, machine, governing and foreign.

**Work cycle** – The sequence of elements which are required to perform a job or yield a unit of production.

**(Observed) Worker Rating** – The assessment of a worker's rate of working relative to the observer's concept of rate corresponding to the standard pace.

**Standard rating** – It is defined as the rate of output which qualified workers will naturally achieve as an average output for a given period of time. This rating is denoted as 100 or 100%.

**Rating factor** – It is the multiplying unit to the standard rating which gives the observed rating. For e.g., if the observed rating is 100, rating factor is 1; if observed rating is 90, the rating factor is 0.9 and so on.

**Basic (Normal) time** – It is defined as the time taken by a qualified worker to do a piece of work at the standard rate of performance.

Basic time = observed time \* rating factor = observed time \* (worker rating / 100)

**Relaxation allowance** – The additional time that is allowed to a worker for a specified work over and above the basic time, counted as a percentage of basic time and taken into account several factors depending upon the job.

**Work content** – It consists of work plus allowances for rest, personal needs, and any other allowance for additional work.

**Standard time** – The total time in which a job should be completed at standard performance.

*Standard time = basic time + allowance*

**Allowed time** – A time allowed for payment purposes to the factory worker where the standard time is increased appropriately by a factor representing a bonus and / or policy.

**Standard minutes** – A standard minute (SM) expresses a unit of work in terms of the 100 BS scale. Standard performance is recognized as being 60 SMs an hour. It is different from standard time, in that the latter includes ineffective and occupied time.

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### ☞ **An Example**

Consider a firm where an observer is observing the time required by three different workers to assemble a PC. The following are the observed time in case of the three workers:

Sl. No.	Time Required to Assemble a PC (in minutes)		
	Worker A	Worker B	Worker C
1	34	30	37
2	36	29	35
3	32	31	37
4	33	30	36
5	35	29	34
6	37	31	37
7	34	29	36

8	33	30	35
9	31	30	35
10	32	29	34

Observed Time for Worker A is  $(34+36+32+33+35+37+34+33+31+32) / 10 = 33.7$  minutes  
 Observed Time for Worker B is 29.8 minutes  
 Observed Time for Worker C is 35.6 minutes

Say, the observed rating for Worker A is 100 (rating factor is 1), for Worker B it is 115 (rating factor is 1.15) and for Worker C, it is 90 (rating factor is 0.9)

Then,

Normal Time for A is  $33.7 * 100/100 = 33.7$  minutes  
 Normal Time for B is  $29.8 * 115/100 = 34.27$  minutes  
 Normal Time for C is  $35.6 * 90/100 = 32.04$  minutes

If the ratings would have been correct, all the three would have shown more or less the same normal time. This clarifies the meaning of Normal (basic) time. In other words, it simply means that the normal time should be this, but because you are slow, you are taking more time (observed time is more for C) or because you are fast, you take less time (observed time for B is less). In the above example, if we assume that A has been rated correctly, B has been over-rated and C has been under-rated. This is the problem with worker rating.

Given that allowance is 10% (or 0.10), the standard time for A is  $33.7 + 33.7*10 = 37.07$  minutes. If worker rating is correct and there is no variation in the allowance, then all workers will also have the same standard time. But in practice, the allowances for different workers may be different based on age, sex, etc.

Finally, the Allowed Time is calculated by giving an additional time as a percentage of the standard time. In this case if the allowance is 20% for A, allowed time is  $37.07 + 20\%$  of  $37.07 = 44.484$  minutes.

As is seen, we could have merged the two allowances (one added to the normal time and the other to the standard time) into one. This would have meant that the Allowed Time is same as the Standard Time. Now the question - how is the allowance used for payment purpose? The more the allowance, the more time the worker has to assemble a PC and so his target for a particular period is less. But with the standard time available, he is definitely assembling more which means that he gets paid more!

## Techniques of Work Measurement

### Time Study

A technique for determining as accurately as possible, the time required to carry out a specific task by a qualified worker at a defined level of performance. It is the most widely used technique in work measurement.

#### Constraints

- ✗ Studies cannot be made in a hurry
- ✗ Values once estimated cannot be altered unless the work content of the job and the conditions of work change

#### Essentials

- ✓ An accurate specification of when the job begins and when it ends, and the method by which it is to be carried out including details of materials, equipment, conditions, etc.
- ✓ A system of recording the observed (actual) time taken by workers to do the job while under observation

- ✓ A clear concept of what is meant by standard rating
- ✓ A means of assessing the amount of rest which should be associated with the job
- ✓ Availability of measuring equipments like stop watches, stationeries, time study sheet, etc.

#### *How?*

- ✓ Break the operation into elements, depending upon the nature of the job and the purpose of the study
- ✓ Determine number of cycles to be timed
- ✓ Observe and record time taken
- ✓ Undertake performance rating
  - Weighhouse rating – takes into account four factors, namely skill, effort, working conditions and consistency; each is rated and converted into percentage value from a fixed table
  - 100% rating
- ✓ Obtain basic time
- ✓ Make allowances
  - Process allowance
  - Relaxation allowance
  - Special allowance
  - Periodic activity allowance
  - Interference allowance
  - Contingency allowance
  - Policy allowance
- ✓ Obtain allowed time

#### **Synthesis**

Time study techniques are not suitable where direct observation is not convenient. Under such circumstances, we may estimate a standard time on the basis of previous experience of similar jobs. Time standards arrived at this way are called synthesis.

Synthesis is a work measurement technique for building up the time for a job at a defined level of performance by totaling element times obtained previously from time studies on other jobs containing the elements concerned, from synthetic data.

#### *Steps in Synthesis*

- ✓ Collect full details of the job (Dimensions, tools, methods, conditions)
- ✓ Analyze job into constituent elements (Activity grouping to enable synthetic elements to be applied if relevant)
- ✓ Select appropriate basic times from synthetic data for all elements
- ✓ Select and apply synthetics covering contingent factors
- ✓ Verify detail of elemental analysis for job method and conditions
- ✓ Total basic times, RA and allowance to establish the standard time for the job

#### *Advantage over time study*

- ✓ Fast
- ✓ Consistency

#### **Analytical Estimating**

A work measurement technique whereby the time required to carry out elements of a job at a defined level of performance is established from knowledge and practical experience of the elements concerned.

#### *Steps*

- ✓ Collect full details of job
- ✓ Analyze job into constituent elements
- ✓ Apply synthetic data and estimate basic times for the remaining elements and contingencies

- ✓ Apply the appropriate RA as a blanket allowance
- ✓ Verify detail of elemental analysis for job method and conditions
- ✓ Total basic times, RA and allowance to establish the standard time for the job

### **PMTS (Predetermined Motion Time System)**

A work measurement technique whereby times established for basic human motions (classified according to the nature of the motion and the conditions under which it is made) are used to build up the time for a job at a defined level of performance.

In this method, the actions involved are the following –

- ✓ Break down the work into a list of motions
- ✓ Arrange the list of motions in correct sequence
- ✓ Enter against each motion, the rated time

The rated time of motions are obtained from a set of tables which have been compiled for various motions. The sum of the times gives the total time to perform the work. All times are standardized at normal rating. Allowances are later added.

e.g. lift a pencil -> motions like reach / grasp, move etc. are basic motions

#### *Types*

- MTM (Method Time Measurement) -> very accurate
- Work factor synthesis – It may be Detailed, Simplified or Abbreviated
- Motion Time System

### **Activity Sampling**

This type of study consists of taking a number of observations at random intervals, wherein the state or conditions of the object of study is noted and classified into predefined categories pertinent to the system. The percentage of observation recorded for a particular activity or delay, within reasonable limits, is a measure of the percentage of total time during which that activity or delay occurs.

For e.g., 16 random visits to observe show that machine is idle in 4 visits. Deduction made is that machine was idle 25% of the time.

This method is appropriate when the cycle time happens to be very long and /or continuous direct observation is not feasible or when data is required at unexpected times.

*Equivalent terms* – work sampling / ratio delay / snap reading method of observation

### **References:**

1. Aswathappa K, Bhat K S, Production and Operations Management, 1<sup>st</sup> Edition, Himalaya Publishing House
2. Nair N G, Production and Operations Management, 1996E, Tata McGraw Hill