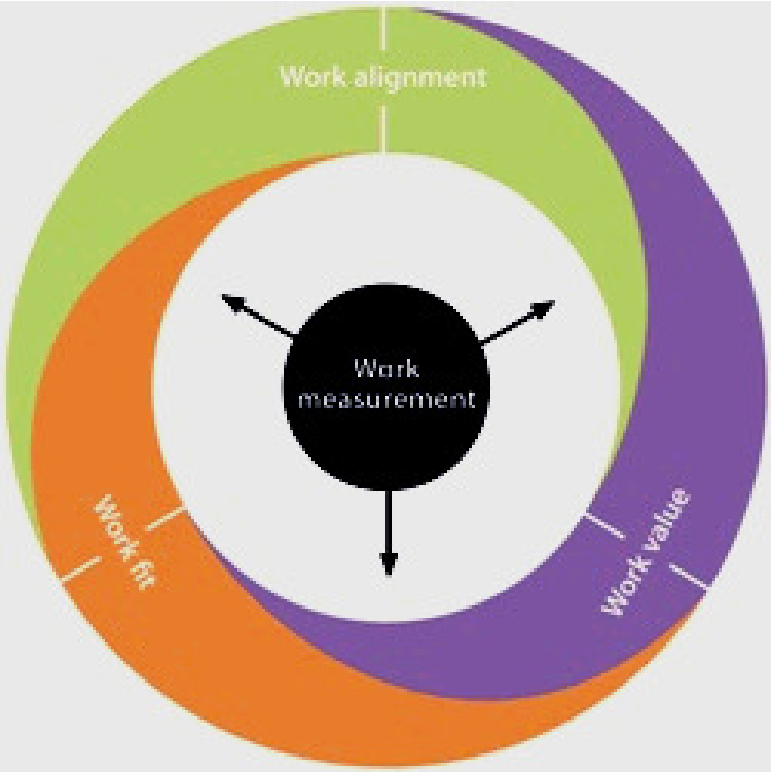
WORK STUDY-

WORK MEASUREMENT



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

REVISED TRAINING MODULE FOR THE ADVANCED WORK STUDY COURSE

WORK MEASUREMENT

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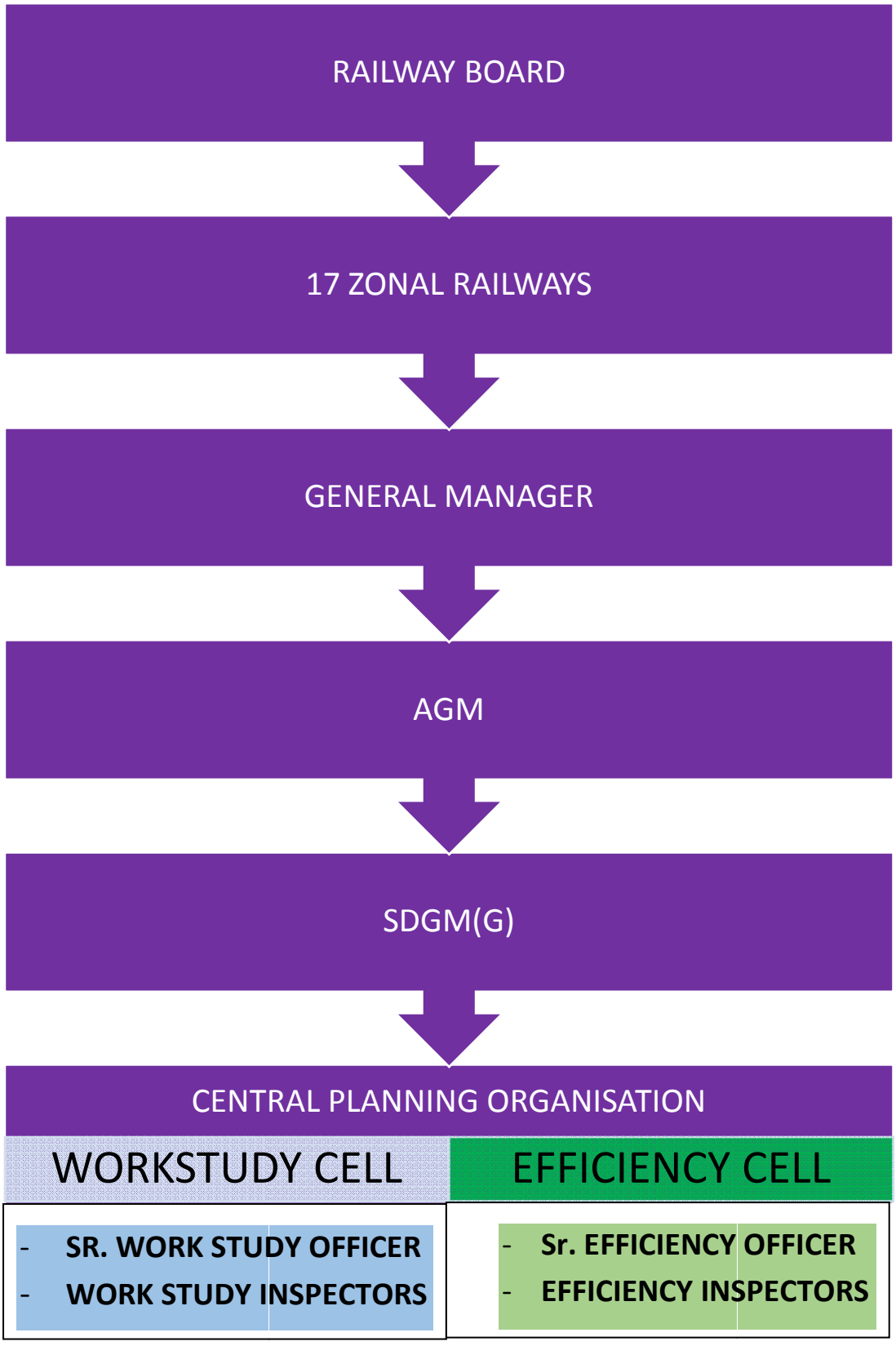
REVISED TRAINING MODULE FOR THE ADVANCED WORK STUDY COURSE

WORK MEASUREMENT- CHAPTER- 1

ORGANISATION SET UP

1.1 ORGANISATION SET UP



AT Railway Board Level:

Director (E&R) is in-charge of all 17 Zones Central Planning organizations.

At Zonal Level:

Work study Officer or Efficiency Officer assisted by Work study Inspectors.

At Divisional Level:

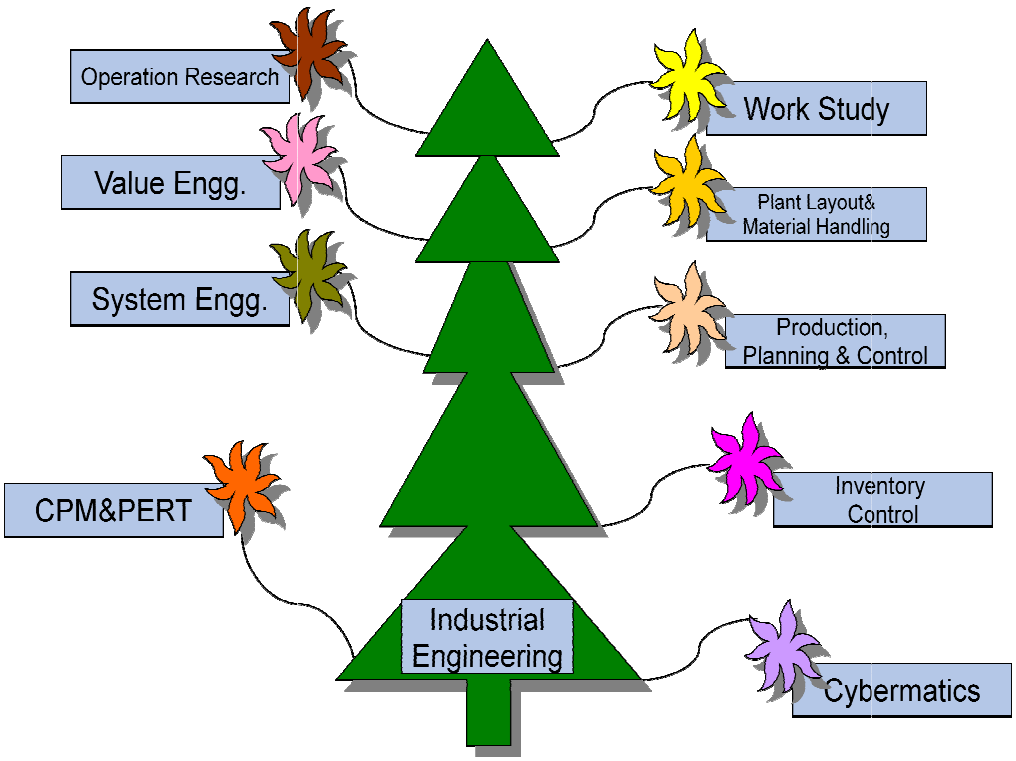
ADRM generally make a nodal officer to co-ordinate with central organization.

Function of Work study Cell:

Work study cell only under takes work studies confined to Zonal Railways. From Work study cell, letter goes to Zonal and Divisional HODs' regarding invitation of subjects for Work study. On receiving suggestions from Zonal and Divisional levels, they will be summarized and in consultation with SDGM, some important and vital subjects will be enlisted. The finalized list will sent to Railway Board.

1.2 Introduction to Work Study:

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



1.3 DEFINITION OF WORK STUDY:

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

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

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

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

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

1.4 OBJECTIVES OF WORK STUDY

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

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

Therefore, the objective has three aspects.

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

1.5 NEED OF WORK MEASUREMENT

Work-study is a term used to embrace the techniques of method study and work measurements, which are used in the examination of human work in all its context, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvement.

The relationship of work-study to the following topics:

a) Clerical procedure: A clerical procedure is a series of formal clerical steps needed to process a specified record sheet. A clerical procedure has class parallels with assembly line work in the factory. In the factory, a raw material is subjected to a series of operations to transform it to a finished product. In the office, stores requisitions and other prime data are subjected to a series of operation to transfer them to the actual cost of materials consumed as shown in the profit and loss account.

b) Cybernaics: The term was introduced by Norbert Wiener, an American mathematician, with the meaning “communication and control in the animal and the machine”. The term “general system’s theory” is now tending to replace the word “Cybernatics”.

c) Organisation and methods: this is the family of techniques used to improve administrative performance. The “O” organization is concerned with the formal theory and practice of organizational structures. The “M” methods, signifies clerical method study.

d) Computers: Computers are high speed automatic machines which perform the four arithmetic operations and can store, sort and output data either at as a print out or as a visual display.

The main types of applications for computers are: l) commercial applications

ii) scientific applications, iii) process control and iv) data banks.

e) Statistics: Statistics is a branch of applied mathematics which is concerned with interpreting quantitative data.

f) Operational research: It is attach of the modern science on complex problems, arising in the direction and management of large system of men, machines, materials and money in industry, business, government and defence. The purpose of this method is to help management determine its policy and actions scientifically.

g) Critical path analysis: A group of techniques for presenting information, to assist the planning and controlling of project.

h) Value analysis: A technique which offers a means of analyzing in great detail all the material aspects, which contribute to material or product cost, with the object of minimizing these costs for a satisfactory level of product performance.

i) Ergonomics: It is derived from two Greek words – Ergon=work and Nomes=laws. It is the study of the relationship between man and the working environment with the aim of making work as efficient as possible and minimizing fatigue. The majority of ergonomic assignments involve research.

j) Variety reduction: It is concerned with the elimination of unnecessary diversity in any sphere of company operations.

k) Planned maintenance: It is the inspection, lubrication, adjustment, repairs and replacement of plant and equipment at pre-determined time intervals and on the basis of pre-determined standards, methods and programmes.

In short, work-study must bring about changes in the working habits of all the people in an enterprise and must lead to higher productivity and greater job security for all the members of the company.

CHAPTER REVIEW:

1) What is the present organisation set up in your Railway?

2) Identify and describe the need of Work measurement in your organisation.

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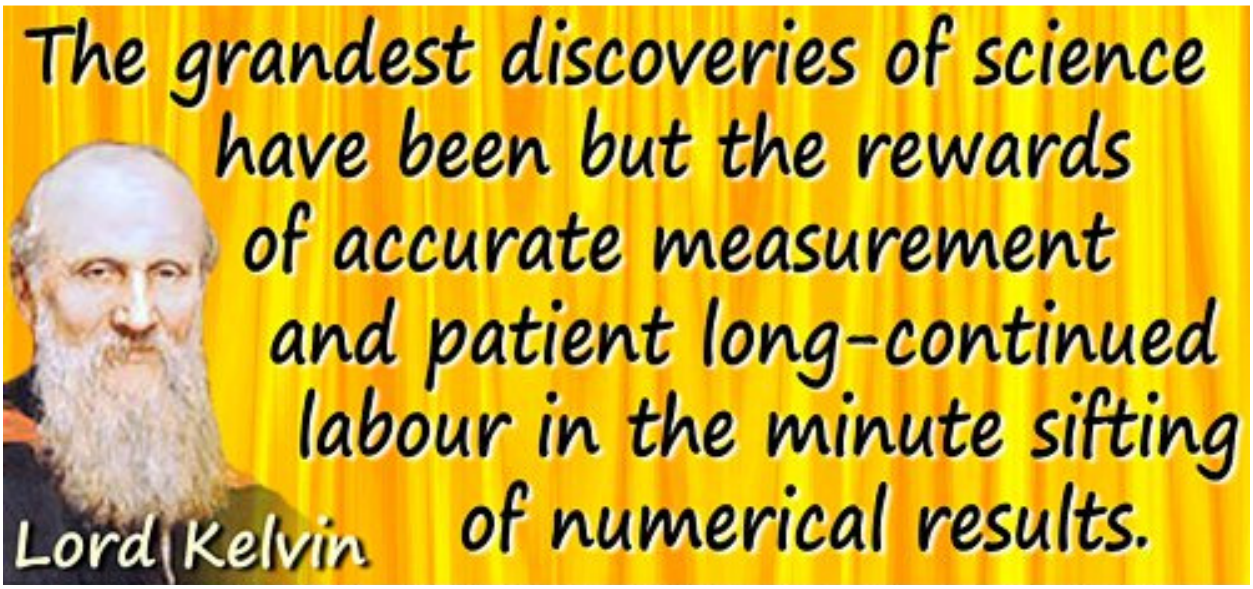
WORK MEASUREMENT- CHAPTER- 2



INTRODUCTION AND DEFINITION OF WORK MEASUREMENT

2.0 INTRODUCTION AND DEFINITION OF WORK MEASUREMENT:

Work measurement is the process of establishing the time that a given task would take when performed by a qualified worker working at a defined level of performance.

There are various ways in which work may be measured and a variety of techniques have been established. The basic procedure, irrespective of the particular measurement technique being used, consists of three stages:

- an **analysis** phase in which the job is divided into convenient, discrete components, commonly known as elements;
- a **measurement** phase in which the specific measurement technique is used to establish the time required (by a qualified worker working at a defined level of performance) to complete each element of work;
- a **synthesis** phase in which the various elemental times are added, together with appropriate allowances (see below), to construct the standard time for the complete job.

The techniques used to measure work can be classified into those that rely on direct observation of the work, and those that do not. For example, some techniques, such as predetermined motion-time systems and the use of synthetic or standard data can provide times from simulation or even visualisation of the work. However, the data on which such techniques are based were almost certainly based on earlier observation of actual work.

DEFINITION:

It 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.

2.1 OBJECTIVES OF WORK MEASUREMENT AND WHERE IT CAN BE APPLIED

- To evaluate the existence of ineffective time
- To evaluate a worker's performance
- To plan work-face needs
- To determine the available capacity
- To determine price and cost of a product
- To compare work methods
- To facilitate operations scheduling
- To establish wage incentive schemes

SCOPE OF WORK MEASUREMENT:

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

2.2 NEED FOR WORK MEASUREMENT

Work measurement is concerned with investigating, reducing and subsequently eliminating ineffective time, that is time during which no effective work is being performed, whatever the cause.

Work measurement, as the name suggests, provides management with a means of measuring the time taken in the performance of an operation or series of operations in such a way that ineffective time is shown up and can be separated from effective time. In this way its existence, nature and extent become known where previously they were concealed within the total.

2.3 SIGNIFICANCE OF QUALIFIED WORKER

A qualified worker is 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.

Types of Workers:

1. Qualified Worker
2. Representative Worker
3. Average Worker

2.4 SPECIFIED JOB

Specified job at specified place i.e., job should be same and place should be similar.

2.5 DIFINED LEVEL OF PERFORMANCE:

It means that the standard performance at a particular given rating and the rating happen to be a coefficient of the performance.

There is no universal concept of Normal Performance. However, it is generally defined as the working rate of an average qualified worker working under capable supervision but not under any incentive wage payment scheme. This rate of working is characterized by the fairly steady exertion of reasonable effort, and can be maintained day after day without undue physical or mental fatigue.

The level of normal performance differs considerably from one company to another. What company a calls 100 percent performance, company B may call 80 percent, and company C may call 125 percent and so on. It is important to understand that the level that a company selects for normal performance is not critical but maintaining that level uniform among time study persons and constant with the passage of time within the company is extremely important.

There are, of course, some universally accepted benchmark examples of normal performance, like dealing 52 cards in four piles in 0.5 minute, and walking at 3 miles per hour (4.83 km/hr). In order to make use of these benchmarks, it is important that a complete description about these be fully understood, like in the case of card dealing, what is the distance of each pile with respect to the dealer, technique of grasping, moving and disposal of the cards.

Some companies make use of video films or motion pictures for establishing what they consider as normal speed or normal rate of movement of body members. Such films are made of typical factory jobs with the operator working at the desired normal pace. These films are found to be useful in demonstrating the level of performance expected from the operators and also for training of time study staff.

The principal use of work measurement is to set time standards which can be used for a no.of different purposes including programme planning, estimating, and as a basis for incentives, for various jobs carried out in the undertaking.

Obviously, if those time standards are to be of any value at all, their achievement must be within the capacity of the majority of workers in the organisation.

It would be no use setting standards so high that only the best could obtain them, since programmes and estimates based on them would never be fulfilled. Equally, to set standards well within the achievement of the slowest workers would not be conductive to efficiency.

How to obtain a fir time from time studies?

As far as possible, studies should be taken on qualified workers. It is not always possible to time a job on an average qualified worker. Moreover, even if it were, people do not work consistently from day to day or even from minute to minute.

The work study man has to have some means of assessing the rate of working of the operative he is observing and relating it to standard pace. This process is known rating.

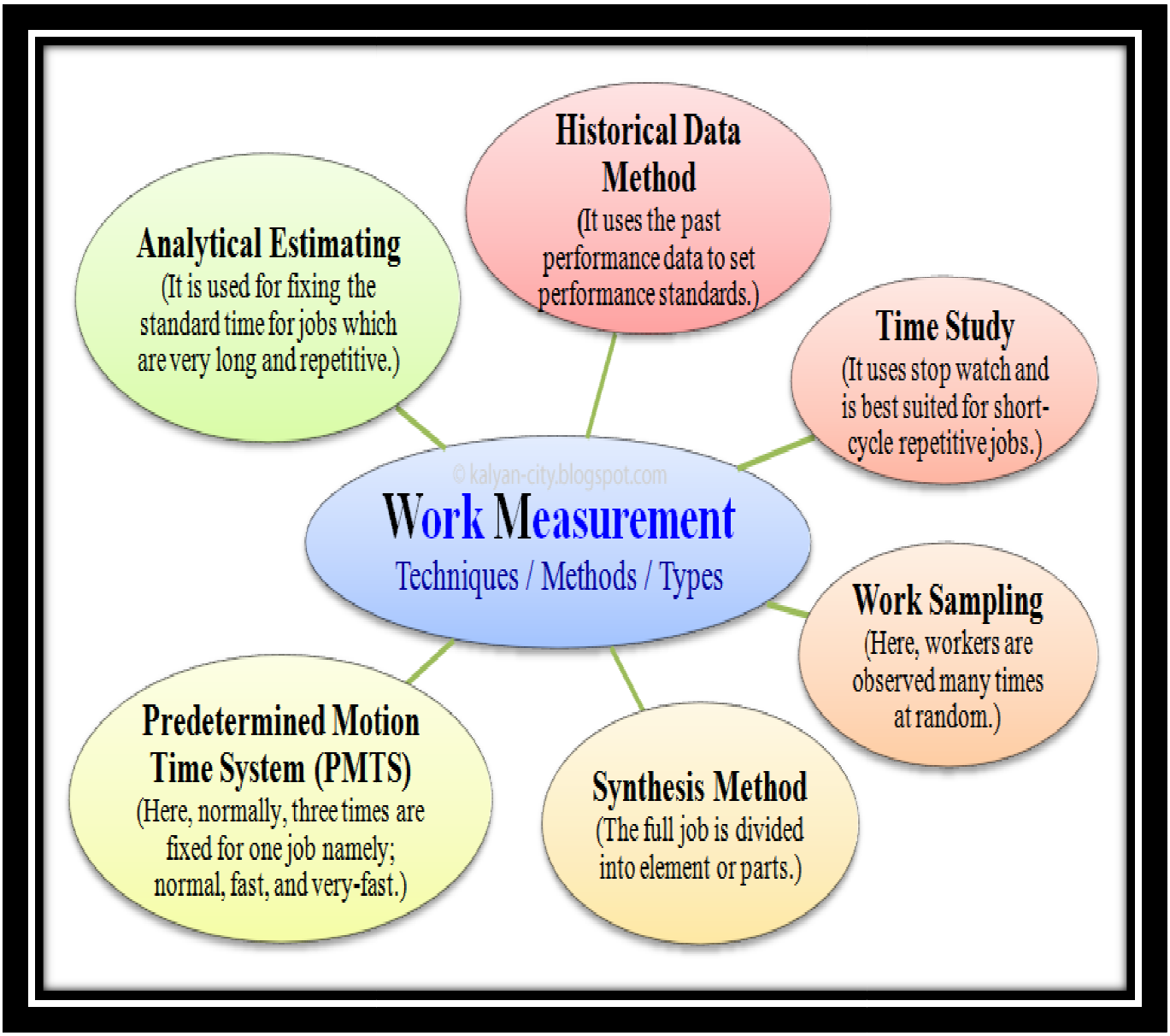
CHAPTER REVIEW:

1) List out the reasons for selection of Work measurement in an organisation.

2) How will you select a qualified worker from the available staff for conducting time study?

3) How can you measure the level of performance of qualified worker during time study?

WORK MEASUREMENT- CHAPTER- 3



VARIOUS WORK MEASUREMENT TECHNIQUES

3.1 VARIOUS WORK MEASUREMENT TECHNIQUES

1. Time study technique.
2. Production study technique.
3 Analytical estimating techniques.
4. Activity/ work sampling.
5. Pre-determined time standard systems (PTS)

3.2 TIME STUDY TECHNIQUE:

Def: It is a technique for determining as accurately as possible, the time required to carry out a specified task by a qualified worker at a defined level of performance.

TIME STUDY PROCEDURE

1. Identify the job to be time studied and the operation to be timed.
2. Obtain the improved procedure of doing the job from the method study department.
3. Select the worker for study.
4. Take the worker as well as shop supervisor into confidence and explain the objectives.
5. Collect the equipments and arrange machinery, jigs and fixtures, etc, required to conduct the time study and ensure their accuracy.
6. Explain to the worker the improved working procedure and use of tools to do the job.
7. Break the job into operations and operations into elements and record. Separate constant elements from variable elements.
8. Determine number of observations to be timed for each elements.
9. Conduct observations and record time.
10. Rate the performance of worker.
11. Repeat the steps above two for number of observations as determined in earlier steps.
12. Compute observed time from the measure central tendency.
13. Calculate the “normal time” from the observed time by using performance rating factor.
14. Add process allowance, rest and personal allowances to obtain “standard time”.

3.3 PRODUCTION STUDY TECHNIQUE:

- It is defined as a continuous study of a relatively lengthy duration extending over a period of one or more shifts.
- It is undertaken with an object of checking the existing or proposed standard time on obtaining other information affecting the rate of output.

CRITERIA FOR CHOOSING PRODUCTION STUDY

- When the job is performed by a group of persons.
- Where awarding of rating is not possible.
- When the process takes more than one shift.
- Where effective and ineffective are to be separated.

- Where ineffective time required to be segregated into avoidable and unavoidable.
- Where time can be converted into man minutes or man hours.

ADVANTAGES

- To obtain a general picture of pre-incentive performance.
- To check output limit on specified item on section or machines.
- To check the corrective ness of standard or allowed time.
- To obtain data for contingency allowance etc.
- To check waiting time and bottlenecks in production.
- To obtain information about various allowances required.

3.4 (a) PMTS, ANALYTICAL ESTIMATING TECHNIQUE

- PTS -Pre-determined Time Study.
- Does not measure elements time by a stop watch and thus avoids the inaccuracies being introduced owing to the element of human Judgment.
- It is assumed that all manual tasks in industries are made up of certain basic human movements which one common to almost all jobs.
- The average time taken by the average qualified worker to perform a basic movement to practically constant.
- Definition: A work measurement technique whereby the time is 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.

PROCEDURE:

1. Select large number of workers doing variety of jobs under normal working conditions in the workshop.
2. The jobs selected are such that they involve most of the common basic motions and are worked under different set of conditions by workers having different ages and other characteristics.
3. Record the job operations on a movie film (Micro motion study).
4. Analyze the film, note down the time taken to complete each element and compile the data in the form of a table or chart.

ADVANTAGES:

- Eliminates in-accuracies associated with stop watch time study.
- Superior to stop watch time study when applied to short cycle highly repetitive operations.
- Time standard for a job can be arrived at without going to the pace of work.
- Unlike stop watch study, no rating factor is employed.
- PTS data is more reliable and accurate as compared to stop watch time study data.
- The time and cost associated with finding the standard time for a job is considerably reduced.

3.4 (b) ANALYTICAL ESTIMATING TECHNIQUE OR STANDARD DATA TECHNIQUE:

- One the work measurement techniques even the time required to carryout the element of the job at defined level of performance is established from the knowledge and practical experience of the observer as far as elements are concerned.
- Almost similar to 'time study technique'.
- The difference - the time for each element is estimated by an observer who is an expert having the knowledge and practical experience of the element concerned.
- Most useful in engineering , construction work, erection work and Inspection.

PROCEDURE:

- Collect the full details of job.
- Analyze the job into its constituents- elements, activity, grouping to enable synthetic data to be applied if relevant.
- Apply systematic data and estimate basic time for the remaining elements and contingencies.
- Apply appropriate relaxation allowance.
- Verify the details of elemental data for job, its method and conditions.
- Sum up total time and relaxation allowance, etc. to establish standard time form the job.

ADVANTAGES:

- It possess almost the same advantages as enjoyed by synthesis of work measurement.
- It aids in planning and scheduling.
- It provides a basis for rate fixing for non-repetitive works in industries.
- It improves labor control.

LIMITATIONS:

- Since analytical estimating relies upon the judgment of estimator, the time values obtained are not as accurate and reliable as estimated by other work measurement techniques.

3.5 WORK SAMPLING TECHNIQUE:

- To evaluate the operating efficiency.
- To locate the causes of loss of efficiency.
- To reduce the idle time of men and machine.

PROCEDURE:

- Classify the strength of activity design in a chart for recording information.
- Make a pilot study.
- From the pilot study made, compute delay/inefficiency percentage.
- Determine accuracy and confidence limit.
- Calculate the number of observations required for fixing the time.
- Plan the schedule of observations.
- Proceed with sampling of observations making note of unusual point if any
- Analyse the data obtained.

ADVANTAGES:

- Generally no equipment is required for gathering data.
- Trained persons are not required to collect the data.
- Study of the number of activities can be done simultaneously.
- Work sampling techniques are not expensive to undertake.
- When it is compared to production study, it is generally liked by workers as an observer does not confront the worker through the day.
- Study can be interrupted at any time without affecting the result.
- Operations which are difficult and expensive to be measured by time study can be subjected to the work sampling techniques.

LIMITATIONS:

- It is not capable of giving elemental data.
- It is not economical for study of single operation or operator.
- When compared to stop watch study the statistical approval of work sampling is difficult to be understood by the worker as well as the management.

3.6 STOP WATCH TIME STUDY

There are four kinds of timing procedures. They are

1. Fly back method.
2. Continuous or Cumulative Method
3. Selective Method
4. Differentia Method

1. FLY BACK METHOD
    - In this method, each element is studied. The stop watch is started from zero and stopped at the end of each element.
    - Reading of time is observed and the needle is flown back to zero to start the next element immediately.
    - Same method is followed till the cycle is over.
    - This method involves three operations of the watch for each element viz., start, stop and fly back to zero.

2. CONTINUOUS OR CUMULATIVE METHOD
    - In this method, the stop watch is started with the beginning of the first element and stop at the end of the last element.
    - Timing for each element is read out and recorded in a fast manner.
    - After completing the cycle, timing of one element is separated from the subsequent element and net time taken for each element is arrived at. This method is followed when the elements are of shorter duration and quick in nature.
3. SELECTIVE METHOD
    - In any one cycle a particular element time can be recorded separately. Such method is called Selective Method.

4. DIFFERENTIA METHOD
    - This is very useful for measuring time of a smaller element. Here the time for smaller elements and bigger elements must be recorded together.

- Thereafter time of only bigger element must be recorded and same must be deducted from the total time.
  For example, let A be a small element and B be a bigger element.
  Then, (A+B) – (B) = A.

3.7 TIME STUDY EQUIPMENT

There are certain equipment's which are required to conduct the time study.

The time study equipment's include the following:

1. A Stop Watch.

2. Time Study Board.

3. Time Study Observation Sheets.

4. Rubber, Pencil, calculator, steel ruler etc.

Time study watch:

An ordinary stopwatch can serve the purpose of simple time study work. But for the sake of the foolproof use of stopwatch and technological advances in the development of watch industry, one of the following stopwatches for the purpose of time study may be used.

(a) Plain Decimal-minute stopwatch:

Fig. 1 shows this type of watch. The large hand of this watch makes one revolution in one minute. The dial is divided into 100 divisions and each division shows 0.01 minute. The small hand completes one revolution in 30 minutes, with the dial markings showing one minute interval.

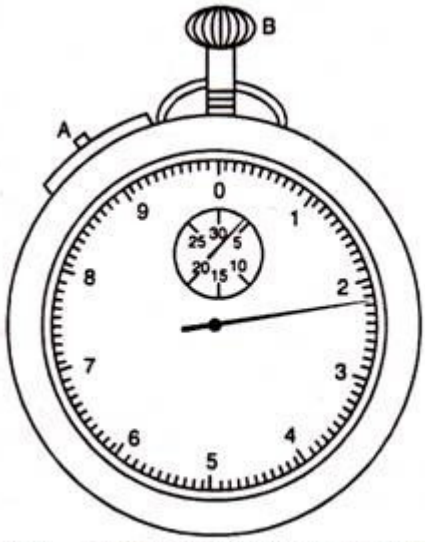


Fig. 1. Plan Decimal-minute stopwatch

The watch is started by moving slide (A) towards the stem and stopped by moving the side away from the stem. Pressure on crown (B) resets the hard to zero. The use of this type of watch for time study purpose is much more than that of the others.

(b) Decimal Hour stopwatch:

This type stopwatch is shown in Fig 2 The large dial is graduated into 100 divisions each representing 0.0001 hour. The large hand makes one revolution in 36 seconds or 0.01 hour. The small hand revolves once for each 30 revolutions of large hand, so that each of 30 small divisions show 0.01 hour.

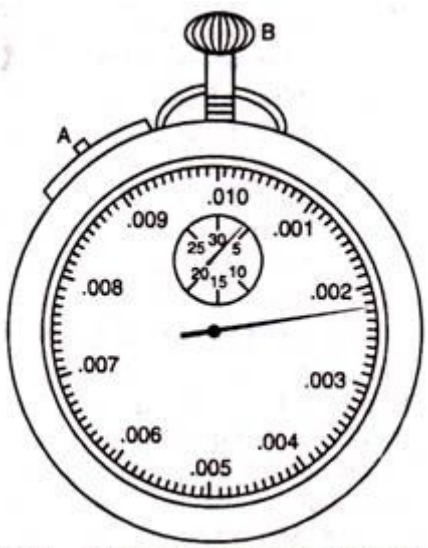


Fig. 2. Decimal hour stop watch

(c) Split-hand stopwatch:

This watch is shown in Fig.3. The large dial divisions for the large two hands are 0.01 minute, with one revolution showing one minute. Successive presses on crown (B) will start the both hands, stop them and return them to zero. Pressing pin A holds one of the large hands at whatever prior position is attained, but allows the other hand to continue its progress.

Thus the observer can then record the time shown by the stopped hand while the next element is being timed. The second pressure on pin (A) causes the stopped hand to instantly catch up the moving hand and continue with it. The timing proceeds in this manner to the end of the study.

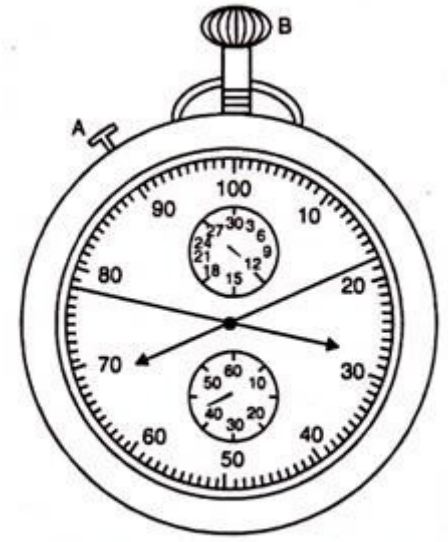


Fig. 3. Split hand decimal minute stopwatch.

The upper small hand registers minutes upto a total of 30 and runs continuously, while the lower small hand accumulates seconds upto 60 in a like manner. This watch is not fit for snapback method.

(d) Wink stopwatch:

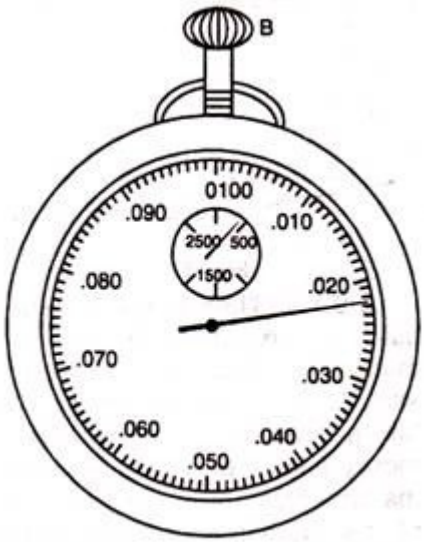


Fig. 4. Decimal minute wink watch.

Fig.4 shows this watch. Each division of large dial represents 0.001 minute, which means one complete revolution of large hand is equal to 0.100 minute or 6 seconds. Each division of small dial equals 0.100 minute and a maximum of three minutes can be accumulated for each time the crown is depressed. This watch is started by pressing the crown stopped by pressing the crown and reset by pressing the crown.

Time study board:

The data or observation sheet, the stopwatch and pencil should be held by a specially designed board shown in Fig. 5. This board provides a convenient writing surface by holding the observation sheet.

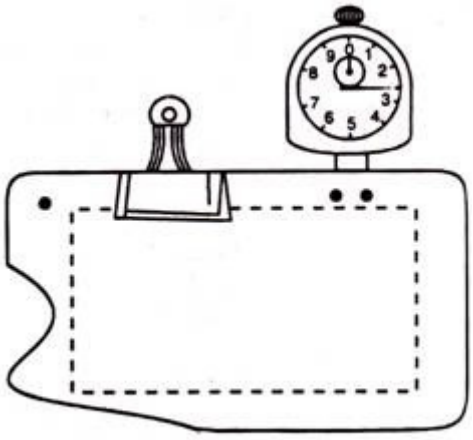


Fig. 5.

It also holds the stop watch in position to be operated by the left-hand free to record observations. The watch is held in a locked holder which gives protection against breakage, permits functioning at an angle to avoid glare on its face and offers a maximum of visibility in use. The board should be of highly polished, smooth, black, rigid plastic or wood material. Approximate dimensions are 13" x 13" x 1/8" to 1/4".

Special boards should be given to the left-handed persons. Other special types of boards are also available. One of them is known as 3-watch board shown in Fig 6 A quick click lever at the upper right-hand side of the board is used to actuate all the three watches.

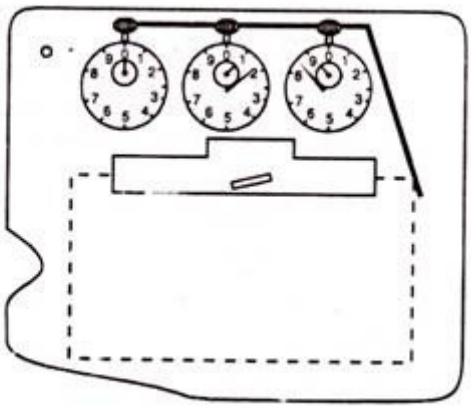


Fig. 6. Three stopwatch time-study board

3.8 TIME STUDY FORMS

Time study can be made on a plain paper but it is very difficult to rule up new sheet every time when study is to be made. Thus, it is more convenient to have the printed forms of a standard size, so that they can be filled neatly. There is no single standard format for taking time study observations.

There are two types of study sheets which mostly finds their use. One is the sheet which is used while making actually the time study or at point of observations. Second is the sheet which is used after study has been taken in the study office. There sheets find their use in study office where as the other are used on the study board.

(a) Sheets used on Study Board:

(1) Time Study Top Sheet:

This is the introductory sheet of the time study. On this sheet, all the essential information about the study is recorded. The top of this sheet shows the detail of operations and the main body shows the elemental break down. Sometimes name tags are given to those elements which are used in other sheets. Fig. 7 shows a typical time study sheet

Time study sheet

Product..... Time study Observer.....
Operation No..... Date.....
No. of cycles.....
Standard time found.....

Element Description	Observed time (stop watch Reading)					Averaged Observed Time	Rating Factor	Normal Time	Allow ances	Standard Time
	1	2	3	4	5					

Fig. 7.

(2) Continuation Sheet:

These are used for further cycles of the study. It consists only of the columns and space for the study and sheet number.

(b) Sheet used in Study Office:

(1) Working sheet:

Working sheets are used for analysing the readings which are obtained during the study. Basic time can be averaged on this sheet. Moreover, the proportions of occupied and unoccupied times can be calculated.

(2) Study summary sheet:

Selected times for all the elements with the frequency of their occurrence are transferred to study summary sheet. This sheet summarises all the relevant information which has been obtained during the time study.

The study summary sheet is clipped at the top of all the other study sheets and thus, is filled with them. Thus, the size of the summary sheet should be same as that of the other study sheets. Foreign elements should also be listed on this sheet.

(3) Analysis of studies sheet:

As the name suggests, the results obtained from the study summary sheet are recorded on this sheet. From this sheet, the basic times for the elements of the operation of the operation cycle are compiled. Usually, thin sheet is must larger than the ordinary study sheets.

(4) Relaxation allowance sheet:

On this sheet, the fatigue and relaxation allowances for each element is tabulated and calculated.

3.9 SELECTION OF JOB TO BE STUDIED

There are certain factors which are to be taken into account while selecting the work for method study:

(1) Economic factors:

Only those jobs are selected which keep good economic importance. Jobs involving bottlenecks which hold up other production operations, operations involving repetitive work etc. are the works that are investigated and studied.

(2) Technical factors:

Availability of the technical knowledge with which study is to be carried out is an important consideration that is to be kept in mind while selecting the job. Take an example of a machine tool which in not running at a speed at which the efficiency is maximum.

So, study will say that speed should be increased but, can the tool be speeded up or in the machine structure able to take up this increased load are the questions which always comes in mind while selecting the job to be studied.

(3) Human considerations:

Human reactions are always very difficult to predict. So, the experience of local personnel and conditions will reduce the problems. So, if the works selected involves the unpleasant features like dirty jobs or lifting of heavy weight are readily accepted by the workers.

3.10 DIVIDING THE JOB INTO ELEMENTS

- An element is defined as a distinct part of a specified job, selected for convenience of observation, measurement and analysis.
- The question of breaking the job into elements for time study is based on the above considerations.
- It depends on the nature of job and purpose of study.

REASONS FOR BREAKING THE JOB

- To know effective and ineffective part of a job.
- To rate as accurately as possible.
- To know elements of high fatigue.
- To give standard time value for every element.

3.11 KINDS OF ELEMENTS

1. MANUAL ELEMENTS:
    - Performed manually without the help of power driven machine.
2. MACHINE ELEMENTS:
    - A process or activity performed with the help of a power driven machine.
3. REPETITIVE ELEMENTS:
    - Element which is performed during every job.
4. NON-REPETITIVE ELEMENTS:
    - Elements which are not performed during every job.
5. CONSTANT ELEMENTS:
    - Elements which are constant in nature.

CHAPTER REVIEW:

1) Give any two practical examples in Railways for each type of work measurement technique.
2) List out the equipment and charts to be kept ready for work measurement and mention the usage of them at site briefly.
3) Why a job to be studied shall be divided into elements. Describe with an example.

WORK MEASUREMENT- CHAPTER- 4

RATING – INTRODUCTION

4.1 RATING – INTRODUCTION:

During the time study, time study engineer carefully observes the performance of the operator. This performance seldom conforms to the exact definition of normal or standard. Therefore, it becomes necessary to apply some 'adjustment' to the mean observed time to arrive at the time that the normal operator would have taken to do that job when working at an average pace. This 'adjustment' is called Performance Rating.

Determination of performance rating is an important step in the work measurement procedure. It is based entirely on the experience, training, and judgment of the work-study engineer. It is the step most subjective and therefore is subject to criticism.

Performance Rating can be defined as the procedure in which the time study engineer compares the performance of operator(s) under observation to the Normal Performance and determines a factor called Rating Factor.

$$\text{Rating factor} = \frac{\text{Observed Performance}}{\text{Normal Performance}}$$

Example

A work cycle has been divided into 8 elements and time study has been conducted. The average observed times for the elements are given in the following Table:

Element No.	1	2	3	4	5	6	7	8
Element Type	M	M	P	M	M	M	M	M
Average actual time (minutes)	0.14	0.16	0.30	0.52	0.26	0.45	0.34	0.15

M = Manually Controlled, P = Power Controlled

Total observed time of work cycle = 2.32 min.

Suppose we select three elements 2, 5 and 8 (These must be manually controlled elements). By using some PMT system, suppose we determine the times of these elements as

Elements No.	2	5	8
PMT System times (min)	0.145	0.255	0.145

Rating factor for element 2 = 0.145 / 0.16 = 90.62 %.

Rating factor for element 5 = 0.255 / 0.26 = 98.08 %.

Rating factor for element 8 = 0.145 / 0.15 = 96.66 %.

The mean of the rating factors of selected elements = 95.12 % or say 95 % is the rating factor that will be used for all the manual elements of the work cycle.

The normal time of the cycle can then be calculated as.

Element No.	1	2	3	4	5	6	7	8
Element Type	M	M	P	M	M	M	M	M
Average actual time (min)	0.14	0.16	0.30	0.52	0.26	0.45	0.34	0.15
PMT system time (min)		0.145			0.255			0.145
Performance Rating Factor	95	95	100	95	95	95	95	95

Normal Cycle Time

= 0.95(0.14+0.16+0.52+0.26+0.45+0.34+0.15) +1.00(0.30)

=1.92+0.30

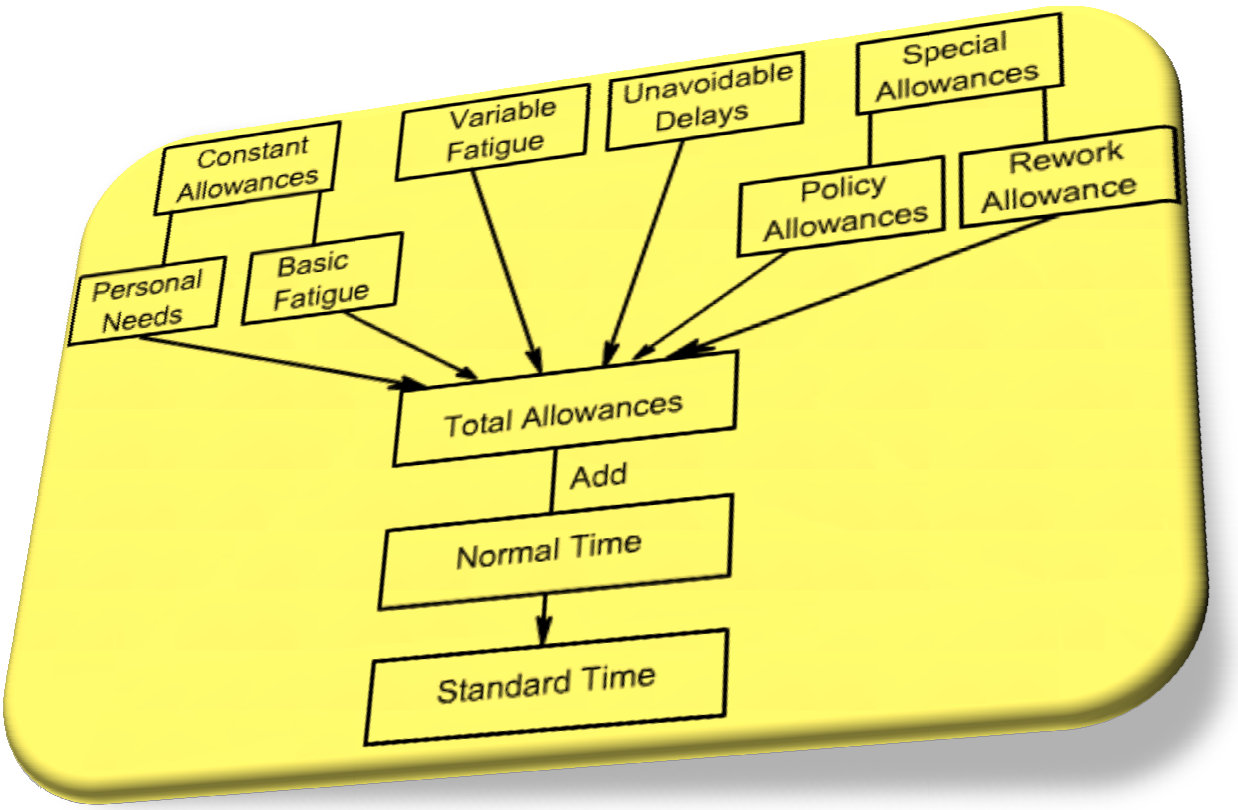
=2.22 minutes

It is to be noted that power controlled (or machine-paced) elements are always given 100% rating.

CHAPTER REVIEW:

1) Signify the importance of rating in time study.
2) Distinguish the ratings applied to various classification of works in Railways.

WORK MEASUREMENT- CHAPTER- 5



RATING AND ALLOWANCES

5.0 RATING- INRODUCTION:

5.1 Conducting of Observations

- The sample size of observations i.e., the no. of observations required for each element is taken, so that a predetermined confidence level and accuracy margin are achieved.
- This can be done by applying either a statistical method or a conventional method.
- While applying the statistical method, a no. of preliminary readings are first taken. Subsequently, the no.of observations (i.e., sample size) required to reach the set confidence and accuracy level can be calculated.
- For instance, for a 95% confidence level & an accuracy level of ±10%the following formula is used.

$$N = \left\{ \frac{20\sqrt{n'\sum x^2 - (\sum x)^2}}{\sum x} \right\}^2$$

Where n' = determined sample size

$\sum x$ = the sum of the preliminary set of individual Observations

$\sum x^2$ = the sum of the squares of the individual observations of the preliminary set of readings.

5.2 Recording OT

The purpose of rating is to determine, from the time actually taken by the operative being observed, the standard time which can be maintained by the average qualified worker and which can be used as a realistic basis for planning, control and incentives schemes.

The speed of the working as recorded by the time taken to carry out the elements of the operation is the only thing which can be measured with a stop watch.

It is very easy for an inexperienced study man either to be fooled by a large no. of rapid movements into believing that an operative is working at a high rate or to under estimate the rate of working of the skilled operative whose apparently slow movements are very economical of motion. Effort is very difficult to rate. The result of exerting effort is usually only seen in the speed.

Operations involving mental activities such as judgement of finish in inspection work are most difficult to assess. Experience of the type of work is required before satisfactory assessments can be made. Rating to the nearest value is found to give sufficient accuracy in the final result. (Instead of 62.5 say 70). Greater accuracy than this can be attained only after very long training & practice.

5.3 Awarding OR

The following scales of rating are in common use.

1. 60-80 Rating scale
2. 75-100 Rating scale
3. 100-133 Rating scale

In the above scales of rating, normal performance is indicated as 60, 75 & 100. The proper performance is being placed below the normal rating. For example, in 60-80 scale, 60 represents normal rating and 80 represents the standard rating.

This scale of rating is followed in repair workshops. In the above scale of rating, the vertical imaginary line is known as rating scale and the readings 60, 65, 70, 75 & 80 are known as rating. Normal rating is awarded to average worker.

In 75-100 scale, 75 represents normal rating and 100 represents the standard rating. This scale of rating is followed in production units.

In 100-133 scale, 100 represents normal rating and 133 represents the standard rating. This scale of rating is followed in public sector units.

5.4 Factors affecting worker's performance

Variations in actual times for a particular element may be due to factors outside or within the control of worker.

Those outside his control may be.

1. Variations in the quality or other characteristics of the material used, although they may be within the prescribed tolerance limits.
2. Changes in the operators, efficiency of tools or equipment within their useful life.
3. Minor and unavoidable changes in methods or conditions of operation.
4. Variations in the mental attention necessary for the performance of certain of the elements.
5. Changes in climate and other surrounding conditions (Eg. Light, temperature)

Factors within his control may be:

1. Acceptable variations in the quality of the product.
2. Variations due to his ability.
3. Variations due to his attitude of mind, especially his attitude to the organisation for which he work.

The factors within his control can affect the times of similarly described elements of work by affects:

a) The pattern of his movements
b) His works place
c) Both in varying proportions

The study man must, therefore have a clear idea of the pattern of movement which a qualified worker should follow, and of how this pattern may be varied to meet the range of conditions which that worker may encounter.

5.5 Comparison of Observed and Standard ratings

Rating depends upon the speed and effectiveness of man works on each element against concept of standard, so that observed time can be converted into 'Basic Time'.

Basic time are those, which would have been taken had the worker can done the job at a standard rating without any relaxation allowance being taken. Basic timing is applicable to incentive worker without any capable supervisor, but it is motivated by monetary benefits.

$$\text{Basic Time (BT)} = \frac{\text{OT X OR}}{\text{SR}}$$

Take the following example,

Scale: 75- 100

PERSON	OBSERVED TIME (OT)	OBSERVED RATING (OR)	BASIC TIME (BT)
A	0.20	100	0.20
B	0.16	125	0.20
C	0.25	80	0.20

From the above figures, we gather the following.

1. 'A' is a standard worker, 'B' is a fast worker and 'C' is a slow worker.
2. While the observed time varies, the basic time is constant which is obtained by multiplying the observed time by the rating factor.
3. For a standard worker the rating is 100, for a fast worker it is more than 100 and for a slow worker it is less than 100.

5.6 Recording of observation on Time study form

The time study form is a pre-designed printed/cyclostyled/photocopied forms of standard size which allow the observer to record the relevant observations in present locations in the form.

The design of the form should be such that it automatically ensures recording of all significant data. The standard size also enables subsequent filing of individual forms without affecting the readability of such data even after being filed.

The design of such forms, particularly so far as its layout is concerned is found to vary rather widely.

Two types of forms are used: (1) those used to record the observation with such overall size that they can be fitted on to the time-study board conveniently, and (2) those which are to be used in the time study office after the observations have been recorded in the first type of forms.

5.7 Number of observations

The sample size of observations i.e., the no.of observations required for each element is taken so that a predetermined confidence level and accuracy margin are achieved.

This can be done by applying either a statistical method or a conventional method.

While applying the statistical method, a no.of preliminary readings are first taken. Subsequently the no.of observations, i.e., sample size, required to reach the set confidence and accuracy level can be calculated.

5.8 Determining BT

The basic time is determined from the observed time as follows:

$$\text{Basic Time} = \text{Observed Time} \times \frac{\text{Observed Rating}}{\text{Standard Rating}}$$

5.9 The analysis of WM, Work content

The Work content is calculated from Basic Time as follows:

Work Content = Basic Time + Relaxation Allowance

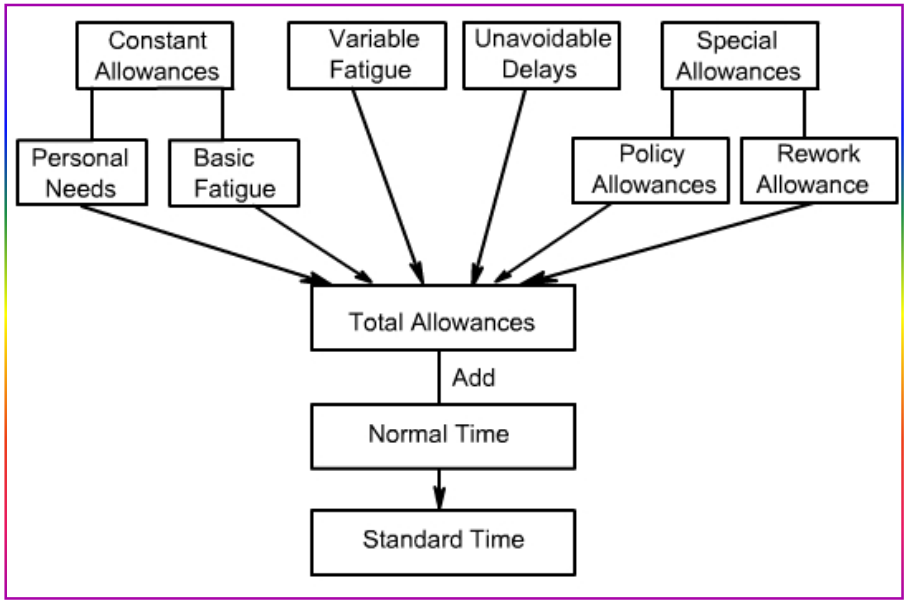
5.10 Various Allowances, its calculations

Allowance means it includes the time which is admissible and added to basic time to compensate workers for fatigue, interference and other contingencies.
Allowances depend upon the job, place, nature and several other things are admissible in performing a job to relieve a person from physical, mental and other functional strains.

There are several type of such allowances are given which are to be summed up to work content and arrived at standard time (ST)

These allowances may fall into one or more of the following categories.

a) Process allowance
b) Relaxation allowance
c) Special allowance
d) Policy allowance



Process allowance:

A process allowance is an allowance of time given to compensate for enforced idleness (which would otherwise cause loss of earning power) on the part of an operator due to the character of the process or operation on which he is employed. For example, an operator may not be able to work because he has to wait for a machine to complete its own part of the cycle. In this case, there is a loss of production for which the operator is not responsible. He must therefore be covered against these losses. This allowance is also called unavoidable delay allowance.

Relaxation allowance:

Relaxation allowance is provided to the worker to recoup his physical and mental strain to carry out the job under different conditions and also to attain his personal needs. The quantum if this allowance depends upon the nature of job. This allowance is given as percentage of the basic time. The strain due to physical and mental exertion is known as basic fatigue.

Special allowance:

Special allowances are given for activities not normally forming part of the operation cycle but essential to satisfactory performance of the work such allowances may be permanent or temporary and fall into three broad classes.

1. **Periodic activity allowances:**
   Allowances for activities carried out at definite intervals or after performing a specified number of cycles, Ex. Regrinding tools, cleaning machines etc.
2. **Interference allowances:**
   This allowance is given to compensate for the loss of earnings as a result of the production loss.
3. **Contingency allowances:**
   A small allowance of the order of 5% given to cover irregular occurrences which are known to happen but whose incidence it may not be possible or economic to study.

Policy allowances:

This allowance is given at the discretion of the management over and above the allowances given to features inherent in the work under consideration. This is used for calculating payments only in order to enhance the performance of the worker.

5.11 RA and other allowances

(a) General handling and Contingencies: This includes cleaning swarf, grinding of tools, using of spanners, procuring cutting compound etc. and for this purpose, **an allowance upto10%** on the operating time is given.

(**Authority:** B**oard's Letter No. 99/M (Prod)/814/35 dated 14-03-2000) acs no.2**

(b) Gauging on machining: 5% allowance is added for all machining operations where gauging is necessary.

(c) Fatigue. As it is not humanly possible for any person to work continuously with a set-speed, an allowance to cover fatigue is added. Since this varies with the types of work, **an allowance up to 12 % is given.**

(**Authority:** B**oard's Letter No. 99/M (Prod)/814/35 dated 14-03-2000) acs no.2**

(d) **Production bonus:** An allowance of 33⅓% is added as production bonus.

Add allowances as under.

(a)Fatigue 25% = 1x 0.25 =0.25
= 1+0.25 =1.25 hrs.
(b) Contingency 12% = $\frac{1.25 \times 12.5}{100}$ = 0.156 hrs.
= 1.25x0.156 =1.406 hrs.
(c) Bonus 33⅓% = $\frac{1.406 \times 100}{3 \times 100}$ = 0.468 hrs.
=1.406+.468 = 1.87 hrs.
(d) Gauging 5% (Not on jobs) = $\frac{5 \times 1.87}{100}$ = 0.09.
= 1.87+0.09 = 1.96

The allowed time for this job will be issued as under :

Without Gauging = 1.87 hrs.
and with Gauging = 1.96 hrs.

In this case 75 % of the allowed time of 1.96 hrs. = 1.46 hrs.

Time saved= 1.96 hrs. - 1.46=0.50 his.

This time saved is equivalent to 33⅓ % of the time taken which proves that the average worker will complete an operation in 75% of the allowed time when he will earn 33⅓% of bonus.

5.12 Standard Time

The **standard time** is the time required by an average skilled operator, working at a normal pace, to perform a specified task using a prescribed method. It includes appropriate allowances to allow the person to recover from and, where necessary, an additional allowance to cover contingent elements which may occur but have not been observed.

CHAPTER REVIEW:

1) Justify the statement 'Observed Time is not the Standard time for a specified job'.
2) Identify the applicable rating scale for various specified jobs in Indian Railways.
3) What are the various allowances are to be considered as prescribed by Railway Board.

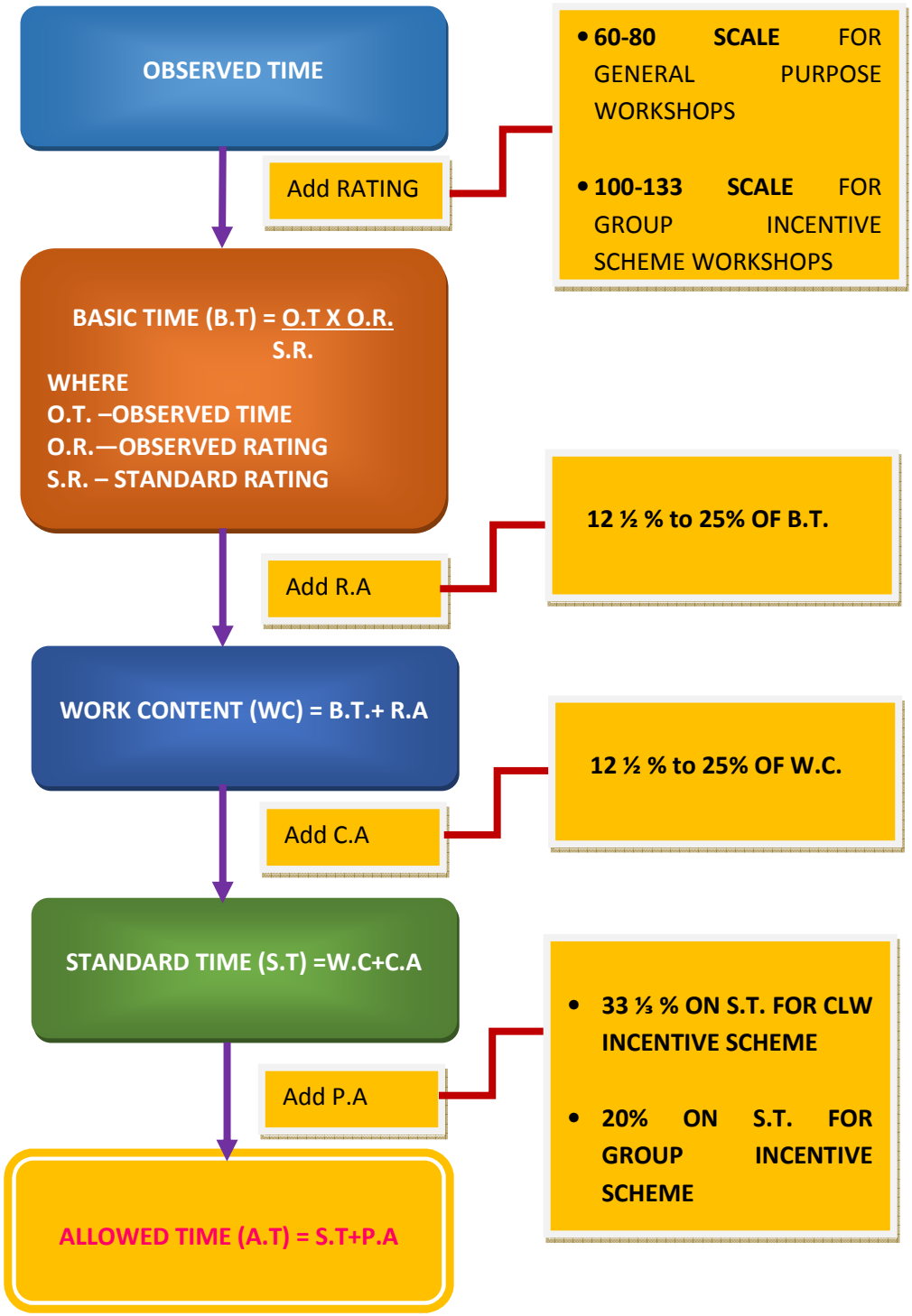
REVISED TRAINING MODULE FOR THE ADVANCED WORK STUDY COURSE

WORK MEASUREMENT- CHAPTER- 6

TIME STUDY PRACTICAL EXAMPLES FOR INCENTIVE AND NON-INCENTIVE WORKERS

6.0 TIME STUDY PRACTICAL EXAMPLES FOR INCENTIVE WORKER

FLOW CHART FOR CALCULATIONS OF ALLOWED TIME FOR INCENTIVE WORKER



6.1 TIME STUDY PRACTICAL EXAMPLES FOR NON-INCENTIVE WORKER

FLOW CHART FOR CALCULATIONS OF ALLOWED TIME FOR NON-INCENTIVE WORKER

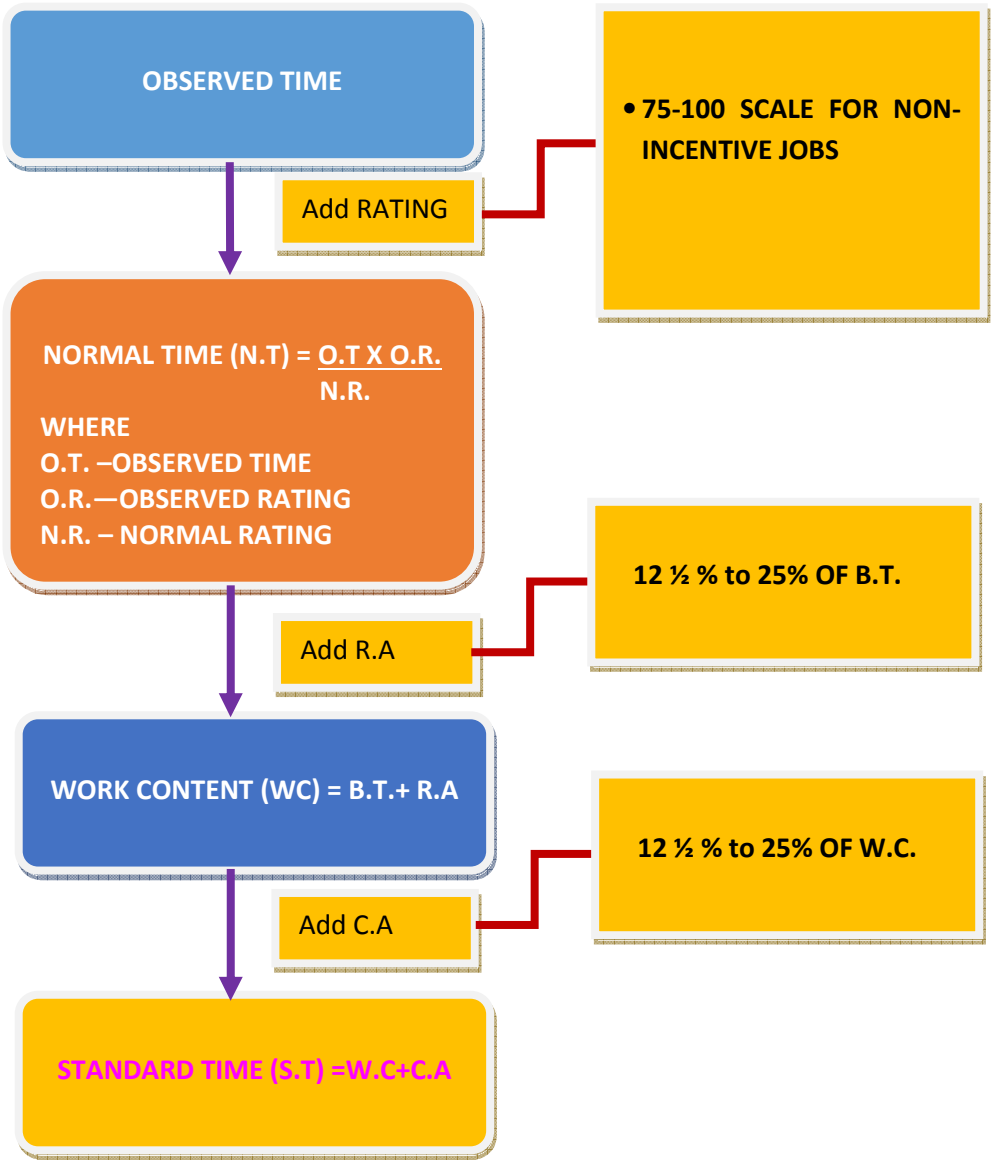


ILLUSTRATION 1: A job consists of 6 elements. Find out standard time for non-incentive work and Allowed Time for incentive work duly arriving RA @ 12 ½ %, CA @12 ½ % and Policy Allowance for incentive work is 33 ⅓ %. Apply 75-100 scale for both types of work for understanding purpose. Note that all timings are in centi-minutes.

S.No.	*O.T.*	*O.R.*
1.	100	80
2.	125	75
3.	75	70
4.	60	90
5.	80	100
6.	85	110

Solution:

From the given data, first Normal Time of each element shall be determined.

S.No.	O.T.	O.R.	NT =O.T. X
1.	100	80	107
2.	125	75	125
3.	75	70	70
4.	60	90	72
5.	80	100	107
6.	85	110	125
	∑ NT =		***606***

Adding RA @12 ½ % to NT (i.e., =75.5), Work Content (W.C)=606 + 75.5 =681.5 centi-minutes.

Adding CA@12 ½ % to WC (i.e., =85.2), Standard Time (ST) = 681.5 + 85.2 = 766.7 centi-minutes.

Or 766.7/100 = 7.6 or say 7 minutes. This calculation is done for Non-incentive job.

For Incentive calculations, again it has to be considered the table given the illustration and standard time shall be determined.

S.No.	O.T.	O.R.	ST =O.T. X
1.	100	80	80
2.	125	75	94
3.	75	70	53
4.	60	90	54
5.	80	100	80
6.	85	110	94
	∑ NT =		***455***

Adding RA @12 ½ % to NT (i.e., =56.8), Work Content (W.C)=455 +56.8 =511.8 centi-minutes.

Adding CA@12 ½ % to WC (i.e., =63.9), Standard Time (ST) = 511.8 +63.9 = 575.7 centi-minutes.

Adding PA@33 ⅓ % to ST(i.e., =191.9), Allowed Time (AT) = 767.6 centi-minutes.

Or 767.6/100 = 7.6 or say 7 minutes. This calculation is done for incentive job.

Observations: (1) The Standard Time for non-incentive work and Allowed Time for Incentive work for same job is more or less same.

(2) The average worker can finish his work by the Standard time.

(3) The average worker can finish his work by Allowed time but he is not entitled to earn extra money as incentive. He can earn this amount only when complete his work before the Allowed time and based on his individual saved hours, he will get his extra perks.

CHAPTER REVIEW:

1) Prepare a sample time study calculation for an incentive job and for a non-incentive job.
2) Explore your views on time derived to a specified job with incentive and without incentive.

WORK MEASUREMENT- CHAPTER- 7

Calculating Average Cycle Time for Spring Assembly

Time Study Sheet (Recording Cycle Time) Date xx/xx/xx

Task ID#	Element Name and ID#	Cycles—Repeated Measures 1	2	3	4	5	6	7	8	$\bar{X}$	Observations on Difficulties and Allowances
1	1A. Attach washer, thread nut	8	10	12	9	12	10			10.2	
	1B. Tighten screw to base	19	12	15	16	11	18			13.7	
	1C. Tension spring to spec	25	35	40	28	32	51			35.2	Often difficult to tension
	1D. Measure spring tension	8	12	7	15	9	8			9.8	
2											

Task ID# 1: Total cycle time per task/elements 413

Number of cycle time measures 24

☒ Seconds ☐ Minutes ☐ Hours $\bar{X}$ CT: 69

Difficulty adjustment: 10

Allowance adjustment: 0

Allowed time: 79

Notes: – $\bar{X}$CT = average cycle time (413 ÷ 6 = 68.8)
– Recheck allowed time periodically

SUMMARISING THE STUDY

7.0 SUMMARISING THE STUDY

The observed time recordings shall be collected and computed based on its observed rating so as to obtain basic time for incentive jobs and normal time for non-incentive jobs. Add allowances accordingly and compile to determine Allowed Time for Incentive jobs and Standard Time for non-incentive jobs.

7.1 NUMBER OF CYCLES STUDIED

The sample size of observations i.e., the no. of observations required for each element is taken, so that a predetermined confidence level and accuracy margin are achieved.

This can be done by applying the statistical method, a no. of preliminary readings (n') are first taken. Subsequently, the no.of observations (i.e., sample size) required to reach the set confidence and accuracy level can be calculated.

For example, for 95% confidence level and an accuracy level of ±10% the following formula is used:

$$n = \left[\frac{20\sqrt{n'\sum x^2 - (\sum x)^2}}{\sum x}\right]^2$$

Where, n' = determined sample size

$\sum x$ = the sum of the preliminary set of individual observations

$\sum x^2$ = the sum of the sequences of the individual observations of the preliminary set of readings.

Example: All the preliminary level 5 observations are made with the individual observations being 7, 6, 7,7 and 6 units of time (1 unit of time = 0.01 minute).

Therefore, n' = 5, $\sum x = 7 + 6 + 7 + 7 + 6 = 33$

$\sum x^2 = 49 + 36 + 49 + 49 + 36 = 219$

And $n = \left[\frac{20\sqrt{5 \times 219 - 33^2}}{33}\right] = 2.4$ or say 3 observations.

However, the statistical method possess some practical difficulties in its application acceptance; like :

- The method is cumbersome.
- It is diffucalt to determine the best size for an operation, since the operation usually consists of several elements each of which may be required to be observed for different no.of times for any set of confidence and accuracy level.
- Ensuring the holding of the assumptions inherent to the statistical method formation.

These limitations have led to a conventional guide of a no.of cycles to be timed based on the total no. of minutes per cycle.

7.2 ANALYSING THE STUDY SHEET

When it is considered that enough observations are made, the next step is to calculate the final representative basic times for each element. This is done on the analysis of time study sheets. The usual method being to calculate the overall weighted average of all the basic times recorded for each element, disregarding any entries which subsequent study work has shown to be erroneous. The weighted average is obtained by multiplying the basic time recorded from a

study by the number of observations of the element made in that study, adding up the products so derived for all the studies, and dividing the total by the sum of all the observations made in all the studies.

7.3 PREPARING THE STUDY SUMMARY SHEET

The first step is to complete the data at the head of the study summary sheet, copying the details neatly, in ink, from the study sheets. From the time off and the time on, the elapsed time may be calculated and entered. When cumulative timing is being practised, the elapsed time should of course agree with the final watch reading. If it does not, there is an error witch must at once be investigated. It is no use doing further work on the study until this is cleared up, for a serious error may be cause for scrapping the study and starting again. Deducting from the elapsed time the total 'check time' - the sum of the 'time before' and the 'time after' – yields the net time. This should agree with the sum of all the observed times when using flyback timing, or the sum of all the subtracted times with cumulative timing.

On the body the summary sheet the study person next lists all the repetitive elements observed, in order of their occurrence, noting the break points used on the reverse of the sheet. When the entries have been made, the sheet should provide for a summarises record of everything that has been observed during the study.

7.4 ALLOWANCE OF STANDARD TIME, STANDARD DATA

Allowances means it includes the time which admissible and added to basic time to compensate workers for fatigue, interference and other contingencies.

Allowances depend upon the job, place, nature and several other things are admissible in performing a job to relieve a person from physical, mental and other functional strains.

There are several type of such allowances are given which are to be summed up to work content and arrived at Standard Time (ST).

These allowances may fall into one or more of the following categories:

- Process Allowance
- Relaxation Allowance
- Special Allowance
- Policy Allowance

Process Allowance:

A process Allowance is an allowance of time given to compensate for enforced idleness (which would otherwise cause loss of earning power) on the part of an operator due to the character of the process or operation on which he is employed. For example, an operator may not be able to work because he has to wait for a machine to complete its own part of the cycle. In this case, there is a loss of production for which the operator is not responsible. He must therefore be covered against these losses. This allowance is also called unavoidable delay allowance.

RELAXATION ALLOWANCE: Relaxation allowance is provided to worker to recoup his physical and mental strain to carryout the job under different conditions and also to attain his personal needs. The quantum of this allowance depends upon the nature of a job. This allowance is given as percentage of the basic time. The strain due to physical and mental exertion known as basic fatigue.

SPECIAL ALLOWNACES

Special allowances are given for activities not normally forming part of the operation cycle but essential to satisfactory performance of the work. Such allowances may be permanent or temporary and fall into three broad classes:

- PERIODIC ACTIVITY ALLOWNACES: Allowances for activities carried out at definite intervals or after performing a specified number of cycles e.g., regarding tools, cleaning machines etc.
- INTEREFERENCE ALLOWANCES: This allowance is given to compensate for the loss of earnings as a result of the production loss.
- CONTINGENCY ALLOWNACE: A small allowance of the order of 5% given to cover irregular occurrences which are known to happen but whose incidence it may not be possible or economic to study.

POLICY ALLOWANCES: This allowance is given at the discretion of the management over and above the allowanced given to features inherent in the work under consideration. This is used for calculating payments only in order to enhance the performance of the worker.

7.5 USE OF TIME STANDARDS IN PALNNING, SCHEDULING COST ESTIMATES ETC.

A well structured organisation embracing Work Measurement Standards would normally be characterised by employing the following principles and procedures and the time standards are used in the following areas:

- Defining the work covered by the allowed (agreed) time - the Job Specification;
- The Standard Minute or Work Unit;
- Programme Planning and the Utilisation of Plant & Labour - Work Plan;
- Estimating;
- Standard Costing & Budgetary Control;
- Incentive Schemes;
- Organisation of the daily recording system associated with Work Measurement: Labour-Cost Control.

CHAPTER REVIEW:

1) Why allowances to be considered while compiling the time?
2) Mention various allowances in % to be taken in compilation to a specified job as per Railway Board's guidelines.

WORK MEASUREMENT- CHAPTER- 8

ANALYTICAL ESTIMATING TECHNIQUES

8.0 ANALYTICAL ESTIMATING TECHNIQUES

Analytical estimating technique is one of the work measurement techniques even the time required to carry out the element of the job at defined level of performance is established from the knowledge and practical experience of the observer as far as elements are concerned. It is almost similar to time study technique that different being that the time for each element is estimated by a person (observer) who is an experience of the element concerned rather than using a stop watch as done in time study technique. This technique is most useful in Engineering, construction work, erection work and Inspection.

8.1 STEPS IN ANALYTICAL ESTIMATING

- Collect the full details of job (diameter, tools, method etc)
- Analysing the job into its constituents elements, activity, grouping to enable synthetic data to be applied if relevant.
- Apply systematic data and estimate basic time for the remaining element and contingencies.
- Apply appropriate relaxation allowance.
- Verify the details of elemental data for job, its method and conditions.
- Sum up total time and relaxation allowance etc., to establish standard time for the job.

8.2 NEED OF ANALYTICAL ESTIMATING TECHNIQUE

The technique of work measurement is used to determine the time values for jobs, having long and non-repetitive operations. The time values are determined by using synthetic data or on the basis of the past experience of the work study engineer, when no synthetic or standard data is available. It is essential, that the estimator must have adequate experience of estimating, motion study, time study and the use of standard data(or synthesized time standards).

8.3 PROCEDURE WITH TYPICAL EXAMPLE OF ESTIMATING THE REQUIRED FOR COMPLETION OF THE JOB

- Classify the strength of activity design in a chart for recording information.
- Make a pilot study.
- From the pilot study made, compute delay/inefficiency percentage.
- Determine accuracy and confidence limit.
- Calculate the number of observations required for fixing the time.
- Plan the schedule of observations.
- Proceed with sampling of observations making note of unusual point if any.
- Analyse the data obtained.

Example:

Date:	*Name of Observer:*	*Study sheet no.*	
Number of observations:		***Total No.***	**%**
Machine Running	Working	62	**62%**
Machine Idle	Repair	8	**38%**
	Supply	7	
	Personnel Need	10	
	Idle	13	

8.4 PRODUCTION STUDY TECHNIQUES

It is defined as a continuous study of a relatively lengthy duration extending over a period of one or more shifts. It is undertaken with an object of checking the existing or proposed standard time or obtaining other information affecting the rate of output. Production study may also be called as output study.

8.5 SUITABLE AREAS OF APPLYING THE TECHNIQUE

- When the job is performed by a group of persons.
- Where awarding of rating is not possible.
- When the process takes more than one shift.
- Where effective and ineffective are to be separated.
- Where ineffective time required to be segregated into avoidable and unavoidable.
- Where time can be converted into man minutes or man hours.

8.6 PROCEDURE IN CONDUCTING THE PRODUCTION STUDY

- The procedure for conducting production study is similar to Time study except recording rating of the workers.
- No. of cycles to be studied shall be decided based on the quantum of work.
- A sample table visualise the study:

SAMPLE SHEET FOR PRODUCTION STUDY TECHNIQUE							
S.No.	***Description***	***Time***		***Time taken***	***No.of Men***		***Total Time***
		From	***To***		***Group-C***	***Group-D***	
1.	Lifting of coach	10.00	10.10	10	1	3	40
2.	Running out of bogie	10.15	10.20	05	0	2	10
3.	Dismantle wheel	10.25	10.45	20	1	3	80
4.	Assembly of Wheel with Bogie	10.50	10.55	05	0	2	10
5.	Place the Bogie	11.00	11.10	10	0	2	20
6.	Lower the coach on bogie	11.15	11.25	10	1	3	40
TOTAL MAN MINUTES							**200**

CHAPTER REVIEW:

1) Mention any two specified jobs where Analytical Method technique is adapted in Railways.
2) Consider any specified job pertaining to Railways and conduct analytical method study and compare with time study technique. Write your observations.

WORK MEASUREMENT- CHAPTER- 9

PRACTICAL EXAMPLES ON LATEST ACTIVITES

9.0 PRACTICAL EXAMPLES ON LATEST ACTIVITES –

(A) ICF AC COACH POH

S.No	Description	Unit	Strip	Repair		Renew		Fit	
			AT	Qty	AT	Qty	AT	Qty	AT
1	Welding	SFT			0:12				
2	Body side door medium repair	RFT	0:21		2:55				0:28
3	Body side door rubber moulding		0:23						0:49
4	Door lock & handle	Each	0:21				0:49		0:37
5	Safety latches	Each	0:14						0:25
6	Door sill plate	Each	0:12						0:23
7	Sill plate locking	Each	0:07				0:25		0:16
8	Interior decolum	Each	0:21				0:12		0:21
9	Aluminium moulding	Each	0:06						0:07
10	Notice plate	Each	0:05						0:07
11	Radius moulding	SFT	0:07				0:11		0:19
12	Corner moulding	RFT	0:06				0:12		0:07
13	Collapsable door				0:58				
14	Attendant seat	RFT	0:25						0:49
15	Attendant berth	Each	0:49		0:49				1:15
16	AC arches	Each	1:40						2:05
17	Ac ceiling	Each	0:08				0:13		0:07
18	Lavatory door medium repair	Each	0:21		1:35				0:33
19	Lock & handle	Each	0:21		0:49				0:37
20	Lavatory ceiling	Each	0:06				0:13		0:07
21	Ceiling moulding	Each	0:07				0:05		0:06
22	Porcelain wash basin	Each	0:49						2:30
23	Banjo Shutters	Each	0:12				0:33		0:16
24	Partition door	Each	0:21		1:35				0:33
25	Door closer	Each	0:49		1:39				1:39

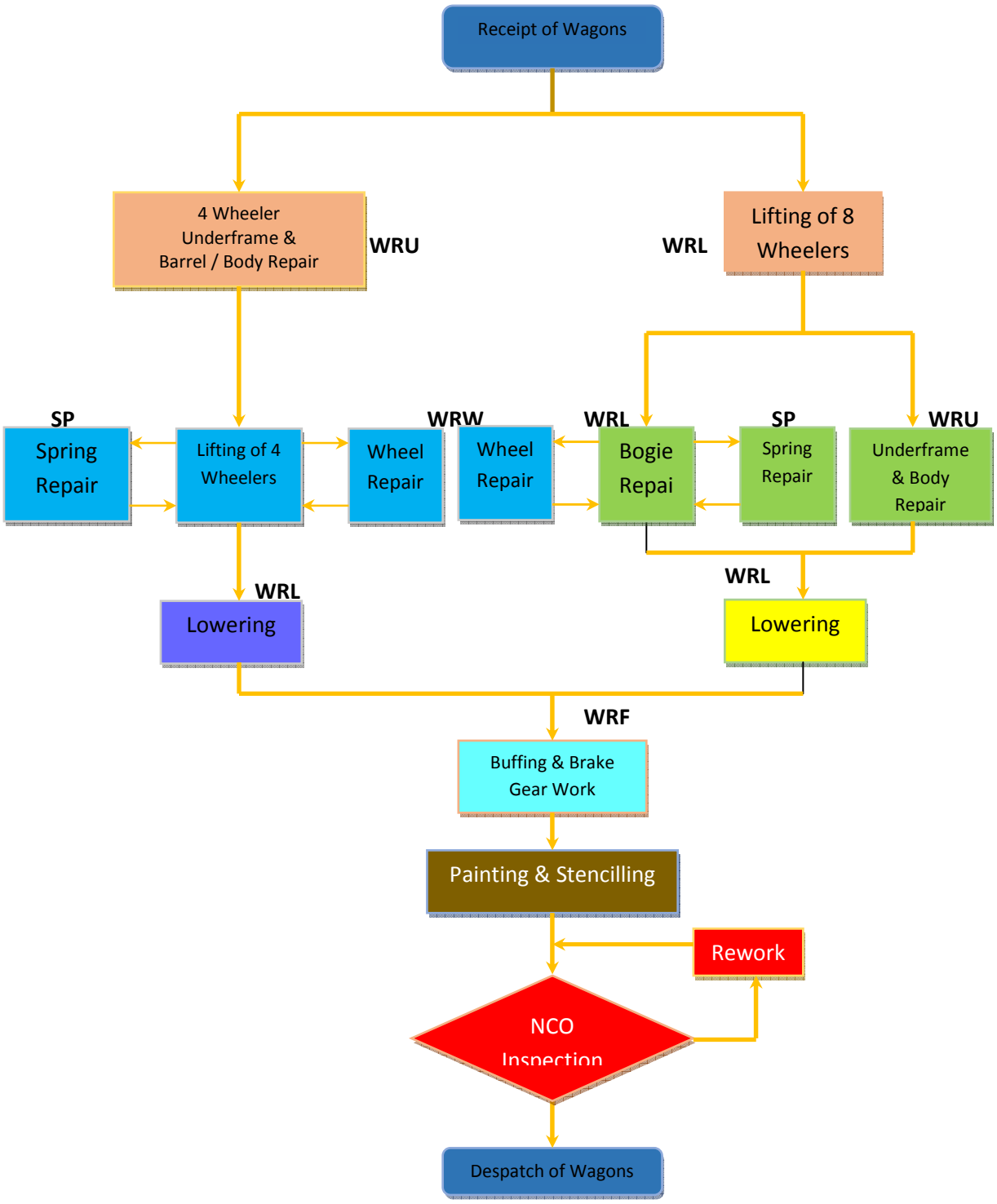
26	Pelmet	Each	0:07						0:16
27	Window curtain	Each	0:07						0:16
28	Smoke glass	RFT	1:40						2:51
29	Smoke glass rubber	Each	1:40						4:11
30	Inner glass rubber (RCF)	Each	0:19						0:37
31	Long seat	Each	1:40						2:30
32	Bed cum back rest	Each	0:49						1:15
33	Upper berth	Each	0:49						1:15
34	Middle berth	Each	0:49						1:15
35	Side upper berth	Each	0:49						1:15
36	Rexine moulding (berth)	Each	0:07						0:09
37	Magazine cover	Each	0:04						0:07
38	Foot steps	Each	0:04						0:07
39	Glass stand	Each	0:04						0:07
40	Coat hooks	Each	0:02						0:07
41	Lotha shelf	Each	0:06						0:04
42	soap dish	Each	0:04						0:06
43	Revolving coat hooks	Each	0:07						0:16
44	Slam lock	Each	0:49		1:39		1:39		0:49
45	Mirror	Each	0:07						0:16
46	Mirror shelf	Each	0:04						0:06
47	Tower bolt	Each	0:04						0:07
48	Interior Screwing	Each	0:05						0:00
49	English commode	Each	0:16						0:33
50	Commode top & bottom cover	Each	0:49						1:03
51	Interior packing	Each	0:16				0:37		0:21
52	Miscellaneous packing	Each	0:07				0:25		0:16
53	Vestibule flap door	Each	0:20		1:35				0:33
54	Vestibule door double action	Each	0:25						0:33

	hinges								
55	Door catch	Each	0:14						0:25
56	Comp. sliding door	Each	0:49		3:20				1:39
57	Fixed table	Each	0:16						0:25
58	Folding table	Each	0:16						0:25
59	Air freshner	Each	0:07						0:16
60	Seat cup-board	Each	0:49		2:30				0:49
61	Spring lock handle	Each	0:25		0:49				0:33
62	Single seat	Each	0:49						1:15
63	single seat back rest	Each	0:49						1:15
64	side arms	Each	0:49						1:15
65	Upper berth protect ional	Each	0:16						0:21
66	Upper berth hand hold	Each	0:04						0:12
67	Upper berth hinge type T/bolt S/plate	Each	0:07						0:12
68	Single seat back rest for chair car	Each	0:49						1:15
69	Seat chair car	Each	1:40						2:30
70	Side arms	Each	0:49						1:15
71	Seat press button	Each	1:15		1:40				0:49
72	Seat back rest table	Each	0:49		1:15				0:49
73	Sea button adjustment	Each	1:40		2:30				0:49
74	Safety chain	Each	0:25						0:41
75	Dust bins	Each	0:49		1:15				0:49
76	Single seat box	Each	0:49		2:30				0:49
77	Part screw pipe	Each	0:49				1:39		0:49
78	3 face looking glass frame	Each	0:25				1:15		1:15
79	Comp. protection beeding	RFT	0:04				0:09		0:06
80	Electrical junction door	Each	0:21		1:35				0:33
81	Paper box	Each	0:04						0:12

82	Lavatory pan	Each	0:12						0:37
83	Box type looking glass	Each	0:25						1:15
84	Lavatory pan packing	Each	0:12						0:04
85	Box type shelf bathroom	Each	0:25						1:15
86	Pipe flanges	Each	0:07				0:28		0:12
87	Pipe packing	Each	0:01				0:09		0:05
88	Flush valve bracket	Each	0:07						0:12
89	Flush valve packing	Each	0:12						0:33
90	Flush cock C.I. bracket	Each	0:04						0:12
91	Flush cock handle	Each	0:07						0:16
92	Towel roller	Each	0:07						0:16
93	Wall protector	Each	0:07						0:13
94	Partition rail	RFT	0:16				0:37		0:21
95	Bottom rail	RFT	0:16				0:37		0:21
96	Drg. Pack	Each	0:25				0:37		0:49
97	Single seat back rest stopper	Each	0:12						0:37
98	Hinges	Each	0:21		0:25				0:37
99	MS chain & links	Each	0:25						0:41
100	"Z" Type moulding	RFT	0:01				0:11		0:07
101	Wooden door stopper	Each	0:04						0:07
102	Bottom runner	Each	0:07						2:12
103	Hasp & staple	Each	0:13						0:14
104	Pipe clips	Each	0:02						0:05
105	AC grills	Each	0:02						0:37
106	"U" type channels	Each	0:12						0:37
107	Upper boxes	Each	0:25						0:49
108	Spring loading	Each	0:25						0:49
109	Water tank brackets	Each	0:03						0:05
110	Elec.J/box door acrylic sheet	Each	0:06				0:13		0:19

111	Chair car arm cover decolum/ alum.	Each	0:06				0:19		0:28
112	Chair car arm partitions	Each	0:11						0:17
113	Chair car base bolts	Each	0:09						0:19
114	Chair car foot rest bolts	Each	0:07						0:07
115	Chair car back rest pins	Each	0:04						0:07
116	Chair car snack table adjustment	Each	0:09						0:19
117	Chair car snack table fitting	Each	0:19						0:28
118	Chair car snack table stopper	Each	0:05						0:09
119	C/car back rest spring adjustment	Each	0:09				0:09		0:28
120	C/Car spring action stopper box	Each	0:14						0:24
121	C/car reclining gear	Each	0:19		0:19				0:28
122	Lav. Mugs with chain	Each	0:05						0:09
123	UIC vestibule decolum	Each	0:21				0:12		0:21
124	"L" type channel	Each	0:09						0:19
125	S/seat back rest supporting bracket	Each	0.11						0.18
126	Foam Ladder	Each	0.08						0.16
127	Single seat back rest latch	Each	0.04						0.12
128	Head Rest	Each	0.08						0.15

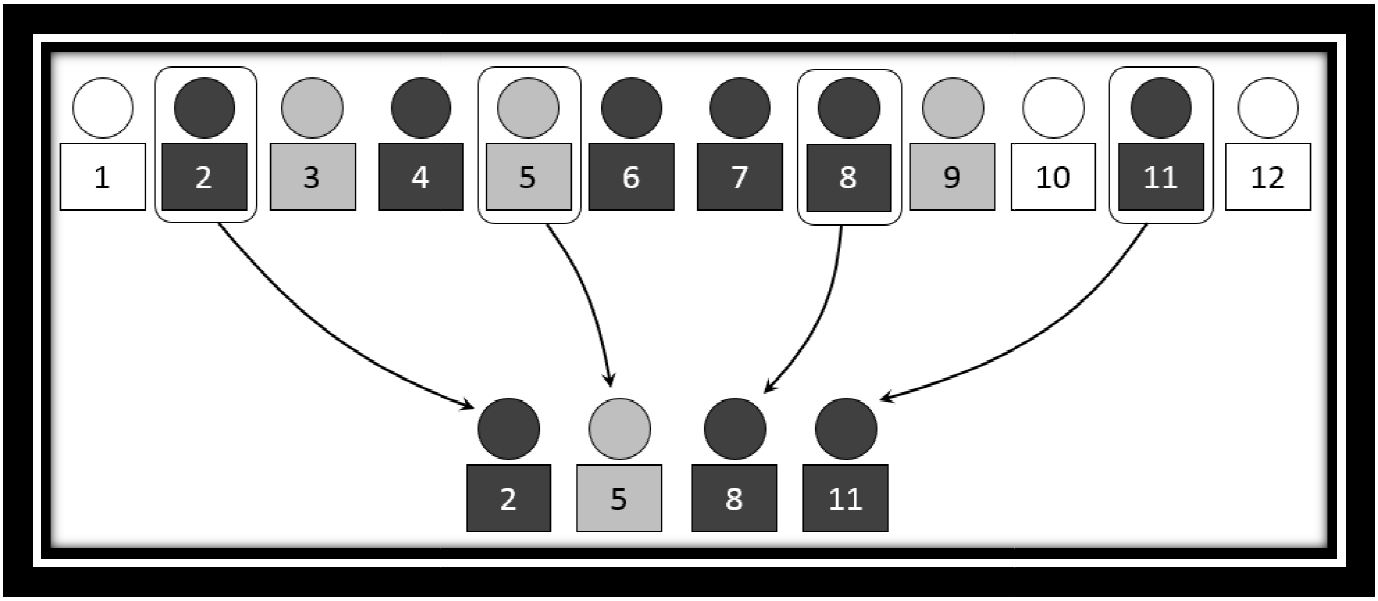
(B) STAINLESS STEEL WAGON POH



CHAPTER REVIEW:

1) Write flow process chart for a specified job in Railways.
2) What are the points to be considered while taking readings in time study?

WORK MEASUREMENT- CHAPTER- 10



WORK SAMPLING TECHNIQUE

(OR)

ACTIVITY SAMLING TECHNIQUE

10.0 WORK SAMPLING TECHNIQUE (OR) ACTIVITY SAMLING TECHNIQUE

Work sampling is a measurement technique in which large number of observations is made over a period of time on a group of machines, process or workers. Each observation records what is happening that instance and the percentage of observations recorded for a particular activity or delay is a measure of percentage of time for which that activity delay occurs.

The larger the number of observations made, the closer it will be with the results obtained from those of a production or continuous study. A balance is achieved between the number of observations made and the accuracy required of the results.

10.1 METHODS OF DRAWING SAMPLES

- Classify the strength of activity design in a chart for recording information.
- Make a pilot study.
- From the pilot study made, compute delay/inefficiency percentage.
- Determine accuracy and confidence limit.
- Calculate the number of observations required for fixing the time.
- Plan the schedule of observations.
- Proceed with sampling of observations making note of unusal point if any.
- Analyse the data obtained.

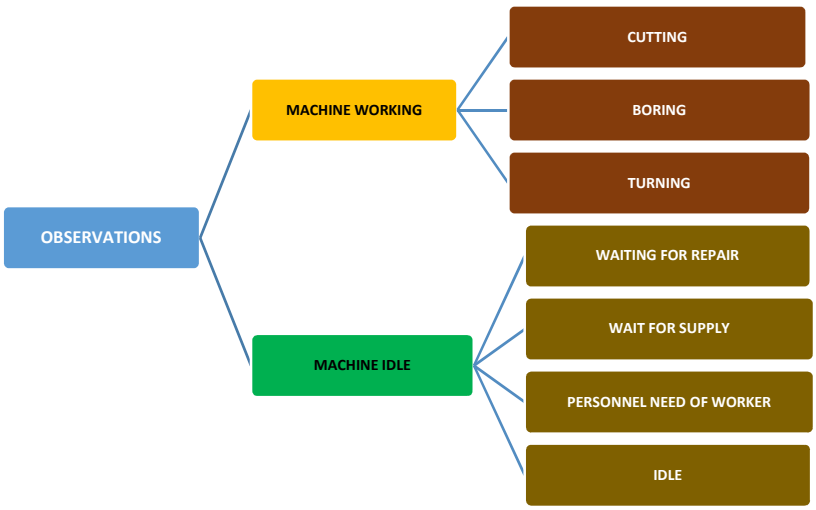
10.2 PROBABILITY-RELATIVE ACCURACY – ABSOLUTE ACCURACY

The probability of an event is the ratio of the number of cases favourable to it, to the number of all cases possible when nothing leads us to except that any one of these cases should occur more than any other, which renders them, for us, equally possible.

The relative accuracy is a measure of positional consistency between a data point and other, near data points. Relative accuracy compares the scaled distance of objects on a map with the same measured distance on the ground.

The absolute accuracy is a degree to which the position of an object on a map conforms to its correct location on the earth according to an accepted coordinate system.

10.3 DETERMINING THE STANDARD TIME EXCERCISES



Date:	Observer name:	Study No:
***No.of observations* = 100 Nos.**	***Total No.***	***%***
Machine Running		
NORMAL	62	**62%**
MACHINE IDLE		
REPAIR	8	**38%**
SUPPLY	7	
PERSONNEL NEED	10	
IDLE	13	

10.4 COMPARISION OF WORK SAMPLING AND TIME STUDY TECHNIQUE

S.No.	*Work Sampling*	*Time Study*
1.	Generally no equipment is required for gathering	Equipment is required.
2.	Trained persons are not required to collect the	Trained persons are required.
3.	Study of no. of activities can be done simultaneously.	Study can be done on next activity only after completion of present activity.
4.	It is not too expensive to undertake.	It is little expensive.
5.	It is generally liked by workers as an observer does not confront the worker throughout the	It is generally not liked by workers as the observer physically observes all his activities throughout the
6.	Study can be interrupted at any time without affecting the result.	Once time study commenced, it must be completed to achieve correct results.
7.	Operations which can not be measurable the quantum of work can be studied by using this	Operations which can be quantified only can be studied by using this technique.
8.	It is useful for those works where more number of workers are being carried out their jobs.	It is suitable to those jobs where a single operator carries his job.
9.	The statistical approach of work sampling is difficult to be understood by the worker as well as the management.	It is easily can be interpreted with simple calculations.
10.	The level of confidence of the time is less compared to Time study.	The level of confidence of the time is more compared to Work sampling.

WORK MEASUREMENT- CHAPTER- 11

PMTS – PRE-DETERMINED MOTION TIME STANDARD TECHNIQUE

11.0 PMTS – PRE-DETERMINED MOTION TIME STANDARD TECHNIQUE

11.1 DEFINITION – INTRODUCTION

Pre determined motion time system (PMTS) is defined as a work measurement technique where by times established for basic human motions (classified according to the nature of the motion of the conditions under which it is made) are used to build up the time for a job at a defined level of performance.

11.2 THEORY – APPLICATION

The technique to build PMTS data does not measure element time by a stop watch and thus it avoids the in accuracies being introduced owing to the element of human judgement.

It is assumed that all manual tasks in industries are made up of certain basic human movements (like reach, move, disengage etc) which are common to almost all jobs.

The average time taken by the industrial workers to perform a basic movement is practically constant.

11.3 ADVANTAGES OF PMTS

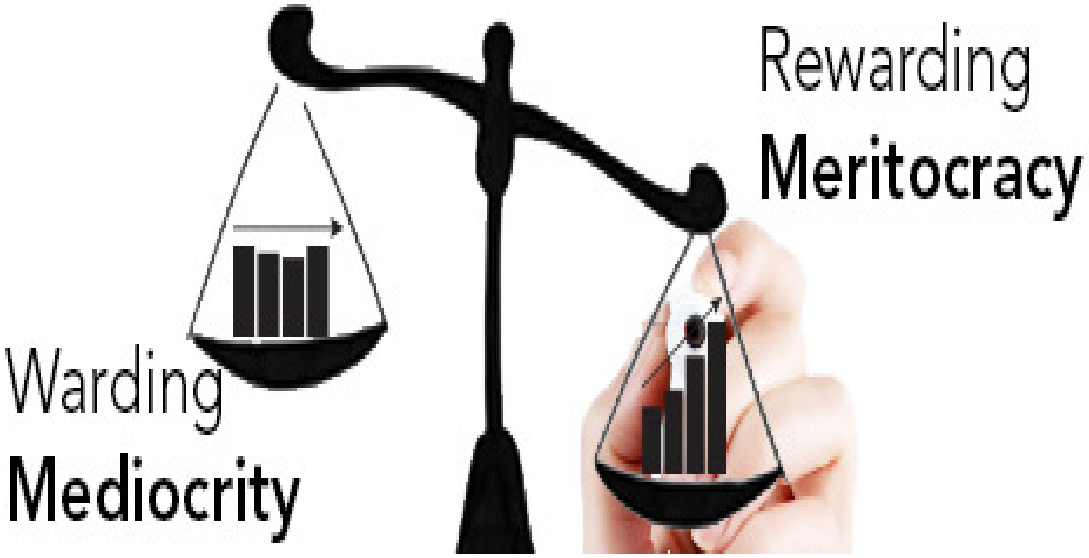
PMTS possesses the following advantages:

- It eliminates inaccuracies associated with stop watch time study.
- It is superior to stop watch time study when applied to short cycle highly repetitive operations.
- Time standard for a job can be arrived at without going to the place of work.
- Unlike stop watch study, no rating factor is employed.
- PMTS data is more reliable and accurate as compared to stop watch time study data.
- The time and cost associated with finding the standard time for a job is considerably reduced.
- PMTS helps in tool and product design.

CHAPTER REVIEW:

1) How PMTS technique is more effective and economical compared to other techniques of Work measurement?
2) Identify areas in Railways where PMTS technique can be adopted?

WORK MEASUREMENT- CHAPTER- 12



WAGE INCENTIVES

12.0 WAGE INCENTIVES, INTRODUCTION

INTRODUCTION

Incentive scheme viewed as "win-win solution' between administration and staff of an Organization.

- Advantages for administration are-
  - no requirement of additional manpower
  - higher and efficient machine utilization
  - more productivity
  - less pilferage of working hours etc.
- Whereas for workers, it gives satisfaction of "earning more by working more" leading to more purchasing power and as end result Organization is benefited with better industrial relations & discipline.
- Presently existing Incentive scheme on Indian Railway Workshops broadly grouped in two categories :

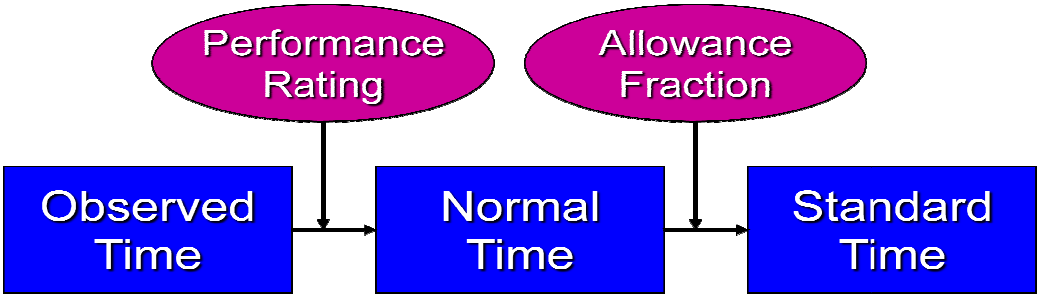
Based on saving time in each activity by employee, thereby performing activity in lesser time than prescribed time, giving scope for increased out-turn (Chittaranjan type –System of Payment by Results).

Directly linked to Outturn given by a Group – Group based incentive scheme (Tirupathi, Kapurthala etc), introduced on Workshops during Jan, 2002.

12.1 (A) INCENTIVE SCHEMES-CLW PATTERN INCENTIVE SCHEME AND

12.2(A) INCENTIVE CALCULATIONS IN CLW

- CLW Incentive scheme also known as "system of payment by results" and is more in favour of employees than the output.
- Need to improve productivity in Rly. Workshops for ensuring better utilization of assets was felt even prior to Independence and piecework bonus system were in existence in Workshops – JMP, KPA, Perambur.
- Rly. Bd. decided in 1949 to introduce same form of Incentive scheme to provide direct financial incentive to workers who exceeded certain Minimum Level of Performance.
- First formal Incentive scheme was introduced in CLW in Dec,1954 and came to be known as CLW pattern of Incentive scheme.
- Scheme was a success and was extended to repair Workshops in 1958, though the implementation was from 1960 after PCO was set up in Workshops.
- Detail of Incentive Scheme available in Chap.IV of Indian Rly. Code for Mechanical Deptt.(Workshops) while Chap.V gives details of 'time records and allocation of labour'.



SALIENT FEATURES

Under incentive scheme, the basic wages of worker are guaranteed.

- Time is yardstick for measuring work.
- Time study carried out as per standard practices of Work-measurement.
- Allowed Time for a work is so fixed that worker of normal ability may earn 33-1/3 % bonus over basic wages.
- AT includes allowances for fatigue, general handling, gauging and production bonus allowance.
- It is expected that normal worker would be able to complete operation in ¾ of total AT, to be able to earn 33-1/3 % Incentive bonus.
- Time saved /lost on AT on each operation is calculated separately for each worker. It cannot be carried over to next month.
- Ceiling for time saved is 50% i.e. if time saved is more than 50%, only 50% would be taken into account for purpose of working Incentive bonus.
- Supervisors up to J.E.-I are included in scheme.
- Under this scheme, workers are divided into three categories:
    i. Direct workers (DW) – work assessed through time studies.
    ii. Essentially Indirect Workers (EIW) – contribute to continuity of work but whose work cannot be assessed through time-studies.
    iii. Indirect Workers (IW) – do not contribute directly or indirectly to the production. THEY DO NOT GET INCENTIVE BONUS.
- Different incentive rates are fixed for each category.
- Under Incentive scheme, Idle time can be booked on following accounts:
    - ❖ Non availability of tools
    - ❖ Non availability of work
    - ❖ Power cut
    - ❖ Machine run down.
- Time office give every month the statements showing number and details of workers in each category for calculating Incentive earned.

INCENTIVE SCHEME – MECHANISMS

(i) Timing of operations : Systematic comparison of time taken for known job is made with AT, which arrived at by careful experimentation, keeping into account conditions of working, quality, promptness of supply services, all standardized.

Time standards fixed for individual operations and time taken carefully recorded for individual workers to assess if standard has been achieved or not. (para-403).

(ii) Time-study:

Before time-study is done, work-simplification must be done.

- All elements of floor-to-floor cycle of work observed, including both effective and ineffective elements.

Ineffective elements are times during which man, machine, or both are idle.

- Each operation split into elements that are basic parts of operation and consist of one or more motions regularly combined in same sequence to establish definite purpose.

Elements could be constant (having standard time allowance for same set of conditions) or variable (where time allowed would change to allow for variation of work required in accordance with dimension or condition of setting).

Effective time is rated and ineffective time classified.

- Wasteful motions and time taken thereon not accounted for.
- Elements have clearly defined break-points.
- Observed time for each element is normalized depending on rating performed by worker.

(ii) Synthetic time: Time standards based on average normalized values ('observed times') of elements for a No. of similar studies in the past, used for synthetic data:

- ☞ Manipulation values
- ☞ Loading/ unloading values
- ☞ Setting-up values
- ☞ Tool-changing values
- ☞ Preoperational values.

- Synthetic time not be confused with 'computed time', which depends on metal removal required and rate at which performed on machine used.
- Block time: based on observed average of activities like POH, repairs, etc. be used. Ad-hoc time based on 'judgment' not appropriate.
- Idle time: Para- 424 provides for fixing 'a minimum machine break-down resulting in booking of idle time …' which when exceeded, result in NIL incentive bonus to maintenance gangs. No guidelines available in Code as to what this percentage should be.
- AT for similar activities across Workshops: should be standard AT for common activities performed by many Workshops, act as guideline, but some variation due to local conditions permitted within Short period. Ideal conditions for ideal time be laid down for ascertaining if any variation be allowed or not.

RATING: Assessment of observed skill / effort involved in each element. Each element assessed independent of previous elements, based on principle - Average worker working under non-incentive conditions just to earn his basic wage, is said to be working at 60 Rating (or said to be producing 60 units of output per hour). Under Incentive conditions, he can work at 80 rating (80 units of output per hour) to earn 33-1/3%.

Rated by Rate-fixers of Rate-fixing Department., trained in the Job.

Normalizing: carried out on observed time for each element during time-study and depends on observed rating. Normalising is done on principle that worker to work at 80 rating to be able to earn 33-1/3% Incentive bonus.

$$\text{Normalized time} = \frac{(\text{Actual Time} \times \text{Observed Rating})}{80^{*}}$$

* indicates Rating under Incentive conditions for 33-1/3% Incentive bonus.

Additional Allowance: Allowances are added to normalized operational time

on cumulative basis.

General handling & Contingencies: 12 ½%

Preparatory work includes work like cleaning swarf, grinding of tools, getting spanners, procuring cutting compound etc.

- **Gauging on machining: 5%,** wherever necessary in machining operations,
- **Fatigue: 12 ½% to 25%** depending upon the type of work.
- **Production bonus: 33-1/3%** added to the Normalized time

Allowed Time (AT): AT worked out by adding normalized time and additional allowances on cumulative basis.

Example:

Normalized time of all elements = 1 Hr.

Fatigue allowance 25% = 0.25 hr. Cumulative time = 1.25 hr - 1.125.

Contingencies 12 ½% = 1.25 x 12.5% = 0.156 hr. = 1.406 hr – 1.237

Bonus 33-1/3% = 1.406 x 33-1/3% = 0.468 hr = 1.87 hr - 1.65

Gauging 5% (not on all jobs) = 1.87 x 5% = 0.09 hr = 1.96 hr. - 1.73

12% Reduction of AT

Since worker is expected to complete the operation in ¾ of time allowed,

it would be completed in 1.96 x ¾ = 1.47 hr.

Time saved = AT- TT = TS

Time saved = 1.96 – 1.47 = 0.49 hr

$$\text{Profit} = \frac{\text{Time saved}}{\text{Time taken}} = \frac{0.49}{1.47} = 33\text{-}1/3\ \%$$

{ calculate above using circular of 1.9.99 }

Preoperational time: allowed per batch for receiving material, instructions,

tools, etc.- called Preoperational time.

Extra time: can be allowed for

- excess machining work on castings/forgings/bars
- hard material
- defects in machine (worker not responsible)
- change in batch quantity.

Excess-time card required to be filled up by Rate-fixer, issued to J.E., countersigned by SSE. Request for extra time made by sectional JE and verified by Inspector, only then excess- time card issued.

Time taken: based on Job-card/Squad card (for squad working), punched ON and OFF on commencement and completion of operation respectively.

Out-turn: based on total quantity 'passed' by Inspector for each operation.

Time Saved/ Lost: difference between total AT and Time taken.

AT includes preparatory per batch and extra time as per excess- time cards. If time taken is less than AT, time is saved. If more time is taken, it is lost

Allowed time includes –

- Time per piece multiplied by quantity passed
- If rejection is on account of material, out-turn of rejection will also be taken into account for proportion of work done on rejects and reason be certified by Inspector.
- Preparatory per batch
- Extra-time as per Excess-time cards.

Where two or more workers are engaged on same job, time saved/lost is apportioned in ratio of time taken by each.

Ceiling limit on Profits: 50% of basic wages,

Profits = time saved / time taken.

Incentive bonus to EIW and Supervisors:

- Ceiling limit of 80% of Average of Direct workers served/ supervised.
- Mistries get at 100% of average incentive bonus of DWs supervised.
- If supervises non-incentive DWs also, bonus given in ratio of DWs to total DWs supervised.
- SSE sends information regarding DW, EIW and Supervisors by 2nd of following month.
- Separate statements sent in respect of each supervisor, listing DWs supervised.

PAYMENT OF INCENTIVE BONUS:

Direct Workers-

- based on net time saved.
- Time saved/ lost separately calculated for each operation
- Ceiling limit 50% for saving applied to each operation.
- Net time saved multiplied by prescribed hourly rate
- Paid monthly with the Salary bill .(para-422)

Essentially Indirect Worker(EIW) and Supervisors:

- paid 80% of average bonus
- Standard hours per month are calculated as

$$\text{Standard hours} = \frac{\text{GA hrs actually worked by DWs during preceding 6/12 month}}{\text{Scheduled hrs that DWs should have worked in same period}} \times 208$$

- Standard hours remain fixed for ensuing 6/12 months after which again calculated.
- Average % of profits of DWs of each section calculated as –

$$\text{Section\%} = \frac{\text{Total net time saved by Section}}{\text{Standard hrs. x No. of DWs in Section}} \times 100.$$

Incentive payment = 80% x Sections% x Total GA Hrs. x Rate

Leave Reserves included in total no. of DWs :

Accordingly, Incentive Bonus payment calculated as –

$$\text{Incentive payment} = \frac{\text{Section percentage}}{100} \times \frac{80}{100} \times \text{No.of GA card hours} \times \text{Hourly rate}$$

For JE, same formula applied,

for Mistries 100% is applied instead of 80%.

- In case of Non-Incentive DWs also under same supervisor, Incentive bonus is multiplied by ratio of DWs under Incentive to total DWs supervised.

Idle-time: Delays and hold-ups for which worker is not responsible, normally for -

- No power
- Machine repair
- Lack of material
- Lack of tools
- Waiting for work
- Crane under repair
- Miscellaneous

Deductions from Supervisors' Bonus for Idle-time:

If on account of lack of work, lack of tools, supervisors are directly responsible, hence deduction to be made from Incentive bonus of Supervisors as per following scale:

Idle-time for above reasons	%Deductions
2% or above but < 5%	10%
5% or above but < 15%	20%
>= 15% or above	No Bonus

Incentive to staff in Service shops:

Millwright, Tool & Template Shops

- where work is measurable, just like DWs; or.

For those work not measured, following system is followed

- Staff segregated into groups, and attached to specific Shops or Sections
- Fix gang strength on Workload/Activity
- Absenteeism recouped if requested by Leader
- Monthly target fixed for breakdown of machines.

  If exceeded, NO BONUS TO MAINTENANCE GANGS.
- Treated just like EIW attached to the DWs of section/shop.

• Vide Bd's L/No. PC-V/98/1/7/4/1 dt. 21/06/99 –

Instructions issued for increase in hourly rates, extension of incentive coverage to SE & SSE by paying incentive bonus at a flat rate of 15% of their basic pay and reducing fatigue and contingency allowances to achieve 12% reduction in AT w.e.f 1/9/99.

Assessment of Staff Requirement :

- Assess requirement of DWs,EIWs, IWSs and Supervisors as per revised Allowed timing

(A) Assessment of DWs –

(i) Average of actual AT for each Shop/activity for last 3 Yrs. reduced by 12%. Updated list of activities undertaken in Workshops compiled for this purpose.

Requirement of DWs worked out by dividing modified AT of each Shop/activity with 267 (Man-Hr per man per month).

(ii) Requirement of EIWs –

Normally, strength of EIW should be 15% or less of the strength of DWs. Initially, existing strength of EIW should be reduced at least in proportion to reduction in strength of DWs.

Zero-based review of EIW requirement carried out by taking into account the induction of modern Material Handling Equipment /facilities and changes in work practices and Rolling Stock being overhauled to arrive at final requirement of EIWs in various Shops.

(iii) Requirement of Supervisors-

Requirement of Supervisors worked out afresh as per extant instructions due to subsequent changes in strength of DWs, EIWs and IWs.

CHECKS & BALANCES –

- 10-20% of excess-time cards in Mfg. Shops and 2-5% of Inspection-cum-Computation Sheets to be personally checked by PE/APE.
- Causes for issue of plus-cards to be investigated and corrective measures taken
- Job-cards/squad cards in the custody of Time-booth clerk
- All completed Job-cards to be sent to incentive bonus section within 48 hrs. of completion of job
- Inspector to record quantity 'Passed' under dated signatures
- Allowed times to be approved by PE –

- to be printed on Job-cards

- hand-written ones to be countersigned by APE / PE

- to be revised if improved machine-tools or time-saving methods introduced

- time lost /saved is during the same month after applying ceiling to saving.

- Abnormal Profits –

When > 50% consistently or by majority of workers, causes to be analyzed.

- Losses – investigate if consistent by majority.
- Overtime – not allowed ordinarily
- Apprentices – not eligible for incentive
- Using Incentive worker for day-work – to be done in very special circumstances.
- Idle-time

- All idle-time to be investigated to prevent wastage

- Idle-time cards in the custody of Time-booth clerk.
- Punched, based on idle-time slips issued by JE
- Up to 15 mins. may not be booked as Idle-time.
  - Accounts office to see that:
- Total time taken tallies with Job-cards
- Saving is not exceeded & time lost accounted for
- Excess time card is attached wherever indicated, with signatures of Rate-fixer, and the SSE.
- DWs, EIWs and Supervisors do not exceed the sanction
- Idle-time penalties imposed in Supervisors' bonus
- Supervisors' bonus in ratio of DWs under incentive to the total DWs under them.
- Idle-time cards cross-checked with Idle-time slips.
  - Total Allowed time as per the passed out-turn. Time to be as approved by the PE.
  - Copy of master Planning card to WAO
  - Suspend / Resume slips attached to Job-cards
  - Idle-time cards to be checked by WM/AWM within 24 hrs. of being punched in.
  - All Job-cards received are accounted for. Check from Time-booth Sl. No. & Statement of Job-cards.
  - Suspended Job-cards to be checked by O-I-C
- From one to next month to be checked by PE /APE

FORMS & FORMATS –

- Time Books (W-502) –For Service shops,

- maintained by Supervisor, posted daily in the Time-sheet by Time- booth clerk.
- Time spent by each DW, W/O No., Ticket No. ,daily.
- Two books maintained for Odd and even days.

- Time-sheets (W-504) – For Service shops, - Show time for which wages are earned by a worker spread over different

Work-orders.

- Job-cards (W.506) – For Incentive shops – Show the time worked by workmen on individual OPS

- Printed by PCO for each operation indicated in the Route-card.
- Contain inspection record also.

- Job-card for Squad-work (W.507):

- Leading hand given one Squad-summary card and

Separate job-cards for each member of his gang.

- Squad Summary Card (W.508):

- Given to the leading hand and punched by him

- Idle-time Card (W.509A):

- Prepared for each workman for each month
- Kept in custody of Time-booth clerk
- Punched on the Authority of idle-time slips
- When punched on, Job-card is punched off; and vice-versa
- Signed by sectional JE, countersigned by SSE.

- Idle-time slip (W.509B): issued by JE
- List of GA cards and job-cards required for –

Night-shift staff (W.510): When no Time clerk

- JE collects GA cards, Job-cards, Squad Summary cards in exchange
- List Tkt. No., Work-Order No., Op.No., Tkt. No. of previous worker if Job-in-Progress or Suspended Job

- Monthly Time-sheet for Indirect Worker (W.511):

- Has Tkt. No., W/O No., Total Hrs., Rate, and Amount

- Monthly Statements of LAP, LHAP & Holidays (W.512):

- Time clerk prepares from GA, submits to Accounts

- Proceeding Time-card (W.513):

- For Jobs remaining incomplete during the month
- Distinct Sl.No., each month by each Time booth
- Required if compilation of WMS is mechanized.

- Incentive bonus Allocation Sheet (W.514):

- Has details of W/O No. and Amount from Incentive bonus bills.

- Suspended Job slip (W.515): Worker is put on another Job suspending one

- Issued by the JE
- Contains W/O Number of suspended and New Jobs, Tkt. No., and reason for Suspended.

- Resumption of Suspended Job-slip (W.516):

- Has details of W/O No., OP. No., Tkt. No.

- Job-in-Progress to another worker (W.517):

- Besides details as in W.516, has Tkt. No. of Old OP.

- Tally Sheets (W.518): Reconciliation with GA

- Details of Job cards, Idle-time and GA cards
- Made for each worker

- Register for monthly reconciliation (W.519):

- Prepared for each shop, based on Tally sheets
- For reconciliation of hours & amounts as per the Labour Pay Sheet & Tally Sheet

- Labour Sub-Ledger (W.522):

- Has details of amounts against each W/O shown in the time booking documents of each shop

- Incentive bonus directly chargeable (from W.514)

• Register of Labour charges (W.524):

- Details of all salary, TA and Labour bill of a Shop

• Labour Schedule (W.525):

- Summary of W.524 for the entire Workshop

• Hourly rates increased to between 4 and 5 times

• Scheme extended to SEs & SSEs

- Incentive = 15% of basic pay flat

• Reduce Allowed Time by 12%

- Fatigue Allowance = 12.5% flat

- Contingency = 10% max.

- If 12% not achieved, reduce AT further

• Orders effective from 1.9.1999.

HOURLY RATES OF INCENTIVE

PROPOSED LINKING OF ALLOWANCE WITH QUALITY PERFORMANCE

• Dry run from 1.1.2000 for 3 months

• Only half the allowance is linked to selected quality indicators

• Parameters to be judged on actual performance with global, quarterly averages for IR as a whole

• Loss of allowance not to absolve SSEs / SSs of their accountability

• Qualifying attendance = 50% of the number of working days of wage period

• For C&W Workshops, Neutral Control Organization would provide the basis

• Scope of NCWS extended to cover the remaining activities, Elect. work also

QUALITY PARAMETERS C&W POH

• Defects at 1st. Offering stage : WT. = 2.5%

- Selected list of defects to be monitored

• Sick marking within 100 days of POH for Coaches

90 days for Wagons : WT.=2.5%

• Coach detachments/Wagon accidents within 6 months per 100 units of out-turn (due to bad workmanship in Workshop) : WT =2.5%

QUALITY PARAMETERS LOCO POH

• Defects noticed in selected areas during Joint Inspection before dispatch : WT. =2.5%

- List identified

• Loco failures within 6 months of POH due to bad workmanship in Workshop: WT. = 2.5%

• Replacement of major sub-assemblies within 6 months of POH : WT. =2.5%

QUALITY PARAMETERS FOR PUs

- Quality parameters have been identified for CLW and DLW for Loco manufacture
- CLW for Steel Foundry
- ICF for manufacturing of Coaches
- Similarly for Wagon Manufacturing Workshops, parameters have been identified.

QUALITY PARAMETERS - MANUFACTURING WORKSHOPS

Total Man-Hrs. lost due to rejections at the Final/Stage Inspection: WT. = 6%.

- Total Plus time issued for rectification work: WT. = 1.5%
- Benchmark to be decided by CWEs based on compiled Data for the past 6 months or more

MISUSES OF INCENTIVE SCHEME

1. **Management & Supervisors Related:**
   - DWs shown as EIW & IW (No quotas in terms of Physical Units)
   - False issues shown to other Shops.
   - Penalty for excessive Idle-time not imposed.
   - ATs not revised on introduction of New M/cs.
   - ATs not linked to learning curve.
   - Outturn of one month shown in another.
2. **Worker – JE Nexus:**
   - Time lost in punching the next Job-card.
   - Loss making Job-cards not submitted.
   - More than one Job-card issued at a time.

3. **Hand Written Cards:**
   - Hand written Job-cards issued by PCO.
   - Time entry on Job-cards done manually.
4. **Inspection Staff – Worker Nexus:**
   - Time spent on rejected Work-piece manipulated.
   - Excessive repairs certified by stage Inspectors.
5. **Rate-fixing Staffs' Slackness:**
   - Plus cards continue indefinitely.
   - Excess given on Non-Stock & Out-Station Jobs.
6. **Lab.Staff Related:**
   - Test pieces not made regularly or reports given late.
7. **Stores Related:**
   - Work Orders issued without ensuring Raw Material availability.

- Alternative Raw Material offered too often.
- Raw Material offered in unusable form.
- Work Orders of very huge Quantities issued.
- New Work Orders not used till previous W.Os. closed.

8. Accounts Related:

- Time Booths not manned throughout.
- Job-cards kept in the custody of Shop Supervisors.
- Tally Sheets not made / monitored regularly.
- It is based on the time saved by the worker against the prescribed time for each activity set by the work-study group.
- It is so designed that a reasonably efficient worker should be able to earn 33% incentive. i.e. if the worker is able to complete a work in 3/4ths of the time prescribed, then he would be eligible to earn 33% incentive.
- However the maximum limit set is that the employee can not save time more than 50% of the allowed time for an activity i.e.more than 50% saving in time will not be eligible for Incentive benefit.

12.1 (B) GROUP INCENTIVE SCHEME (GIS)AND

12.2 (B) INCENTIVE CALCULATIONS OF GIS

As per the directives of railway board for introduction of incentive scheme at CRS/TPTY, the RITES team has conducted the study at CRS/TPTY from 06-09-1999 to 18-02-2000. The Redesigned incentive scheme was implemented at CRS/TPTY from 01-01-2002.

GSCN type of coach (II Sleeper class) was considered as standard production unit.

The conversion factor for other type of coaches was fixed as per allowed time compared to allowed time GSCN coach.

Conversion factor for a particular type of coach = Average man hours for particular coach/Average man hours for Equated GSCN coach.

The RITES re-designed incentive scheme is a group incentive scheme. The work shop is classified into three groups namely

1. Production Shop group
2. Support shop group
3. Support Department group

1. **Production Shop Group**: The shops which are directly connected with POH activities of coach are classified as production shop group. The following are Production shops.
    i. Carriage Fitting shop
    ii. Carriage Body Repair shop
    iii. Paint shop
    iv. Wheel shop
    v. Electrical Train lighting shop

2. **Support Shop Group:** The Shops which are indirectly connected with activities of POH of coaches are classified as support shops.
    i. Mechanical Millwright
    ii. Electrical Millwright
    iii. Machine shop
    iv. Coach movement and Scrap yard
    v. Smithy shop

3. **Support Department group:** Industrial engineering department at AOB which is supporting to the POH activities are classified as support department. The following section have been clubbed together and termed as IED.
    i. Production control organization
    ii. Machinery and plant
    iii. Planning cell
    iv. Quality Systems division
    v. Computer cell
    vi. Incentive cell.

The following are not covered under incentive scheme.

a) Coach inspection wing
b) Material inspection wing
c) Basic Training center
d) Outside power maintenance
e) All Ministerial staff
f) Personnel dept.
g) Accounts Dept.
h) Stores dept.
i) Security Dept.
j) Drawing office.

The incentive calculation for the production shop is worked into two stages.

1. Based on the outturn of the individual shop
2. Based on the outturn of the workshop to traffic.

70% incentive is worked out on the production index of the group (Individual shop outturn)
30% incentive is worked out on the plant production index (i.e., outturn of the shop to traffic.

Factors influencing the incentive:

1. Coach Holding factor
2. Group Attendance Factor
3. Rectification man hours
4. Quality linkage factor.
5. Excessive detention of coach in workshop.

1. **Coach Holding factor:** Cycle time for detention of coaches have been given for each production shops which are as under.
    a) CF Shop – 3.0 Days.
    b) CBR Shop – 9.5 Days
    c) Paint Shop – 5.0 Days
    d) T/L Shop – 2.0 Days.

    There is no cycle time for wheel shop since activities of wheel shop are parallel to that of CF shop. If any shop exceeds the cycle time, coach holding factor will be reduced which in turn affect the incentive earnings.

2. **Group Attendance Factor:** Group attendance factor is introduced to have control over absentisem by group members. The Individual member incentive earning increase with max. Hours present. It is directly related to production index of group. Due to absentisem/leave actual clocked in hours of group are reduced hence group attendance factor will reduce which effects incentive earning.

3. **Rectification man hours:** If any re-work is carried out due to bad workmanship and pointed out by inspection wing or NTXR, the group is penalized by adding 3 times the rectification hours.

4. **Quality linkage factors:** To ensure quality at production, quality linkage factors are incorporated. The quality linkage factor is directly multiplied by the incentive earning factor. Hence, if quality linkage factor is reduced due to En-route failures, the incentive earning of production shops, including support shops & Support depts. are reduced.

   The Quality Linkage Factor 'Q' is as under:

   Q_1 – NTXR fit/Local passing.

   Q_2 – Coaches marked sick within 100days.

   Q_3 – En-route coaches detachments.

   For all the above quality linkage factors i.e., Q_1, Q_2, Q_3, the performance of the shops has to be compared with the following.

   1. Performance of the shop in the last year.
   2. Performance of the Indian Railways.

   If the performance is better in both the Quality linkage factor will be 1.

   If the performance is better in one and bad in other the Quality linkage factor will be 0.95 for Staff & JE's and 0.90 for SSE/SE's.

   If the performance is bad in both the Quality linkage factor will be 0.90 for Staff & JE's and 0.85 for SSE/SE's.

   The Quality linkage factor $Q = (Q_1+Q_2+Q_3)/3$.

5. **Excessive detention of coach in workshop:** The Actual detention period of the particular coach in work shop from date of its receipt from traffic till date of its despatch to traffic is called "Actual detention of a particular coach in workshop". The permissible detention of coach in workshop is 3 months.

   The SPU units deductible for any particular coach detained in workshop is

   a) For coach dispatched within 2-weeks after expiring of permissible detention period for the coach is : 1.0 x SPU for the coach.

   b) Beyond 2-weeks but upto 4-weeks : 1.25 x SPU for the coach.

   c) Beyond 4-weeks but upto 6-weeks : 2.0 x SPU for the coach.

   d) Beyond 6-weeks : Min. 3.0 x SPU for the coach.

   Max. CWM/TPTY.

   This is deducted from group eligible dispatches which effects incentive earning of the group.

Formulae for Incentive Calculation:

Production Group:

1. $\text{Grp. Std. monthly target} = Mngt.approvedannual\,\text{Pr}od.plan \times \frac{No.ofworkingday\,\text{sin}\,amonth}{No.ofworkingday\,\text{sin}\,ayear}$

2. $Std.ManHrsforStd.Mth = 0.875 \times Authorisedmanpr.strengthofthegrp.@133R \times 25Workingdays \times 8hrs$

3. $Grp.AttendanceFactor = \frac{Actualclockedinmanhrs}{0.875 \times Actualstrength \times ActualWorkingdays \times 8hrs}$

4. $Availablemanhrs. = Actualclockedinmanhrs. + 3 \times \text{Re}\,ctificationhrs - Idlemanhrs.ofgrp.$

5. $Grp.\text{Pr}\,oductionNorm. = \frac{Grp.Stdmonthlyt\,\text{arg}\,et \times Availablemanhrsforthemonth}{Std.manhrs.perstd.month}$

6. $Grp.BaseO/P = \frac{100}{133} \times Grp.\text{Pr}\,oductionNorm.$

7. Group Eligible dispatches = Group Accountable Physical dispatches in SPU – SPU units deductable on account of excessive detention of coach in plant.

Group Coach holding factor:

8. Target holding of group for the particular month in SPU-Days = Approved cycle time of Repair for Production Group. In No. of working days **x** Group. Standard Monthly Target.
9. Individual coach actual detention in group for the month (SPU-days) = Individual coach in SPU x Actual detention of individual coach in working days in the Group.
10. Actual Coach detention holding days for the month (SPU-Days) = Sum of individual coach actual detention in Group. for the month for all coaches dispatched from the group.
11. $Grp.CoachHoldingfactor = \frac{T\,\text{arg}\,etholdingofgrp.inSPU - days}{Actualcoach\,\text{det}\,entioninSPU - days}$
12. $Grp.\text{Pr}\,od.Index(PI) = \frac{Grp.Eligibledespatche\,\text{sin}\,SPUpermonth}{Grp.BaseO/PinSPU} \times Grp.AttendanceFactor \times C.H.F$
13. $Plant\,\text{Pr}\,od.Index(PPI) = p\frac{X_a}{X_b} + q\frac{Y_a}{Y_b} + r\frac{Z_a}{Z_b} + - - -$

Where Xa, Ya, Za = Group Eligible dispatches of different production group.

Where Xb, Yb, Zb = Corresponding group base output for diff. Prod. Group.

Where P, q, r = Applicable weightage factor for individual production group.

$$ApplicableWtgFactor = \frac{AllowedTime@100RperSPUofGrp. \times Grp.Std.MonthlyT\,\text{arg}\,et}{Sumof\left(AllowedtimeforSPUofGrp. \times Grp.Std.MonthlyT\,\text{arg}\,et\right)}$$

14. Gross Production Index (GPI) = 0.7x PI +0.3xPPI

15. $$Indiv.Mem.Incen.Erng. = (GPI - 1.0) \times \frac{Act.ClkdinHrsbyMem. - TimespentawayfromWork}{ScheduleNo.ofWorkingHrs} \times IEF \times Q$$

Where IEF = Applicable Individual Incentive Earning factor for the grade of the member = 1.3x Basic Pay.

Q- Quality linkage factor.

Support Shop:

1. $$Wtd.Perf.Index = \frac{(GPI_A \times M_A) + (GPI_B \times M_B) + ---}{M_A + M_B + ---}$$

Where GPI_A, GPI_B,--- = Gross production index of corresponding production group.

Where M_A, M_B, --- = No. of Members of Corresponding production group.

2. $$Std.Man\,Pr.Ratio = \frac{SumofAuthorizedStrengthofall\,Prod.Grps.}{SumofAuthorizedstrengthofallSupportShop}$$

3. $$Actual.Man\,Pr.Ratio = \frac{SumofActualStrengthofall\,Prod.Grps.}{SumofActualstrengthofallSupportShop}$$

4. $$Grp.Perf.Efficiency = \frac{ActualManpowerRatio}{S\,tan\,dardManpowerRatio}$$

5. $$Grp.AttendanceFactor = \frac{Actualclockedinmanhrs}{0.875 \times Actualstrength \times ActualWorkingdays \times 8hrs}$$

6.

$$Indiv.Mem.Incen.Erng. = (WPI - 1.0) \times \frac{Act.ClkdinHrsbyMem. - TimespentawayfromWork}{ScheduleNo.ofWorkingHrs} \times IEF \times Attd.Fac. \times Grp.Perf.Eff. \times 0.8\ *$$

* - Support Shop Incentive linkage constant.

Support Department:

1. $$Wtd.Perf.Index = \frac{(GPI_A \times M_A) + (GPI_B \times M_B) + ---}{M_A + M_B + ---}$$

Where GPI_A, GPI_B,--- = Gross production index of corresponding production group.

Where M_A, M_B,--- = No. of Members of Corresponding production group.

2. $$Std.Man\,Pr.Ratio = \frac{SumofAuthorizedStrengthofall\,Prod.Grps.}{SumofAuthorizedstrengthofallSupportDept.}$$

3. $$Actual.Man\,Pr.Ratio = \frac{SumofActualStrengthofall\,Prod.Grps.}{SumofActualstrengthofallSupportDept.}$$

4. $$Grp.Perf.Efficiency = \frac{ActualManpowerRatio}{S\tan dardManpowerRatio}$$

5. $$Grp.AttendanceFactor = \frac{Actualclockedinmanhrs}{0.875 \times Actualstrength \times ActualWorkingdays \times 8hrs}$$

6.

$$Indiv.MemIncenErng. = (WPI - 1.0) \times \frac{Act.ClkdinHrsbyMem. - Timespentawayfrom Wok}{ScheduleNoofWorkingHrs} \times IEF \times Attd.Fac. \times Grp.Perf.Eff. \times 0.5^{\#}$$

[#]- Support Dept. Incentive linkage constant.

Salient Features of Group incentive Scheme:

1. Idle time booking is permitted in case failure of external power supply, When it exceeds 60Minutes at a stretch.
2. No Ministerial category, Personnel will be covered under incentive group.
3. All the on-roll members of the group from unskilled level up to SSE level are included as members of the group and eligible for incentive.
4. Excessive detention of coaches in individual shops and plant as whole attract negative effect on group performance.
5. Defects on coaches dispatched by supplying group to receiving group causes adverse effect on supplying group incentive performance.
6. Effect of Plant Production Index (PPI) for total plant performance gets included in group incentive earning calculation.
7. Individual member incentive earning is directly proportional to members own clocked in hours.
8. To assist in getting better attendance at work by group members a group attendance is included in Scheme.
9. Different grade of incentive covered staff have defined incentive earning factor as approved by Railway board.
10. Quality linkage factor is included in the scheme to control quality of coaches.
11. Maximum limit for incentive earning in a calendar month period under this is 50% only.
12. Coaches output accountal will be done coach type wise only and not by category of repairs executed.

Disadvantage of Group Incentive Scheme:

1. Machine Codal life is decreased.
2. More maintenance.
3. Un-willing to take non-incentive works.
4. Un-Employment increases.
5. Deterioration of health.
6. Jealousy between different groups.

7. Absentisem of any of the group members effects incentive of all other members.

Difference between Group incentive scheme & CLW incentive scheme:

S. No	*Group Incentive scheme*	*CLW incentive scheme*
1.	This is based on the RITES group incentive.	The CLW pattern is an individual incentive scheme.
2.	The Outturn of the entire group considered for working out Incentive.	Incentive is paid when an employee completes the activity less than the allowed time.
3.	There is no provision of keeping staff under Non- Incentive in group.	There is such provision.
4.	There is provision to avoid excessive coach detention.	There is no provision to avoid excessive coach detention.
5.	There is a quality linkage factor for quality control.	There is no such provision.
6.	Min. Incentive earning is 20% & Max. is 50%.	Min incentive earning is 33% & Max. is 50%.

CHAPTER REVIEW:

1) Discuss the role of provisions of incentive allowance to workers in Railway workshops and the present and long run results of implanting the incentive schemes in Railways.
2) Distinguish between Payment by Results (CLW pattern) incentive scheme and Group Incentive Scheme (GIS pattern).
3) Prepare an incentive calculation for a specified job considering any one incentive scheme.

WORK MEASUREMENT- CHAPTER- 13

BENCH MARKING

13.0 BENCH MARKING – INTRODUCTION – SCOPE, DEFINITION

Benchmarking is a technique in which a company measures its performance against that of best in class companies, determines how those companies achieved their performance levels and uses the information to improve its own performance. Subjects that can be benchmarked include strategies, operations and processes.

Bench marking is defined as a measurement of the quality of an organization's policies, products, programs, strategies, etc., and their comparison with standard measurements, or similar measurements of its peers.

The objectives of benchmarking are (1) to determine what and where improvements are called for, (2) to analyze how other organizations achieve their high performance levels, and (3)to use this information to improve performance.

Benchmarking is basically process of measuring products, services, and processes against those of organizations known to be leaders in one or more aspects of their operations. Benchmarking provides necessary insights to help you understand how your organization compares with similar organizations, even if they are in a different business or have a different group of customers.

Additionally, benchmarking can help you identify areas, systems, or processes for improvements—either incremental (continuous) improvements or dramatic (business process reengineering) improvements.

Benchmarking has been classified into two distinct categories:

Technical benchmarking — performed by design staff to ascertain the capabilities of products or services, especially in comparison to the products or services of leading competitors. For example, on a scale of one to four, four being best, how do designers rank the properties of your organization's products or services? If you cannot obtain hard data, the design efforts may be insufficient, and products or services may be inadequate to be competitive.

Competitive benchmarking — Compares how well (or poorly) an organization is doing with respect to the leading competition, especially with respect to critically important attributes, functions, or values associated with the organization's products or services. For example, on a scale of one to four, four being best, how do customers rank your organization's products or services compared to those of the leading competition? If you cannot obtain hard data, marketing efforts may be misdirected and design efforts misguided.

13.1 APPLICATION OF BENCH MARKING ON IR (IRBM), (SCRBM)

Annexure added

13.2 DEPARTMENTWISE BENCH MARKING

Annexure added

13.3 HOER – MAN POWER PLANNING

Definitions

- **Full night** : period between 10 pm and 6 am

- **Long-on** : a period of duty over 8/10/12 hours in case of Intensive/Continuous/Essentially Intermittent workers respectively.
- **Roster** : Document which shows the hours a Railway employee is expected to be on duty every day, the daily as well as weekly rest and break between spells of duty in a day.
- **Short-off** : A period of rest which is

- In case of Intensive workers less than 12 hours in a roster of six hours duty and less than 14 hours in a mixed roster of 6 and 8 hours duty.

- In case of Continuous workers less than 10 hours.

- In case of Essentially Intermittent workers less than 8 hours.

Authority to Classify

- Power to declare the employment of a Railway employee Intensive or Essentially Intermittent vests with Head of the Railway Administration which can be delegated to Chief Personnel Officer.
- During emergency situations it can be exercised by an Officer not below the rank of Senior Scale.
- A copy of every declaration of classification shall be sent to Regional Labour Commissioner and if it is made by an Officer (Sr Scale) a copy to be sent to Head of the Railway Administration and Chief Personnel Officer.

Appeals against Classification

- Any Railway employee aggrieved by a declaration of classification may prefer an appeal to Regional Labour Commissioner within 90 days of the date of declaration. RLC may after srutiny of documents or fresh job analysis may order for a change in classification.
- Any Railway employee of Railway Administration aggrieved by a decision of Regional Labour Commissioner may prefer an appeal to the Secretary to the Government of India, Ministry of Labour before the expiry of 90 days from the date on which the decision of Regional Labour Commissioner is communicated.

Classification

1. **Continuous :** The employment of a Railway employee is said to be continuous except when it is excluded or has been declared to be Essentially Intermittent or Intensive.
2. **Essentially Intermittent :** The employment of a Railway employee is said to be Essentially Intermittent when it has been declared to be so by the prescribed authority on the grounds that daily hours of duty of the Railway employee normally include periods of inaction aggregating to 50% or more (including at least 1 such period of not less than 1 hour or 2 such periods of not less than half an hour each) in a tour of 12 hour duty (on the average over 72 consecutive hours) during which the Railway employee may be on duty, but is not called upon to display either physical activity or sustained attention.
3. **Excluded** : The employment of a Railway employee is said to be Excluded if he belongs to any one of the following categories,
    - Railway employee employed in managerial or confidential capacity.
    - Armed guards or other personnel subject to discipline similar to that of any armed police forces.
    - Staff of the railway schools imparting technical training or academic education.
    - Such staff as may be specified as supervisory.
    - Matrons

- Sisters-in-charge
- Matrons not on regualar shift duty in Railway Hospitals
- Health Educators and District Extension Educators
- Family Planning Field workers
- Lady Health Visitors
- Auxiliary nurses-cum-midwives
- Projectionists.
- Other categories prescribed.

4 **. Intensive** : The employment of a Railway employee is said to be Intensive when it has been declared to be so by the prescibed authority on the ground that it is of a strenous nature involving continued concentration or hard manual labour with little or no period of relaxation.

Supervisory Staff

- Ministry of Labour by written order specify Railway employees or classes of Railway employees as supervisory on the ground of holding a position of responsibility employed on duties mainly of supervisory character and because of his nature of work comparitively free to adjust his hours of duty or work.
- Copy of every such order shall be send to Chief Labour Commissioner, New Delhi.

Criteria for Classification

1. **Continuous :** All Railway employees except those excluded from Hours of Employment Regulations are assumed to be 'Continuous'. Thereafter on the basis of factual job analysis, it may be classified as Essentially Intermittent or Intensive.
2. **Intensive :** Two important factors in declaring and employment as Intensive are : (i) strenuous nature of the work tending to cause mental or physical strain (ii) continuous application to such work with little or no period of relaxation. Thisis considered to have been satisfied where period of inaction or relaxation do not aggregate 6 hours or more in a cycle of 24 hours or one hour or more in a shift of 8 hours.
3. **Essentially Intermittent :** If daily duty hours which should be assumed to be 12 hour/day include
   - one period of inaction of not less than one hour or two such periods of not less than half an hour each AND
   - various periods of inaction (including that above) aggregating 50% or more during which he is not called upon to show either physical activities or sustained attention.
   - NOTE : In calculating above, periods of inaction of less than 5" shall be ignored.

CLASS	*Standard Hours*	*Statutory Limit(Sec 132 of Railways Act 1989)*	*Preparatory & Complementary work*
Intensive	42 h /week	45 h /week	3 h /week
Continuous	48 h /week	54 h /week	6 h /week
Essentially Intermittent	48 h /week + 12/24 h additional hours*	75 h /week	3 or 4 1/2 h /week *

** (i) Gateman 'C' , Caretakers, Chowkidars & Saloon Attendant and Railway employees in roadside stations provided with quarters within 0.5 km of place of duty - 24 h additional duty and 3h/week Preparatory & Complementary work*

(ii) Other Railway employees in EI roster - - *12 h additional duty and* 4 1/2 h*/week Preparatory & Complementary work*

- Preparatory & Complementary work is treated as:
  i. When it is less than 15 min - not treated as duty, not exhibited in roster
  ii. 15 min to less than 45 min (Continuous) - half an hour
  iii. 45 min to 1 hour (Continuous) - one hour
  iv. For Intensive & EI 15 min to 30 min is treated as half an hour
- Total hours for Preparatory & Complementary work shall be fixed so as not to exceed maximum hours.

Running Staff

- Running staff will have a link roster with standard hours 104 hours and statutory limit of 108 hours.
- Link should be such that it won't exceed 10 hours from "*signing on"* to *"Signing off".*
- They are given 4 periods of rest 30 consecutive hours or 5 periods of 22 consecutive hours each including a full night.

Split duty

- Spells of duty shall not exceed 3 and no of breaks not to exceed two.
- In case of employment of Continuous nature Railway employee whose place of residence is beyond 1.6 km from the place of duty seven hours of split duty shall be treated as equivalent to 8 hours of normal duty.
- While preparing rosters long on and short off shall be avoided.

MAN POWER PLANNING

- Manpower planning is a process which aims to have the right number of staff at right places with right type of skills at right times to enable the organisation to achieve it s short term and long term goals. In other words, manpower planning is the system, which ensures the manpower availability at a given point of time.
- Manpower planning means establishment of job specifications or qualitative requirements of jobs to determine the number of people required and to find supply source.
- Manpower recruitment is related to matching the personal qualities of employees with the job requirements.

Job analysis and Job description

- Job analysis means analysing the corporate plans, objectives, finance, investments, products, marketings etc. with the trend of turnover, promotion patterns, transfers, qualifications, training, experience, performance standards and performance actuals.
- Job description includes job design, job specifications, job enlargement, job enrichment, job responsibilities etc. When these elements are co-related, the job demand is known.
- Job analysis, job specification and job design are the important factors involved in human resource development and manpower planning.

Assessment of Manpower in Railways

In open line, factors like normal wastage, death, deputation, dismissal, creation of assets and posts, leave reserve, rest givers, yardsticks etc., influences the assessment of manpower.

- In construction projects, performance evaluation and review technique, phasing of work etc., are used to assess manpower.
- There have been dynamic change in the technology and modernisation, electrification, computerisation, mechanisation of track maintenance etc. are taking place at fast rate to meet the challenges of traffic requirements in Indian railways. To meet the challenges of the changing environment, systematic manpower planning is essential. Therefore a category-wise analysis of staff should be carried out, to identify the surplus and to arrange manpower in the areas of need. This adjusts the surplus in one category to other categories, where there is demand. Manpower planning ensures that the existing manpower is utilized to the maximum extent.
- Manpower planning emphasise on training to different categories of staff to improve the skill and to increase productivity. This step reduces the availability of unskilled staff, increase productivity and maximise manpower utilisation. Regular conversion training programs reduce the wastage of manpower due to changeover. The staff are also deputed for refresher course, conversion course, promotional course etc. with the aim to develop organisationally effective personnel with pride in their work and faith in management.
- The primary objective of the manpower planning is to ensure the availability of the required skill and to reduce wastage. When the manpower availability is clearly known arrangements can be easily made to cater to the additional needs of manpower as indicated in the forecasts. Normally, the field officers responsible for executing the job are responsible for the manpower planning.

13.4 OPERATING RATIO

Accountability for Performance Budgeting. Underlying the annual budgets are certain assumptions in. respect of physical outputs such as movement of a specific quantum of traffic, consequential workload on maintenance of track, rolling stock and other assets, fuel consumption, optimum utilization of assets and generally operating the system efficiently, etc. The extent to which these assumptions are actually realized is judged through a number of performance indices which are worked out periodically and annually. The more important and commonly used operating efficiency indices are:

(a) Freight traffic

(1) Originating tonnage of revenue-earning freight traffic by broad commodity groups.
(2) Earning per million stones of originating traffic by selected commodities.

(b) Wagons

(3) Wagon kilometres per wagon day.
(4) Net tonne kilometres per wagon day.
(5) Wagon turn-round (time elapsed between successive loadings of a single wagon). {6) Detentions
to wagons in important marshalling yards.
(7) Percentage of loaded to total wagon kilometrage.
(8) Net tonne kilometres moved per annum per tonne of wagon capacity.

(c) Engines

(9) Hours worked per day per engine available for use, service wise and traction wise.
(10) Engine kilometers per day per engine day on line/in use on goods services traction wise.
Net tonne kilometers per goods engine hour on line/in use.
(11) Engine kilometers per engine failure, traction .vise.
(13) Fuel consumption under the various services, traction wise.
(d) Train operation
(14) Average speed of goods trains, traction wise.

(15) Average load of goods trains, gross and net in terms of wagons, traction wise.
(16) Punctuality of Mail and Express and other passenger trains.
(e) Rolling Stock repairs.
(17) Percentage of under and awaiting repairs-locomotives, coaches and wagons.

Some useful information on Operating Ratio:

- Codal provisions - Para 308 & 434 of I.Rly.Finance Code.

- It is regarded as one of the Most Important financial statistics/ratios and has frequently been used as an Index of the operating efficiency of the Railways.

- Definition of O.R.: Percentage of Gross Working Expenses to Gross Earnings of any accounting year. In general, Operating ratio is the number of rupees spent to earn every 100 Rupees.

- If O.R. is less than 100 = Organisation is in profits.
- If O.R. is more than 100 = Organisation is in losses.

- Definition of Gross Working Expenses (GWE): Ordinary Working Expenses-OWE (Demands 3 to 13) plus Appropriations to DRF-Depreciation Reserve Fund and Pension Fund. Note: True expenses in an accounting period whether or not actually disbursed. That means excludes Suspense.

- Definition of Gross Earnings: Coaching Earnings (Abstract X) + Goods Earnings (Abstract Y) + Sundry other Earnings (Abstract Z) Note: true or accrued earnings in an accounting period whether or not actually realised. That means excludes Suspense.

- Always considered Apportioned Earnings instead of Originating Earnings.

$$O.R = \frac{\text{Gross Working Expenses}}{\text{Gross Earnings}} \times 100$$

Important Note:

- Gross Expenditure (Working Expenses actually disbursed during an accounting period) = Gross Working Expenses + Suspense

- Gross Receipts (Earnings actually realised during an accounting period)
- = Gross Earnings + Suspense.

That means :-

- Gross Receipts - Always includes Suspense

- Gross Earnings - Always excludes Suspense. It is denominator for O.R. formulae.

Similarly

- Gross expenditure - includes Suspense.

- Gross Working Expenses -excludes Suspense. It is numerator for O.R. formulae.

- In the examinations, if Gross Expenditure figure given, deduct Suspense from that in order to arrive Gross Working Expenses. Similarly deduct Suspense from Gross Receipts to arrive Gross Earnings.

- Assumption is Suspense on Expenditure side is Debit balance i.e., plus figure and Suspense on Earnings side is Credit balance i.e., plus figure.

- In case of confusion, what you presume is clearly spelt out at the end of solution in the Examination. (by way of Notes). In that case, examiner will award marks in spite of incorrect answer. Because Examiner will take into consideration whether you understand and expressed the concept or not.

- There is no ideal Operating Ratio for Indian Railways. In rail road sector, an operating ratio of 80 or lower is considered desirable. However lower O.R. helps in generating internal resources for meeting requirement of Plan Expenditure on Safety (RSF), Amenities to Passengers & Staff (D.F) and other Capital investments such as laying of new lines, acquisition of Rolling Stock etc (Capital Fund).

- In the year 2005, Indian Railways, changed its accounting policy for the lease charges. The lease charges have been broken into two parts - capital and revenue. While revenue has been charged to working expenses (Demand No.9G), capital portion is separately provided for in the capital budget (Plan Head 2200-Leased assets - Payment of capital component of lease charges to IRFC etc.). This has resulted in the reduction of working expenses and the operating ratio.

- Measures to be taken to achieve the Lower/efficient O.R. are

    - Maximizing the traffic earnings inter-alia include rationalization of fare and freight tariff; effective marketing strategies to capture more and more traffic; creation of additional capacity and optimum utilization of the existing rail infrastructure.

    - Contain the expenditure through diverse means including strict economy and austerity measures; improved man-power planning; better asset utilization and inventory management; optimizing the fuel consumption etc.

- The Best ever O.R of Indian Railways was 74.7 % in 1963-64.

- Last few years O.R. of Indian Railways is

    - 2009-10 - 94.7 %
    - 2010-11 - 92.3 %
    - 2011-12 - 94.9 %
    - 2012-13 - 88.8 % (against the target of 84.9%)

- Target O.R of 2013-14 - 87.8 %

- Target O.R of 2016-17 - 74 %

- 2016-17 i.e., terminal year of 12th Five Year Plan (2012-17) target O.R. is 74 % (to equal the best ever O.R. of Indian Railways in 1963-64 - 74.7 %)

- Comparing O.R of Indian Railways with other countries ' railways systems - Not possible due to different computation methodologies across different countries thus reducing validity of comparison of such statistical figures.

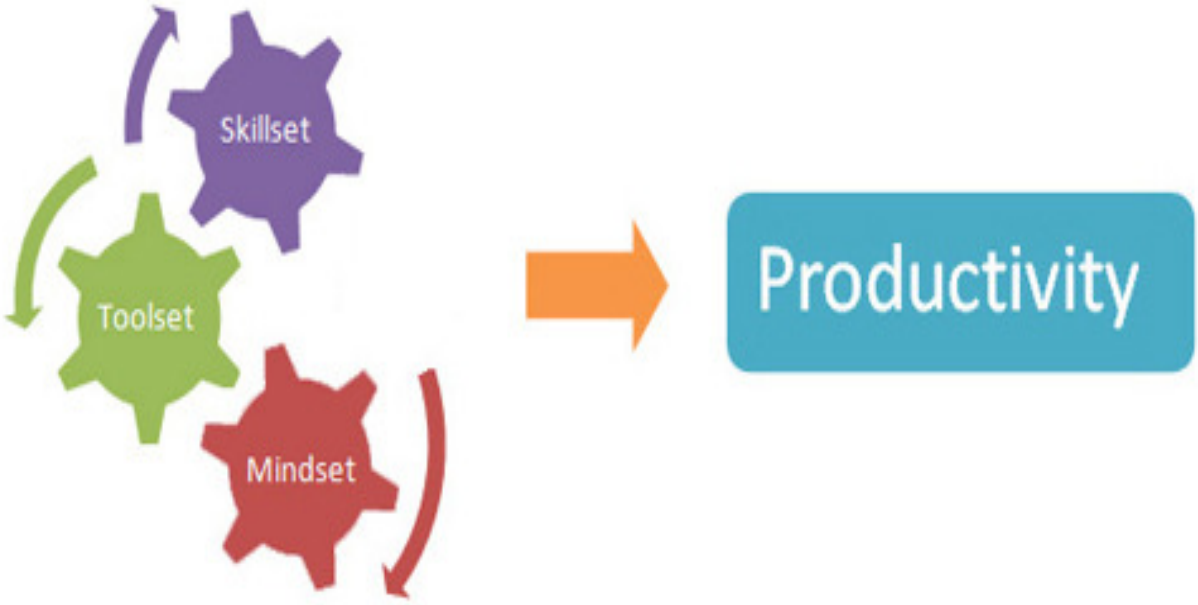
13.5 YARDSTICKS IN IR

Annexure added

CHAPTER REVIEW:

1) What do you understand by bench marking? State any standard bench markings available in Indian Railways.
2) Why operating ratio shall be monitored?
3) How man power planning is done in Indian Railways.

WORK MEASUREMENT- CHAPTER- 14



PRODUCTIVITY TECHNIQUES

14.1 PRODUCTIVITY TECHNIQUES

Introduction: In order to understand the role of work study, we need to understand the role of method study and that of time study.

Method study (also sometimes called Work Method Design) is mostly used to improve the method of doing work. It is equally applicable to new jobs. When applied to existing jobs and existing jobs, method study aims to find better methods of doing the jobs that are economical and safe, require less human effort, and need shorter make-ready / put-away time. The better method involves the optimum use of best materials and appropriate manpower so that work is performed in well organized manner leading to increased resource utilization, better quality and lower costs.

It can therefore be stated that through method study we have a systematic way of developing human resource effectiveness, providing high machine and equipment utilization, and making economical use of materials.

Time study, on the other hand, provides the standard time, that is the time needed by worker to complete a job by the standard method. Standard times for different jobs are necessary for proper estimation of

- manpower, machinery and equipment requirements
- daily, weekly or monthly requirement of materials
- production cost per unit as an input to better make or buy decision
- labor budgets
- worker's efficiency and make incentive wage payments.

By the application of method study and time study in any organization, we can thus achieve greater output at less cost and of better quality, and hence achieve higher productivity.

Productivity improvement techniques

1. **Value Engineering (VE)** is the process of improving the value of a product at every stage of the product life cycle:
   a. At the development stage, it improves the value of a product by reducing the cost without reducing quality.
   b. At the maturity stage, it reduces the cost by replacing the costly components (parts) by cheaper components.

   VE also tries to improve the value and product quality. Value is the satisfaction which the consumer gets by using the product. VE tries to give maximum value for the lowest price. This enhances the productivity.
2. **Quality Circles (QC)** was introduced in 1960 in Japan. QC is a small group of employees who meet regularly to identify, analyze, and solve problems in their department. The QC members advise the management to implement new methods to solve work-related problems. QC increases the productivity.
3. **Financial and non-financial incentives** : The organization must motivate the employees by providing financial and non-financial incentives.
   a. Financial incentives include better wages and salaries, bonus, etc.
   b. Nonfinancial incentives include better working conditions, welfare facilities, worker's participation in management, etc.
4. **Operations Research (OR)** uses mathematical and scientific methods to solve management problems, including problems of productivity. OR technique uses a scientific method to study the alternative courses of actions and to select the best alternative. OR uses techniques such as linear programming, game theory, etc., to make the right decision. Thus, OR helps to improve productivity.
5. **Training** is a process of increasing the knowledge and skills of the employees. Training is a must, for new employees and experienced employees. It increases the efficiency of the employee. Thus, it results inhigher productivity.
6. **Job Enlargement** is a horizontal expansion of a job. It is done to make jobs more interesting and satisfying. It involves increasing the variety of duties. For e.g. a typist may be given the job of accounts writing in addition to the typing work. This technique is used for lower level jobs.
7. **Job Enrichment** is a vertical expansion of a job. It makes routine jobs more meaningful and satisfying. It involves providing more challenging tasks, and responsibilities. For e.g. A manager who prepares performance reports is asked to make plans for his department. The Job Enrichment technique is used for higher-level jobs.
8. **Inventory Control** : There must be a proper level of inventory. Overstocking and under stocking of inventories must be avoided:
   a. Overstocking of inventories will result in blocking of funds and there are chances of spoilage or misuse of materials.
   b. Under stocking of inventories will result in shortages. This will block the smooth flow of production, and so the delivery schedules will be affected.
9. **Materials management** deals with optimum utilization of materials in the manufacturing process. It involves scientific purchasing, systematic store keeping, proper inventory control, etc. The main objective of materials management is to purchase the right quantity and quality materials, at the right prices, at the right time, to maintain favorable relations with suppliers, to reduce the cost of production, etc.

10. **Quality Control's** main objective is to produce good quality goods at reasonable prices, to reduce wastages, to locate causes of quality deviation and to correct such deviations, to make the employees conscious of quality, etc.
11. **Job Evaluation** is a process of fixing the value of each job in the organization. It is done to fix the wage rate for each job. A proper job evaluation increases the moral of the employees. This increases the productivity.
12. **Human factor engineering** refers to the man-machine relationship. It is designed to match the technology to a human requirement. The term Ergonomics has originated from the Greek word *Ergos* meaning work and *Nomikos* implies law. So, it means 'Law of Work'. It tells us how to fit a job to a man's psychological and physiological characteristics to increase human efficiency and well-being.

14.2 MULTI SKILLING & MULTI TASKING TECHNIQUES

Multi skilling may be defined as the training of a single employee in multiple skill-sets. It promotes workers who have a range of skills or knowledge for working on several different projects, which may or may not be a part of the worker's technical job description. This increases productivity and cuts the bottom line for a company, which does not have to hire additional personnel to do other jobs.

Multitasking, in a human context, is the practice of doing multiple things simultaneously, such as editing a document or responding to email while attending a teleconference. The term "multitasking" originated in the computer engineering industry. It refers to the ability of a computer to apparently process several tasks, or computer jobs, concurrently. Computer multitasking in single-CPU microprocessors actually involves time-sharing of the processor; only one task can actually be active at a time, but partial work on each task is rotated through many times a second. With multi-core computers, each CPU can perform a separate task simultaneously.

MULTI SKILLING :

NEED FOR MULTI SKILLING

In an era of specialization, the downturn has interestingly brought into focus the necessity of having a multi-skilled workforce.

- Multi-skilled workforce helps to avoid retrenchment, reduce hiring and increase efficiency.
- Possession of an additional skill goes a long way in opening new channels and opportunities for professionals.
- It allows the company to bring about cost-cutting in various forms and more importantly, an individual does not become indispensable for the company, or rather a company need not depend on a particular person for doing a specialized job in which he is an expert.
- A multi-skilled workforce helps in addressing customer demand faster and better.
- It would be self-managed and flexible according to the requirements of the company.
- From the perspective of the employee, multi-tasking would allow them to become diversified and maintain high levels of motivation and enthusiasm.

TYPES OF MULTISKILLING

1. **VERTICAL MULTISKILLING:** The extent to which supervisory or administrative support tasks are learned by individuals.
2. **HORIZONTAL MULTISKILLING:** This is learning skills from another discipline or function within an organisation.
3. **SKILL BROADENING** : Where minor elements and tasks are learned on top of the predominant activity (major task). So expertise is maintained in the major task with elements added to increase efficiency.
4. **CROSS SKILLING/DUAL SKILLING** : Where another major activity is learned in addition to the main craft and a person is considered competent to carry out any activity in these two main disciplines.

- **DEPTH MULTISKILLING:** This is the acquisition and application of more complex, specific skills within the same trade or discipline.
- **MULTISKILLED TEAMS:** A multi skilled team is a group of individuals who collectively have a range of skills. Traditional single skilled individuals collected into one team and managed by one supervisor, or A team of multi skilled individuals.

The intent is to have a team where the strengths and specialities are combined, which increases the range of skills available to tackle certain issues.

MULTISKILLING INITIATIVE

- Plotting a multi-skilled profile for each of the plant personnel.
- Developmental initiatives through OTJ training.
- Assessments and remapping.

WHO NEEDS TO GET MULTISKILLED?

- It is important to understand who needs to get multi skilled. Do they need to be at a particular level or position, or doing a specific work? Interestingly, most experts do believe that being multi-skilled is level-agnostic.
- Technical staff- People trained in technical skills need to have mastery over more than one platform
- Non-technical staff- The non-technical staff can be trained in support functions to save an organization considerable cost.
- Training should preferably be in related/adjacent fields, so that the existing skills of the employees are appropriately leveraged.
- Multi skilling is not so much about a particular level or category of employees. It is about a mindset. It is about skill sets and it is fairly level-agnostic.

TECHNIQUES OF MULTISKILLING

Multi skilling can be developed through a variety of techniques which are as follows:

- Coaching and Mentoring
- Job-Rotation
- Job-Shadowing
- Self-Learning
- Temping
- Team-based Cross-functional projects

COACHING & MENTORING

COACHING

- Takes place between worker and supervisor
- Can provide specific performance improvement and correction

MENTORING

- Senior employee paired with a junior employee ("protégé")
  - Helps to learn the ropes
  - Prepares protégé for future advancement

JOB ROTATION

- Train on different tasks/positions
- Often used to train entry-level managers
- Also used to provide back-up in production positions

JOB SHADOWING

- Job shadowing is a career exploration activity that offers an opportunity to spend time with a professional currently working in a person's career field of interest. Job shadowing offers a chance to see what it's actually like working in a specific job.
- The new hire may spend one to five days following the routine of the employee, learning general job responsibilities, observing how the tasks are carried out, and getting some insight into methods that allow for efficient handling of the job.

SELF-LEARNING

- **In self-directed learning (SDL)**, the individual takes the initiative and the responsibility for what occurs. Individuals select, manage, and assess their own learning activities, which can be pursued at any time, in any place, through any means, at any age. In schools, teachers can work toward SDL a stage at a time. Teaching emphasizes SDL skills, processes, and systems rather than content coverage and tests. For the individual, SDL involves initiating personal challenge activities and developing the personal qualities to pursue them successfully.

TEMPING

- Temping means working short employment stints with a variety of clients, usually through a temping agency or staffing firm. Although temporary, the worker bases his/her working life around this kind of work as it offers increased flexibility and variety
- Temping is a tri-party agreement, between the client company, the third party vendor and the employee (also known as associate or temp.
- The temp workers work in the facility of the client companies, but receive salary and benefits from the temp agencies.

LEARNING BY DOING

- New forms of learning by doing seem to be emerging. Technology could play a role in finding innovative ways to enable skills development and greater understanding of personal actions, reactions and decisions.

ADVANTAGES OF MULTISKILLING

- Workforce is more flexible.
- Helps in change management.
- Employees are better prepared to anticipate problems or requirements or other areas.
- Employees can assume other tasks when there is absenteeism.
- Employees can be moved into other positions at peak operational time.
- Employees become more aware of the work flow.
- More talent available for the organizations.
- Out of the box thinking, influx of new ideas, creative solutions through role reversals and lateral moves.
- People in different functional areas are connected.
- Increasing task variety increases employee satisfaction.
- Greater employability for employees.
- Contributes towards employee training & development.
- Cost-effectiveness and cost-cutting.
- Better cope-up with technological change.
- Test trainees, helps identify person's strengths & weaknesses.

BARRIERS TO MULTISKILLING

- Demotivates intelligent and aggressive employees who seek specific responsibility.
- Eventually creates a number of employees with limited job knowledge.
- Encourages generalization, more appropriate for developing line managers than functional staff.
- Sometimes, there is an undercurrent of frustration.
- New jobs, environment and learning can unnerve employees.
- Employees fear not living up to expectations.
- Employees are uncomfortable with the changes and cannot deal with the conflict of the role and their personality.

14.3 INTERPERSONAL SKILLS

It is defined as the set of abilities enabling a person to interact positively and work effectively with others. Development of the interpersonal skills of employees is a key goal of training and development initiatives for many companies, and is considered a constructive manner in which to handle office disputes and other personnel issues. These skills include the areas of communication,listening, delegation of tasks and leadership.

When we think of "skills" for work, often we think only of those competencies we put on our resume: the core skills we've learned such as programs, platforms, diplomas and degrees. Often, we forget that we possess many different core skills, particularly those interpersonal skills that could land us the job of our dreams.

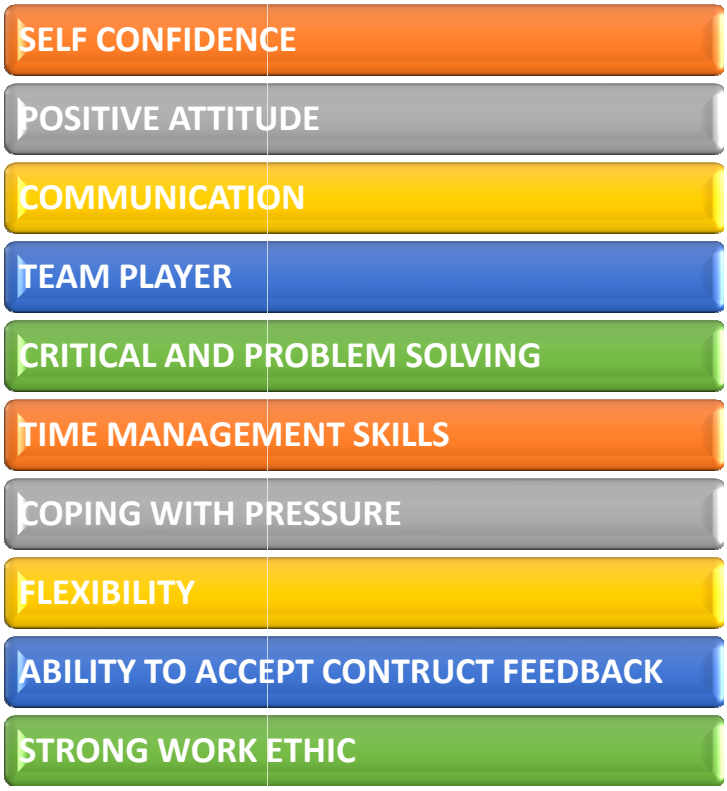
Interpersonal skills relate to a person's "EQ" (Emotional Intelligence Quotient). This is the cluster of personality traits, social graces, communication, language, personal habits, friendliness, and optimism that characterise our relationships with other people.

In today's job market, having technical skills is not enough. You need to go beyond the call of duty and show that you have what it takes to fit within the organisation's culture.

Recruiters today have pre-screening tests available at their disposal, to weed out applicants before they even get to the interview stage. They use personality tests and assessments and gauge who will be a better fit between two applicants of similar qualifications and experience.

They rely on identifying interpersonal skills. Interpersonal skills will give you a chance to differentiate from other job applicants as well as work mates and move up the ladder. These complement your technical skills, enhance your job performance and social interactions, and work hard to give you an edge over others. Unlike hard skills, these are interpersonal.

The list shows some important interpersonal skills required to working class:



14.4 RELIABILITY ENGINEERING

Reliability is an engineering discipline for applying scientific know-how to a component, assembly, plant, or process so it will perform its intended function, without failure, for the required time duration when installed and operated correctly in a specified environment.

Reliability is "quality changing over time" or A motion picture instead of a snapshot

Reliability is a measure of the result of the quality of the product over the long run. Reliability terminates with a failure—i.e, unreliability occurs. Business enterprises observe the high cost of unreliability. The high cost of unreliability motivates an engineering solution to control and reduce costs.

MIL-STD-721C Definitions of Terms for Reliability and Maintainability gives the following definition for reliability:

Reliability is the probability than an item can perform its intended function without failure for a specified interval under stated conditions.

This definition provides the following four aspects of reliability:

1. Reliability is a probability based concept; the numerical value of the reliability is between 0 and 1
2. The functional performance of the product has to meet certain stipulations and a functional definition of failure is needed. For example, a failure means different things to the user and to the repair person.
3. It implies successful operation over a certain period of time
4. Operating or environmental conditions under which product use takes place are specified

Cost of Unreliability

Cost improvement efforts are more productive when motivated from the top-down rather than bottom-up because it is a top management driven effort for improving costs. Finding the cost of unreliability (COUR) starts with a big-picture view and helps direct cost improvement programs by identifying:

1. Where is the cost problem--what sections of the plant,
2. What magnitude is the problem--all business loss costs are included in the calculation, and
3. What major types of problems occur

Cost of unreliability programs study plants as links in a chain for a reliability system, and the costs Incurred when the plant, or a series of plants, fail to produce the desired result.

Cost of unreliability begins with the big picture of failures to produce the desired business results driven by failures of the process or it's equipment. Elements of the process are considered as a series reliability model comprising links in a chain of events that deliver success or failure. Logical block diagrams of major steps or systems are identified. Failure costs are calculated by category expecting that history tends to repeat in a string of chance events unless the problems have been permanently removed and success demonstrated by objective measures.

Designing For Reliability

Reliability does not just happen. It requires that the following three key elements be in place

- A commitment from top management to ensuring reliability
- A reliability policy (that goes hand-in-hand with a Quality Policy)
- A philosophy that designs reliability in at an early stage

Ways To Improve Reliability

- Use proven designs
- Use the simplest possible designs
- Use proven components that have undergone reliability component testing
- Use redundant parts in high risk areas. Placing two components in parallel will reduce the overall probability of failure
- Always design fail safe
- Specify and use proven manufacturing methods

MEASURES OF RELIABILITY

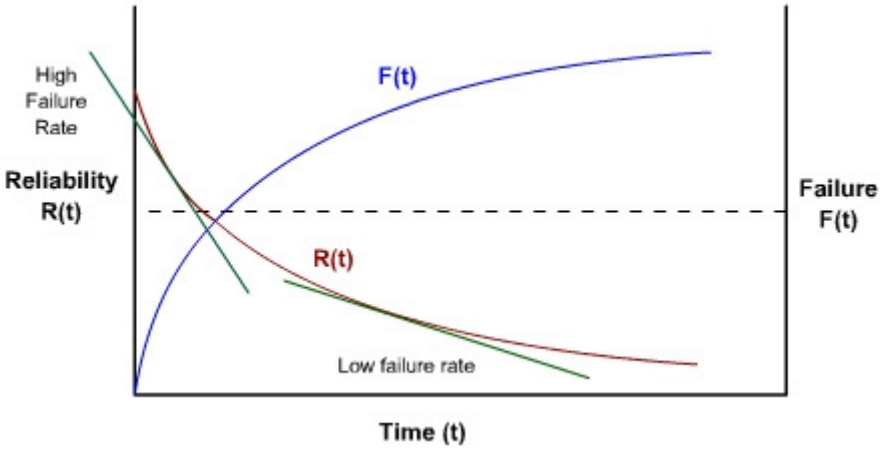
Reliability is the probability that a system will still be functioning at time t.

$$R(t) = \frac{\text{Number surviving at t}}{\text{Number existing at t}}$$

This can be expressed as "the cumulative distribution of failure"

$$F(t) = 1 - R(t) = \frac{\text{Cummulative number of failure at t}}{\text{Number existing at t = 0}}$$

These two measures are the mirror image of each other (Refer Figure below). The reliability will start at 1 and decay to approach 0 over time. The cumulative distribution of failure will start at 0 (no failures) and approach 1 as all the items fail over time. The slope of the reliability curve at any time t is the failure rate at that point in time. These measures give the overall reliability or failure at time t



Probability density function

We wish to have an idea of the probability of an item failing in a given unit time period. This is termed the "probability density function" and is given by

$$f(t) = \frac{\text{Number failing in unit time t}}{\text{Number exisitng at time t = 0}}$$

The failure or hazard rate gives the failure density over a period of time as with the "probability density function", but is based on the current population. This gives a much better indication of the changing reliability of a system over time.

$$\lambda(t) = \frac{\text{Number failing at unit time t}}{\text{Number surviving at time t}}$$

14.5 JOB EVALUATION AND MERIT RATING

Job Analysis Defined as Process of defining a job in terms of its component tasks or duties and the knowledge or skills required to perform them ***NOTE***: JA focuses on the **job** rather than the job holder

Purpose of a Job Analysis - Necessary to success of human resource functions and provides a legal foothold for organizations to defend themselves against employment-related litigation

Products of Job Analysis - *Job Description* – Written statement about what job holder actually does, how, and why **Specifies the task requirements**

• *Job Specifications* – Delineate the KSAOs that seem necessary for job specifies **the people requirements**

• *Job Evaluation* – Determine the worth of a job Used **to establish compensation rates**

- Job Analysis Strategies

Standard Methods for Conducting Job Analysis Standard methods generally take one of two forms:

1. Job-Oriented Focus on describing various tasks that are performed on the job Very specific task description

2. Worker-Oriented Examine broad human behaviors involved in work activities Description of general facets of the job

Standard Methods for Conducting Job Analysis • Job-Oriented Approaches Task Inventory Approach Functional Job Analysis

• Worker-Oriented Approaches Job Element Method Position Analysis Questionnaire Common Metric System

Job-Oriented Approaches

Task Inventory Approach Task statements generated by Subject Matter Experts (SMEs) SMEs – Individuals who are incumbents or experts regarding the target job Incumbents then put a check next to statements that describe their job Data provide a picture of the job

Functional Job Analysis Obtain information about what tasks a person performs and how those tasks are performed Uses task statements, but they are rated on the following dimensions: ***Data* – Extent to which cognitive resources are needed to handle info, facts, ideas *People* – extent to which interpersonal resources are needed *Things* – Extent to which physical resources are needed (strength, speed etc)** Used to Create the Dictionary of Occupational Titles (DOT)

Worker-Oriented Approaches

Job Element Method: Identify the characteristics of superior workers on a job Element here means – Knowledge, Skills, Abilities, and Other characteristics (KSAOs) necessary for effective perf. Use SMEs to develop list of job elements SMEs provide work examples of elements Notice differences with Task Inventory

Position Analysis Questionnaire (PAQ) Standardized instrument that focuses on general work behaviours 194 items; SMEs decide about whether the item pertains to their job and evaluates it along a series of dimensions (importance to job, amount of time spent on this item, etc.). Items fall into six Dimensions Concerns: Not for white-collar jobs College reading level Too abstract, so many jobs look similar.

Common Metric System newly developed instrument (Harvey) 2,077 items organized along 80 dimensions Takes 3 hours to complete on-line Items are more behaviorally specified than PAQ items and has a lower reading level Relevant for both Managerial and Non-Managerial jobs

Job Evaluation Overview

Job Evaluation Defined An assessment of the relative value of jobs to determine appropriate compensation

Objectives in Setting Compensation Rates **Internal equity:** Fairness across jobs within the organization (job evaluation) **External equity:** Fairness within jobs across organizations(wage surveys)

Standard Methods for Conducting Job Evaluation

Target of comparison

Point System Job Classification Common Standard Factor Comparison Job Ranking Other Jobs Job Components Whole Job **Unit of Comparison**

The Point System

• Step 1: Identify compensable factors • Step 2: Define degrees within factors • Step 3: Assign points for each degree and factor **Typical Procedure**

Note. All of the above involve judgments made by SMEs.Hypothetical Point Values for Job Factors

• Step 4: Rate each job on each factor to determine point value

• Step 5: Examine relation between value and pay (e.g., create a salary plot)

• Step 6: Set or adjust pay rates to ensure internal and external equity **Typical Procedure**

Common Problems in Job Evaluation 1. Identification of a common set of compensable factors

2. Rating errors Halo error Gender composition Stereotype bias History effects

3. Conflict between internal and external equity

Pay Equity

The Problem: pay inequity • Women's wages are between 70% - 90% of men's wages • Why?

Legislative Attempts to Remove Inequities • **Equal Pay for Equal Work** introduced in Ontario in 1951 gradually changed to include "similar" work • **Equal Pay for Work of Equal Value** introduced in Ontario in 1987 companies required to evaluate jobs on the basis of skill, effort, responsibility and working conditions must pay jobs according to value

Use of Job Evaluation to Achieve Pay Equity

• Step 1: Identify job classes occupied mainly by men and by women

• Step 2: Determine a common set of compensable factors

• Step 3: Rate and compare jobs

• Step 4: Make wage adjustments where necessary

Use of Job Evaluation to Achieve Pay Equity

1. Lack of comparable jobs 2. Difficulty in finding a common set of compensable factors 3. Potential rating biases 4. Conflict with other determinants of wages 5. Making wage adjustments **Potential Problems**

Pay Equity: Lessons Learned from the Canadian Experience **1. Proactive** (vs. complaints based) requires all employers over a certain size to have a pay equity policy **2. Phase in** start with the public sector and then larger organizations in the private sector **3. Flexibility** Allow for exemptions based on market value (where there are shortages), merit, seniority, etc. **Source**: Gunderson (*Journal of Social Issues,* 1989)

Pay Equity: Lessons Learned from the Canadian Experience **4. Adjustment Ceiling** keep yearly adjustments to a reasonable level **5. Phase in** involve unions in attainment of pay equity objectives **Source**: Gunderson (*Journal of Social Issues,* 1989)

14.6 MANAGEMENT POLICIES – DECISIONS, OBJECTIVES

It is essential to update the information on Management policies of the Railways. Timely obtained decisions and target oriented objectives of the Railway of Zonal level and Unit level shall be obtained for the purpose of the review of the man power planning of the organisation.

14.7 PERFORMANCE INDICES

Annexure Attached.

14.8 WORKSHOP MANUFACTURING SUSPENSE

Railways are a commercial concern. Costs incurred in their workshops affect maintenance cost of the running the Railway. Any extravagance in workshops is likely to tell upon the operating costs resulting in erosion of profits. It is therefore necessary to have proper cost control over expenses incurred in workshops. For this purpose a suspense head of WMS is needed under which all expenses incurred in a workshop are accumulated and analyzed so as to pinpoint sources of waste and inefficiency.

WMS account is a Capital Suspense Account under Plan Head 7200 under Demand number 16.

NEED FOR MAINTAINING WMS

Railways being commercial concern costs incurred in Workshops affect maintenance costs of running of Railways. Any extravaganza will tell upon operating costs and erosion of profits.Necessary to have cost control over expenses. WMS pinpoints sources of wastage and efficiency.

The jobs and the allied activities undertaken in workshops are multifarious. It is essential to arrive at the unit cost of repair activity/manufacture for the purpose of allocation and budget framing.

RESUME ON WORKSHOP MANUFACTURING SUSPENSE ACCOUNT

WMS is a capital suspense head of account under PH 7200 and forms part of inventories in the Railway Balance Sheet. Hence, unusual balances and balances beyond the specified limits attract Dividend Liability and is a point of concern for the Zonal Railway. To ensure control over Expenditure

of the Workshop Manufacturing Operation (for the outturn of services and manufacturing goods) the Suspense Head maintained in WAO's will enable the Management to understand the outflow of cash element wise i.e. Direct Labour, Direct Material, Direct Expenditure vis-à-vis with outturn of the workshops.

Review of WMS Account identifies

- Capacity utilization of the workshop.
- Deployment of skilled Labour and their utilization in Manufacturing operations / Service operations (POH etc.)
- Close watch of material drawals to Shop Floor and their consumption pattern.
- Identification of Quantum of On Cost as a percentage to Direct Labour and control the overhead expenditure.

Element-wise details of WMS Account: -

- **Debits**
- **Shop Labour:** The cost of wages incurred in a workshop as a 'Direct Cost' to operations i.e. Artisans of various shops is booked to WMS Account on accrual basis. This is done through operation of 'Labour Suspense.' It is checked to see that the bookings under the Labour Suspense is cleared continuously to WMS Account to represent the actual cost of production.
- **Depot Stores:** Actual consumption of stores done through form S-1313 by the Executive is passed through SMS JV and is checked to see that the debits booked to WMS are correct by ensuring correctness of rates and quantities (Abnormal shop drawals).

Direct Purchase: Purchases made through Non-Stock Indents are accounted under this element of item. Same are checked to see that the Funds are available under PU - 04 and the repeated purchases made through NS Indents are proposed for stocking to attain the advantages of Bulk Purchases.

Miscellaneous Adjustments: Items under this head are checked to see that Inter-Shop transfer of materials should be as minimum as possible, since abnormal transfer transactions indicates lopsided planning by Production Engineer.

Credits:

Capital, DRF, DF, OLWR: The adjustments made through Capital Works are checked to see that unless the asset is created and the order is finalized, the expenditure should not be booked to 'Capital Head'. Capital work orders are reviewed and abnormal delays in progress of works are identified and reported.The outstanding Capital Work Orders towards closure of Final Accounts should be 'NIL', unless there are any throw forward works (RSP works).

Capital Stores Suspense:

- Manufacture Stores: The rates under manufacture stores are checked to see that they are certified by the Cost Accountant and are revised periodically.

- Returned Stores: While affording credit under Returned Stores points to be checked are (I) Scrap items for their rates (Borings, Turnings, Non-Ferrous Items). (ii) Reclaimable items are identified and classified as "Stores in Stock".

Revenue Operations:

- Demand No. 6: The bookings to Demand No.6 (Repairs to Carriage & Wagons), are taken from the total expenditure appearing against the individual Standing Work Orders, separately under the heads labour and Stores. The labour component of the expenditure in the WGR is based on the total labour hours against each work order multiplied with the Average hourly Rates of respective categories of Artisan Staff, while that of the stores portion is taken from the drawals of stores indicated in the Issue Notes, Work Order wise. The expenditure booked through the Standing Work Orders are reviewed to see that the same are closed every month and co-related with the physical out turn.
- Demand N0.7: All the works relating to workshop Machinery and Tools, Service Motor Cars, Cranes and other unclassified equipment in the workshop are carried out against different work orders. As is done in respect of Demand No.6 above, the bookings of Labour and Stores are extracted from WGR, Work Order wise as well as activity wise and finally cleared to Demand No.7 with Corresponding credit to WMS Account.

Miscellaneous Manufacturing Revenue:

Generally, a transaction pertaining to sparing to material, Wheel Sets, Cost of execution of Divisional Work Orders are accounted for under the subject head.

The following points need scrutiny

- That the rates at which the debits are passed on to other units are as per the latest books rates and sparing of material does not in any way resulting shortages in the shops.
- The rates charges for wheel sets are as per the latest PL number.
- With respect of Divisional Work Orders, it must be ensured that the expenditure incurred on Labour and Stores Elements are charged to the consignees in full together with the overheads.
- As a matter of general Norm/Parameter, it must be ensued that in respect of Repair Shops the Closing Balance is not in excess of 3% of Gross Credits, while for manufacturing shops by closing Balance unto 6% of Gross Credits is permissible.

Monthly Review of Balances under WMS

- All items are current, under taken upon issue of proper Work Order under sanction of CA
- Balances should consists of Labour/Material/On-cost only related to unfinished jobs/ jobs completed awaiting adjustments
- No credit items
- Deposit has been made where job done for outsiders
- No inefficient balances, promptly carry out periodical adjustments w.r.t., over/under charges.

14.9 USE OF COMPUTERS AND IT SERVICES TOWARDS HIGHER PRODUCTIVITY

Most everyone can agree that business productivity can be traced to an organization's ability to successfully execute on overall strategy. What else ensures business success? Businesses need engaged and highly productive employees executing on goals that are aligned with the organization's strategic objectives.

And, if execution is the key to a successful business—what are the steps to increasing your business productivity for greater execution on your strategic goals? How do you know your business alignment and people performance are working at optimal levels to maximize business productivity resulting in the best possible results?

Greatest benefits of business productivity software:

Using technology to maximize your business productivity creates the platform to realize true business success. Business productivity software ensures organizations have the tools to overcome the challenges of executing on strategy every day and prospering in today's economic times. Increased business productivity can be traced to the automation of processes allowing for faster communication of strategy, increased time spent on strategic priorities and greater project completion rates.

The following are additional ways business productivity software drives business processes more efficiently to gain optimal results:

Create an open and communicative environment. By centrally locating the performance appraisal information within a formal online framework, managers can more easily communicate business strategy and create measurable goals for their employees that will support overall company objectives. It also allows for greater visibility, thereby allowing employees to see the whole picture and understand better how individual goals fit into the company's business objectives. This creates energized and engaged employees, thereby raising the business productivity of the company.

Connect teams virtually within the company. Create employee portals and team sites to help people work productively across the organization, no matter what location or team. You will eliminate "corporate silos" that effectively cut off communication because employees can utilize technology to reach out to others working on similar projects or find experts to answer their questions throughout the organization.

Motivate your employees using technology. Based upon the information gathered in an online performance evaluation, managers can compare current skills with those required for advancement or other recognition or reward opportunities that present themselves as the manager tracks progress on employee goals throughout the year. You may also find you need to redirect employees to different departments if you feel their business productivity could increase elsewhere. If there are

impediments to better performance, the company should review why it is happening and try to eliminate these through better allocation of resources or additional training.

Monitor business productivity and employee progress on goals. Online business productivity software solutions enable managers to more easily track progress during every phase of goal completion and offer immediate reinforcement or coaching to keep performance and deadlines on track. This process leads to greater business productivity because your organization is staffed with a workforce of people who are continually learning new skills and being challenged to do their very best. When it comes to the people who work for you, alert, motivated, and happy employees will work harder. Encourage your staff by rewarding them for their successes, using both monetary and non-monetary incentives.

Analyze performance - Today's technology provides advanced reporting and business analysis capability to help you gain a deep understanding of business performance, customer preferences, and market trends. And, your executives and business managers can access performance metrics and analytical reports and use this information to work together to set or redesign strategy.

Generally speaking, employees want to be appreciated for their hard work. Business productivity software can bridge the gaps in communication and convey to each member of your team that they are valued. With your people working at their highest capabilities and your business aligned from top-to-bottom, you will be creating a workforce that is engaged, productive and loyal. Feeling valued is the key to employee loyalty which leads to greater business productivity.

CHAPTER REVIEW:

1) List out any 10 productivity techniques which you feel practicable in Railways.
2) Justify how the productivity will will be enhanced by implementing the techniques.
3) What are the practical difficulties while adopting multi skilling technique to workers in Railways and suggest methods for attaining better results from it.