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## **UNIT 16 WORK MEASUREMENT**

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### **16.0 LEARNING OUTCOME**

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After going through this Unit, you should be able to:

- Discuss the concept and objectives of work measurement
- Bring out the essentials of work measurement
- Highlight the basic steps of work measurement; and
- Analyse important work measurement techniques

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### **16.1 INTRODUCTION**

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There is a widespread concern amongst the public about inefficiency in public systems management. As organisations grow in size and complexity, they become difficult to manage. In most of the organisations, tasks are performed by hit and trial methods, i.e., without any yardstick to measure the individual and collective performance. The measurement of human work has always been a problem for management since the days of Taylor's 'scientific management'. The plans for the provision of goods or services at a predetermined cost are often dependent on the accuracy with which the amount and type of human work involved can be forecast and organised. While, it has been a common practice to make estimates and set targets based on past experience, these too frequently prove a rough and unsatisfactory guide. Without measurement, the organisation operates in vacuum with hardly any basis for comparison or control. Hence work measurement is an effective tool to facilitate these activities. In this Unit, the basics of work measurement

techniques, and its significance for management and organisational productivity will be discussed.

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## **16.2 WORK MEASUREMENT: CONCEPT AND OBJECTIVES**

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Work measurement is concerned with the determination of the amount of time required to perform a unit of work. The time required for this task is commonly referred to as the 'standard' or 'allowed time'. Thus, work measurement provides a yardstick for human effort, which can help in efficient staffing, improved planning and control and sound incentive schemes.

The International Labour Organisation (1974), defines work measurement as "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."

The Work Study Report of the Secretariat Training School, Ministry of Home Affairs, Government of India (1966) defines it as "the application of techniques designed to establish the work content of a specified task by determining the time required for carrying it out at a defined standard of performance by qualified worker".

Work measurement is thus a device for estimating more precisely the amount of time it should take or will take to perform the assigned work. Work measurement has negative and positive roles. Negatively, it locates the existence of ineffective time; positively it sets standard time for the performance of work. Since method study is a technique for reducing work content, therefore, it is necessary that method study should precede work measurement. In short, work measurement aims at investigating, reducing and subsequently eliminating ineffective time.

It is very easy to apply this technique to highly repetitive operations. It is considered difficult, to apply this technique to work pertaining to key administrative posts, work with unpredictable results and those which need special requirements. However, we must try to use this technique even under such situations through establishing norms or standards of performance which may be less precise but rational.

Work measurement is concerned with investigating, reducing and eliminating ineffective time in work performance. Besides, it also helps in setting performance standards which connote, the optimum rate of output that can be achieved by a qualified worker on an average in a working day with due allowance being made for the necessary time required for rest. The following objectives are fulfilled through the application of work measurement in an organisation:

### **1. Comparing Alternative Methods**

There are generally many methods to perform a given job. Where two alternative methods seem equally good and suitable, the one, which consumes less time for completion, is considered better. The techniques of work measurement offer the best means of making this choice.

## **2. Determine the Staffing Pattern**

Staffing is an important area of management. Work measurement can help in making the public organisations staffed by persons in right quantity and quality. Most of the committees and commissions have reported that government offices are over-staffed to a great extent but they have not offered any method by which to assess and curtail the staff.

## **3. Effective Planning and Scheduling of Operations**

Effective planning and scheduling of operations require the exact estimation and availability of resources – personnel, money and material. All these can be made possible through the technique of work measurement as the information generated by this technique forms a reliable basis for planning and forward loading the personnel and material for the administrators to utilise them to their best advantage. The main cause of the failure of the planning in India has been the lack of any accurate measurement of work. Unless the work has been measured, it cannot be planned and scheduled with any assurance that a promised operation can be executed.

## **4. Effective Means of Control**

Once the operations have been planned, then they are to be implemented to ensure the pre-designed output. Maintenance of proper records for all types of activities, and data pertaining to performance, which is maintained while work is being done, form a reliable basis for control.

## **5. Helpful in Cost Estimation**

Standards are helpful in determining the cost of the work performed. This facilitates management in preparing budgets and measuring the effectiveness of forecasts. By knowing what the cost should be and comparing them with budget figures, it is possible to ascertain the reasons for the difference. This may mean that there is a need for devising more efficient procedures and setting new standards to conform to them. Thus, standards help in reducing costs.

## **6. Better Staff Morale**

It creates better morale among staff through their perception of what is expected of them in terms of quantity and quality. The efficient staff can be separated from the inefficient and thus the work of efficient workers can be recognised. This is also helpful in installing incentive wage system.

## **7. Measures of Efficiency**

Standards serve as a basis for measuring the effectiveness of any organisation by indicating the achievements as compared with the standards.

## **8. Better Management**

On the basis of certain set standards, managerial functions can be predicted and discharged more effectively.

## **9. Direction to Future Research**

The standards, which are laid down give clue to the problem areas where research may be carried out to solve the problem.

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## **16.3 ESSENTIALS OF WORK MEASUREMENT**

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Besides the competence, the personnel doing work measurement must ensure the congenial environment within the organisation where work improvement programmes are being launched. The persons conducting work measurement must possess commonsense, imagination, patience, enthusiasm, tact and above all a pleasing personality. Let us discuss some of these factors, which may be kept in mind by the persons undertaking work measurement and the top management to ensure the best results.

### **a. Cordial Relationship**

Work study team must establish cordial and equitable relationship with the persons working in the organisation being investigated. This would generate harmonious relationships advantageous to both sides. The study team should constantly endeavour to dispel the impression that they would devise anti-staff policies and measures. There should be mutual trust, sincerity, devotion, loyalty and an open attitude.

### **b. In-built Reliability, Consistency and Uniformity**

The work study team should not suggest superficial suggestions, but ensure that the standards meet the criteria of reliability, consistency and uniformity. The organisation must provide the coercive measures in case of deviation so that the system can operate well.

### **c. Incentive Opportunity**

The management must ensure provision of incentives to those who can ensure more efficiency and productivity as compared to the standards framed. This would encourage the keen workers to progress fast rather than allowing them to frustrate. .

### **d. Participative Management**

Before enforcing the new standards, we must ensure their acceptance by all the employees in the organisation through participative management or management by objectives. There is a fear that the employees may resist and even resort to strikes, etc. if not taken in confidence. Such standards would be accepted whole-heartedly and would produce best results.

### **e. Cost Benefit Analysis**

A huge cost is incurred in carrying out the work measurement programmes and ultimately maintaining such programmes. As a result of such an investment there should be certain benefits and saving over a period of time. The initial costs may tend to

increase, but they should soon level off to a point where savings should inevitably crop up.

**f. Careful Selection of the Work Measurement Team**

The success of the measures of work measurement programmes depends to a great extent upon the right skills and attitudes of the personnel associated with the team. Only properly trained and experienced personnel in the relevant field should be chosen. Measurement is a practical job and it requires a competent and experienced person.

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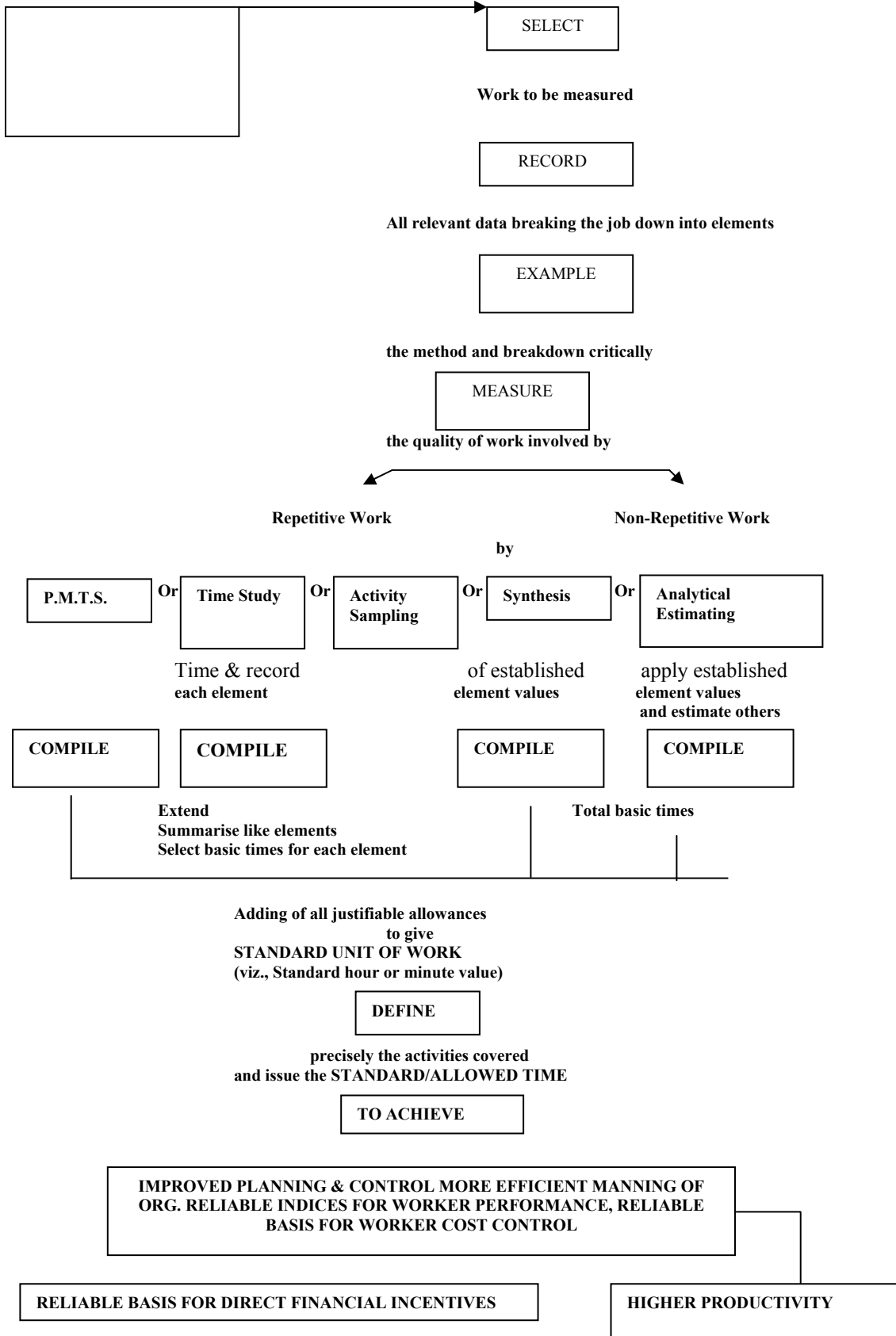
## **16.4 WORK MEASUREMENT: BASIC STEPS**

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There are certain important basic steps in performing a complete work study. Some of them are relevant for method study, while these and some others are relevant for work measurement. Isolating those steps, which are necessary for work measurement, the basic procedure could easily be formulated. The essence of work measurement, would rely upon selecting the requisite unit of measurement. A standard unit of measurement should be comparable, exact and stable. The measurement of all work done in an organisation could be carried out through by any of the three ways i.e. individual output, groups on routine work and groups on special work. It includes certain basic steps as follows:

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|----------------|--|
| <b>Select</b>  | the work to be studied.  |
| <b>Record</b>  | all the relevant data relating to the circumstances in which the work is being done, the methods and the elements of activity in them.   |
| <b>Measure</b> | each element in terms of time over a sufficient number of cycles of activity to ensure that a representative picture has been obtained.  |
| <b>Examine</b> | the recorded data and element times critically to ensure that unproductive or random elements are separated from productive elements; the recorded times of each element and determine a representative time for each. |
| <b>Compile</b> | time for the operation, which will provide a realistic standard of performance and will include time allowances to cover suitable rest, personal needs, contingencies, etc.  |
| <b>Define</b>  | precisely the series of activities and method of operation for which the time has been allowed and issue the time as standard for the activities and methods specified.  |

**Figure 16.1 Work Measurement**



Source: ILO, Work Study (1974)

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## 16.5 WORK MEASUREMENT TECHNIQUES

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We shall now discuss some important techniques of work measurement.

### 1. Subjective Judgment

Here work measurement involves the subjective judgment of the management, i.e., experience and guess work. This is generally known as rule of thumb standard. It is very difficult to apply these standards universally and in large-scale organisations. Moreover, these cannot be justified on scientific grounds.

### 2. Record of Past Performance

These represent what is rather than what should be. Standards thus arrived are indicators of work and time requirement and can be used for controlling the operations. It may be calculated as follows:

$$\text{Staff members} \\ \text{Minutes per unit} = \frac{\text{Total Number of staff members considered} \times \text{Minutes in work week}}{\text{Weighted number of units completed}}$$

This method is not suitable to improve the performance of organisation as standards are measured on the basis of past performance and not what ought to be.

### 3. Scientific Methods

There are many scientific methods. These are:

- I. Time Study
- II. Pre-determined Motion Time Systems (PMTS)
- III. Activity Sampling
- IV. Analytical Estimating
- V. Synthesis

#### I. Time Study

Time study is the most important technique of work measurement. It is concerned with the direct observation of work while it is being performed. Let us define the concept of time study as applicable to work measurement. According to I.L.O (1974), "Time Study is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions, and for analysing the data so as to obtain the time necessary for carrying out the job at a defined level of performance".

In a document issued by Secretariat Training School, Ministry of Home Affairs, Government of India(1966), it is stated that "Time Study is a technique for determining

as accurately as possible from a limited number of observations the time necessary to carry out a given activity at a defined standard of performance.”

According to J.A. Larkin, (1969), time study is “a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions, and for analysing the data so as to obtain the time necessary for carrying out the job at a defined level of performance.”

The basic steps in the time study procedure have been depicted as follows.

- i) This is said to permit the rate of working to be assessed more accurately than would be possible if the assessments were made over a complete cycle. The operator may not work at the same pace throughout the cycle and may tend to perform some elements faster than others.
- ii) Enable the different types of elements to be identified and distinguished, so that each may be accorded the treatment appropriate to its type.
- iii) Enable elements involving high fatigue to be isolated and to make the allocation of fatigue allowances more accurate.
- iv) Facilitate checking the method so that the subsequent omission or insertion of elements may be detected quickly. This may become necessary if at a future date the time standard for the job is queried.
- v) Enable a detailed work specification to be produced.
- vi) Enable time values for frequently recurring elements, such as the operation of machine controls or loading and unloading work pieces from fixtures, to be extracted and used in the compilation of synthetic data.

When the above preliminaries are taken care of, the actual measurements can begin. The basic time study equipments are:

- (i) Stop-watch
- (ii) A Study board
- (iii) Pencils (jotting down equipment)
- (iv) Time Study forms
- (v) Slide rule (for speeding up calculations), and
- (vi) Measuring instruments for distance and speed such as rulers, tapes micrometer, technometer, (revolution counter) etc.



## **2. *Pre-Determined Motion Time Systems (PMTS)***

It is a work measurement technique whereby time established for basic human motions are compiled to build up the time for a job as a whole at the defined level of performance.

Basic human motions are tabulated with time standard for each basic human motion. When using these systems to compute the standard time for a job, the operation is first analysed into its component motions; going in much greater detail than is normally done in method study. The time corresponding to each of the minutely analysed motions is then read from tables, and the job time is obtained by adding all the individual times. To apply one of the basic systems to manual task, taking only one minute to perform may require as much as 100 minutes of analysis and computation.

### **Advantages**

- i) The tabulated values are ready for immediate use and do not have to be built-up within the individual organisation.
- ii) They are universal in character and not confined to a limited number of elements. Time standards for most of the physical activities carried out in the average factory can be built-up from the basic times.
- iii) They are applicable anywhere, so that, in theory, identical jobs done in different factories should have identical time standards if the work study persons setting them have been properly trained.
- iv) They focus attention on the method before the time can be set and offer a more precise means of recording than any other existing system.
- v) They are of value in training operators in new methods, since the paths of movement are precisely described.
- vi) Because of the detailed breakdown, changes in methods can immediately be identified.

### **Uses of Motion – Time Measurement**

This method has been applied for a number of years for:

1. Developing effective methods in advance of imitating production.
2. Improving existing methods.
3. Establishing standard data.
4. Estimating.
5. Guiding product design.
6. Developing Effective tool designs.
7. Establishing time standards.

8. Selecting effective equipment.
9. Training supervisors to become highly methods conscious.
10. Settling grievances.
11. Research, particularly in connection with methods, learning time and performance rating.

### **Disadvantages**

- i) It is not scientifically possible to add times for individual small motions in the way required by the systems, as a particular motion may be influenced by preceding and succeeding motions.
- ii) It is uneconomic for non-repetitive jobs.
- iii) It requires highly trained staff.

### **3. Activity Sampling**

Activity sampling is a technique in which a large number of instantaneous observations are made over a period of time, of a group of facilities, machines, and processes of workers. Each observation records what is happening at that instant and the percentages of observations recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs.

Rhyne and Freeman(1986), have stated that the power of the work sampling technique lies in the theory of probability “that is a few observations taken at random from a large group (population) tend to represent the characteristics of the group.”

Activity sampling is also known as ratio-delay study, observation ratio-study, snap reading method, random observation method, machine utilisation studies and activity ration studies. The technique essentially measures (i) activities and delay, (ii) certain measures manual tasks to establish a time standard for an operation.

### **Objectives**

The activity sampling attempts to:

- i) Determine the various causes for the given degree of labour and equipment utilisation and the effect of each cause.
- ii) Determine the spheres in which management policies and their application needs to be studied in detail for purpose of improvements. This may suggest either necessity of method study or development of proper maintenance procedures or production planning and control system or any other such aspect of management.
- iii) Get a measured evaluation of a machine utilisation as a basis for decisions regarding machinery replacement or purchase of additional machines.
- iv) Determine operator, machine and departmental efficiency.

- v) Establish limits of variations for operator, machine and departmental efficiency for purposes of maintaining day-to-day control over their working.
- vi) Determine extent of seasonal or periodic variations, if any, of workload.
- vii) Isolate men or machines responsible for maximum inefficiency for purposes of taking technical or administrative steps to rectify the situation.
- viii) Determine personal and daily allowances to be incorporated in time standards.

### **Activity Sampling Steps**

- i) State the objectives, purposes of the project or problem and describe in detail each item to be measured.
- ii) Design the study.
- iii) Determine the number of observations to be made and issue instructions accordingly to study team-members. This should not be made known to the object being studied.
- iv) Make the observations according to the plan.
- v) Check the accuracy or precision of the data at the end of the study.
- vi) Prepare report and state conclusions and recommendations.

### **Advantages**

- i) It can measure many of such activities as are impracticable or too costly to be measured by time study or by other work measurement techniques.
- ii) Unlike time study, one management analyst can collect information about simultaneous activities of a group of men or machines or both.
- iii) It can be learnt quickly.
- iv) It can be interrupted at any time without affecting the results.
- v) It can be used where the stopwatch is banned.

### **Disadvantages**

- i) It is difficult to apply this on jobs of short duration.
- ii) It cannot provide elemental details that can be obtained from time study.
- iii) It is sometimes difficult to convince the management and the workers about the validity of the result of an activity sampling.

## **4. Analytical Estimating**

According to I.L.O (1974),“Analytical estimating is a work measurement technique whereby the time required to carry out elements of a job at a defined level of performance is estimated from knowledge and practical experience of the elements concerned”.

This technique serves all the basic purposes of other work measurement techniques. However, it is slightly less precise owing to the greater reliance on judgment.

### **Essential Features**

1. The employment of skilled persons with experience in the work concerned as estimators.
2. Giving these persons a thorough training in work study, including both method study and time study. It is important that they should be able to recognise standard performance rates of working.
3. The making of an initial method study of the job in as much detail as it is economical.
4. Breaking down the job into elements and determining time for each element based on standard performance. Where possible, element times are derived from time study data or synthetic times. Where no such data exist, time is estimated on the basis of the estimator’s experience.
5. When all the element times at 100 rating have been determined they are added together and the total basic time for the operation is worked out. Relaxation allowances are added as a percentage of the total time. Any additional allowances are then added.

The theory of analytical estimating appears simple but it is difficult to apply in practice. It must be carried out under the guidance of an expert.

### **5. Synthesis**

According to an I.L.O. Publication, (1974), “Synthesis is a work measurement technique for building-up the time for a job at a defined level of performance by totaling element time obtained previously from time studies on other jobs containing the elements concerned, or from synthetic data”.

Government of India Secretariat Training School Manual (1966), states, “Synthetic times (or synthesised time standards) are time standards built-up (synthesised) from element times previously obtained from direct time studies.”

This 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. The main purpose of the synthesis stage of the work measurement is thus to take the measured constituent parts (elements) and build them together again. The procedure of synthesis is commonly called setting-up and there are varied ways of accomplishing it. For this technique, the normal/basic times of small elements of work have to be available set out in properly indexed files. These cover manual processing or and machine activities which have been measured by time studies.

Provided valid data exist and the analyst identifies all the constituent elements of the job and applies this data correctly, then the resulting time standards should be as accurate as if measured by time study.

When compiling synthetic times it is not important that the operations providing the basic data should have been timed under identical conditions; in particular, similar methods and equipment must have been used and the operation must have been broken into identical elements. The possibility of using data from any one study as a basis for synthesis time is one of the reasons for making a precise and full job specification at the time of issue of the time standards.

Three types of elements may be encountered when compiling synthetic times:

1. Elements, which are identical from job to job.
2. Elements which are similar in nature but vary in difficulty and in the length of time necessary to perform them as the size, weight, pressure, etc., involved.
3. Elements, which are controlled by the physical or technical characteristics of the material and the process, including automatic machine elements controlled by speed, depth, etc.

### **Advantages**

1. They are usually based on data derived from a large number of studies and are thus more reliable than time derived from single study.
2. Where the elements for which synthetic times have been compiled recur repeatedly in various jobs performed in the undertaking, so that the work involved in compiling such times is justified, they often eliminate the need for prolonged individual studies, although it is usual to make a short check study after the synthetic time has been compiled in order to ensure that no activity has been overlooked.
3. They are valuable in estimating time standards for production planning and estimating for quotation purposes.
4. They are useful in planning teamwork activities such as in an assembly line or group working, as in garment making, to reduce imbalance in the early stages.

### **Essential Steps to Establish Standard Data**

1. The range of items to be covered is determined.
2. A trail breakdown of elements common to all items is established.
3. Time studies are made of the entire range of items to be covered.
4. A master list of elements is prepared and listed on a master summary sheet.
5. The individual element times for each time study are posted on the master summary sheet.

6. The constant elements are separated from the variable elements and the results are shown in the form of curves, tables and formula.

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## **16.6 CONCLUSION**

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The effectiveness of public systems management is dependent to a great extent on the satisfactory performance of human resources. There is a need to develop yardsticks to determine human effort, which facilitate the planning of operations, staffing, control and suitable incentive mechanisms. This involves determining the time needed for carrying out functions at a level of performance. This facilitates accountability for the performance of assigned tasks..

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## **16.7 KEY CONCEPTS**

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### **Element**

An element is a distinct constituent part of a specified activity or task composed of one or more fundamental motions and / or machine or process activities selected for convenience of observation and timing.

### **Rating**

It is the assessment of the worker's rate of working relative to the observer's concept of the rate corresponding to standard pace.

### **Work Time Study**

It is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions, and for analysing the data so as to obtain the time necessary for carrying out the job at a defined level of performance.

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## **6.8 REFERENCES AND FURTHER READING**

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## **16.9 ACTIVITIES**

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1. Observe any activity being performed in your house or neighbourhood and attempt to determine time required for its performance.
2. Enquire from any employee working in public or private enterprise about any work measurement techniques developed in the organisation.