MEE1014 Industrial Engineering and Management

B.Tech (Mechanical)

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Module-4

Introduction to Work study:

Method study – Time study – stopwatch time study – Work measurement - performance rating- allowances – Ergonomics.(6 Hours)

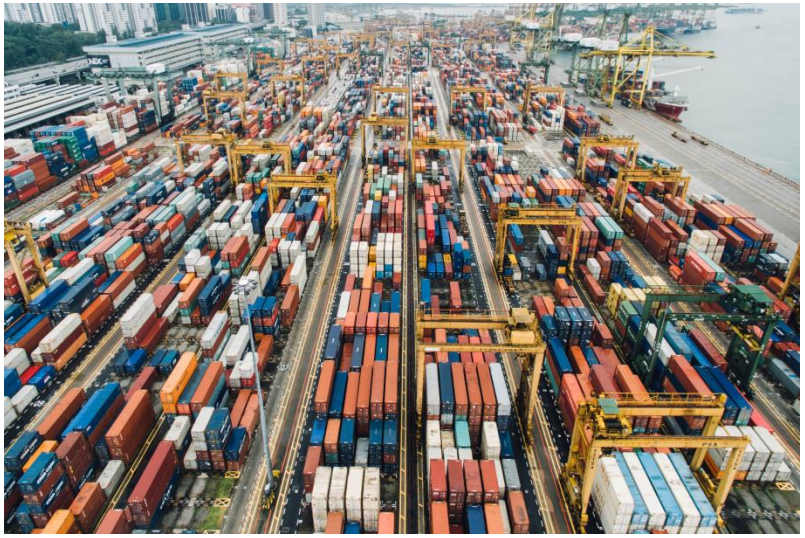
Expected Outcome

CO4	Analyze the existing operations that happen in factories for establishing time standards for different activities.

Work study

Work Study

- To find better ways of doing work
- To reduce the waste
- Optimum use of Human, Machine and Materials
- Effective use of industry and equipment



Work Study

- Work study = Method study + Time study
- **Method study** - Develop a new and better method of doing the job
- **Time study** - Perform the specified job at a defined level of performance

Courtesy: youtube.com

Courtesy: printerest.com

Method study

Method Study - Definition

- Also called as **Methods Engineering** or **Work Design**
- As per BS 3138, "Method study is the **systematic recording** and **critical examination** of existing and proposed ways of doing work as a means of developing and **applying easier and more effective methods and reducing cost**"
- Eliminate unnecessary operations, reduce waste, avoid delays → **improvement in productivity**

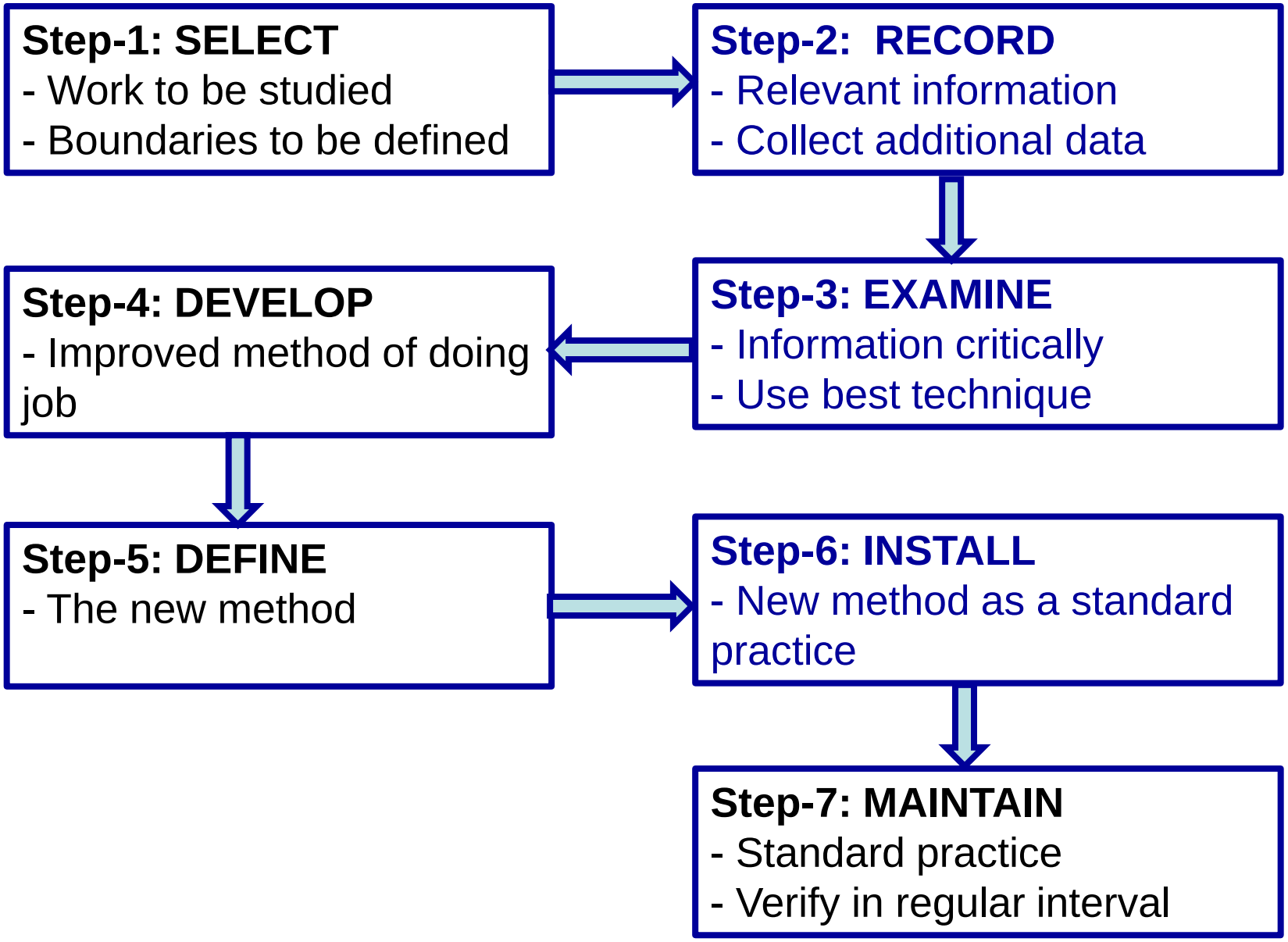
Method Study - Definition

- Improvement in Productivity is achieved by
  - ✓ Improved plant layout
  - ✓ Improved workplace design
  - ✓ Utilization of equipment, human and materials
  - ✓ Standardization of work procedures
  - ✓ Better working environment

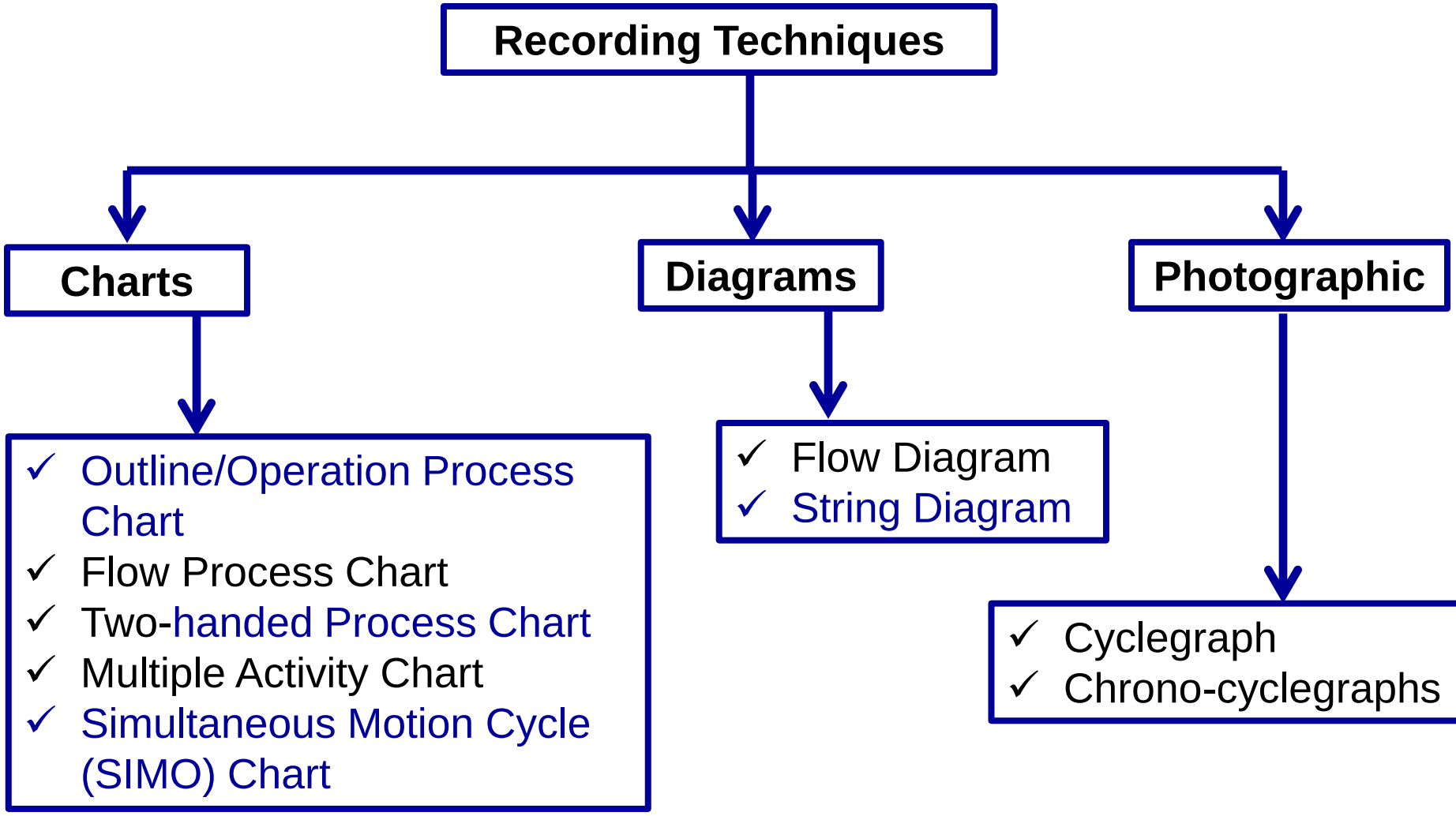
Method Study - Objectives

- **Objectives**
  - ✓ Present and analyse the facts related to the given circumstances
  - ✓ Critical examination of the facts
  - ✓ Develop the best possible solution for the given circumstances

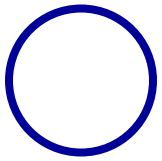
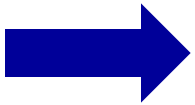
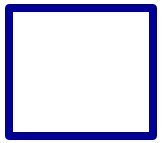
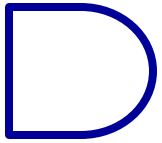
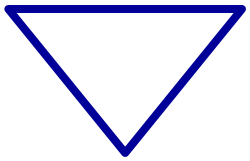
Method Study - Steps



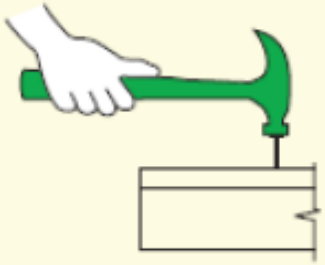
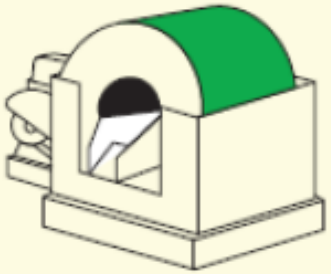
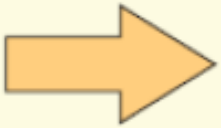
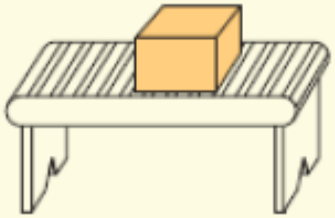
Method Study - Recording Techniques



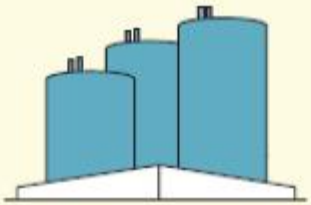
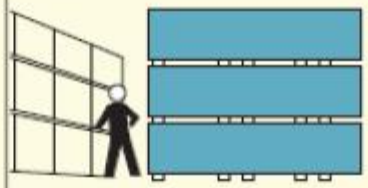
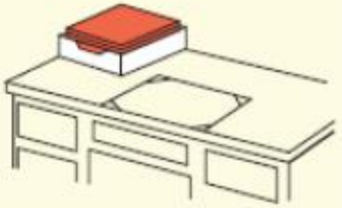
Method Study - Symbols used

Activity	Symbol
Operation	
Transport	
Inspection	
Delay	
Storage	

Method Study - Symbols used

Operation  A large circle indicates an operation such as	 Drive nail	 Mix	 Computer/word processing
Transportation  An arrow indicates a transportation, such as	 Move material by cart	 Move material by conveyor	 Move material by carrying (messenger)

Method Study - Symbols used

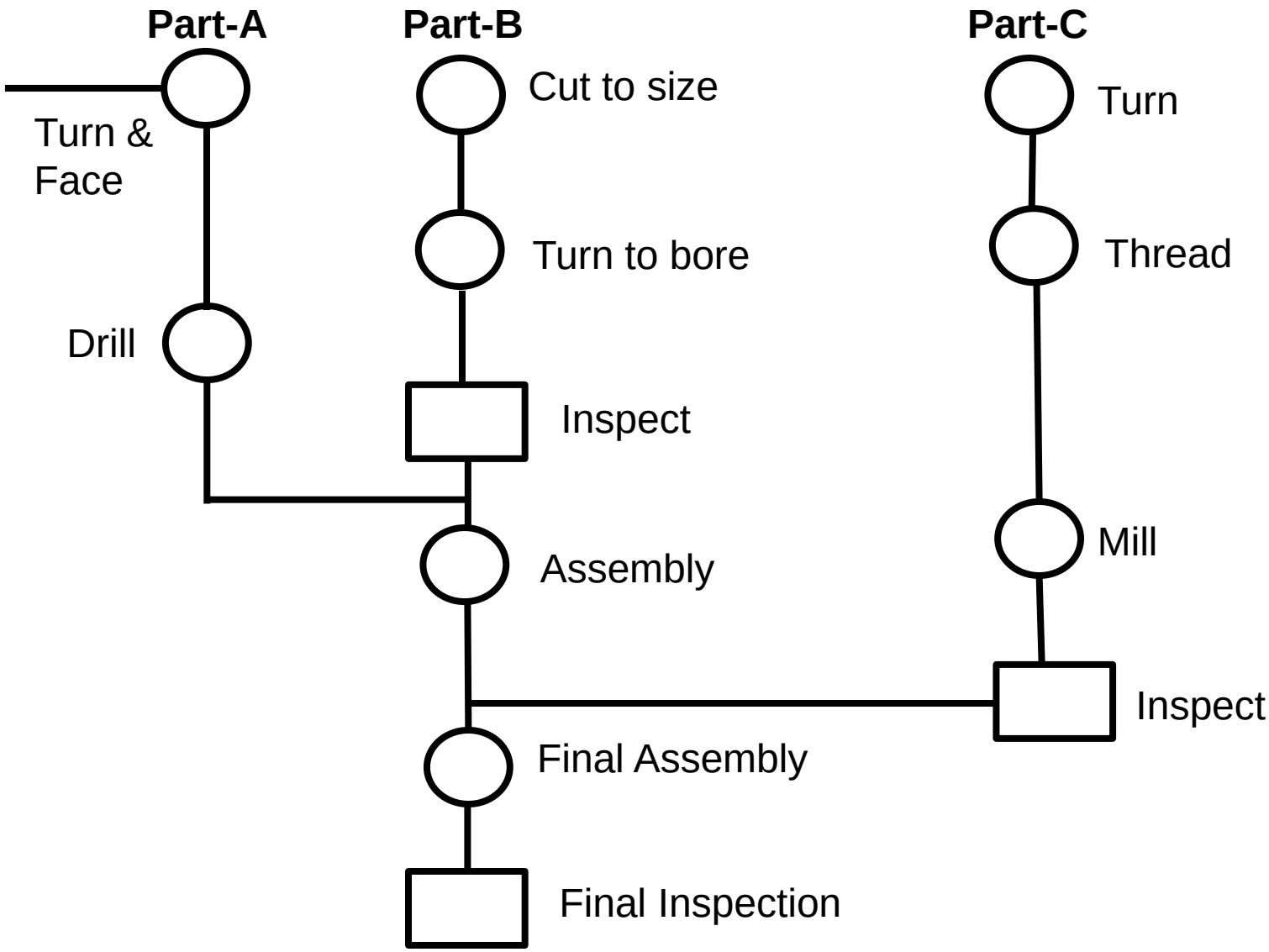
Storage  A triangle indicates a storage, such as	 Raw material in bulk storage	 Finished stock stacked on pallets	 Protective filing of documents
Delay  A large Capital D indicates a delay, such as	 Wait for elevator	 Material in truck or on floor at bench waiting to be processed	 Papers waiting to be filed
Inspection  A square indicates an inspection, such as	 Examine material for quality or quantity	 Read steam gauge on boiler	 Examine printed form for information

Method Study - Outline/Operation Process Chart

- Record only major activities and inspection
- Uses only "**operations**" and "**inspections**" symbols
- Used to visualize the entire sequence of operations and inspections occurred in the process
- Represent graphically the operations and inspections carried out on the material

Method Study - Outline/Operation Process Chart

- **Example: Washer Assembly**



Method Study - Flow Process Chart

- Representing sequence of activities in graphical form
- Sequence of activities include operation, inspection, transport, delay and storage represented using process chart symbols
- Amplification of operation process chart
- **Types:**
  - ✓ **Material Type** - Records the events occur to the material
  - ✓ **Man Type** - Records the activities performed by the worker
  - ✓ **Equipment Type** - Records the usage of equipment

Method Study - Flow Process Chart

- **Benefits**
  - ✓ To improve material handling
  - ✓ To avoid delays and waiting time
  - ✓ To reduce the distance travelled by material/worker
  - ✓ To improve the layout
  - ✓ To reduce cycle time

Method Study - Flow Process Chart

Table➡Flow process chart for flow analysis

CHART NO. 1 SHEET NO.1		SUMMARY		
ACTIVITY: TRADITIONAL GERMINATED BROWN RICE PRODUCTION		PRESENT	PROPOSE	SAVING
LOCATION: UBON RATCHATHANI, THAILAND	OPERATION ○	5	-	-
PREPARED DATE: 16 JANUARY 2012	TRANSPORTATION ⇨	6	-	-
APPROVED DATE: 16 JANUARY 2012	INSPECTION □	1	-	-
OPERATOR: KANOKWAN SUPAKDEE PAWINYADA BOONROM CHET SRIMAITREE	DELAY D	0	-	-
SUPERVISOR: ASST.PROF.PEERASAK S. NATTHAPONG N.	STORAGE ▽	1	-	-
	DISTANCE (METER)	47	-	-

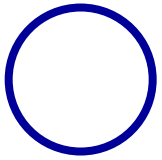
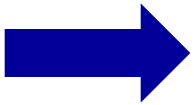
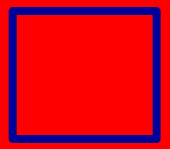
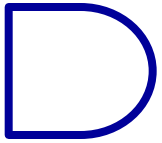
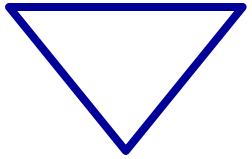
DISTANCE (m)	TIME (sec.)	SYMBOL	DESCRIPTION
-	N/A		Raw materials receiving (after germination process)
10	N/A		Move to drying process
-	N/A		Drying process
14	N/A		Move to rice milling process
-	N/A		Rice milling process
1	N/A		Move to packing area
-	N/A		Packing rice to plastic bag
3	N/A		Move to scale
-	N/A		Weight the finish product
16	N/A		Move to packing station 2
-	N/A		Packing station 2 (wrapping with brand's packaging)
3	N/A		Move to storage area
	N/A		Storage
47	N/A	5 6 1 0 1	Total

Courtesy: Systematic Layout Planning for Germinated Brown Rice Mill under GMP and ISO22000:2005 requirements, IOSR Journal of Engineering, 2(10, 2012

Method Study - Two handed Process Chart

- Also called as **Left-Right Hand Chart**
- Detailed type of flow chart
- Activities of left hand and right hand of the operator is recorded independently
- Used for repetitive operations

Method Study - Two handed Process Chart

Symbol	Activity
	Operation: Represents the activities performed by the worker
	Transport: Movement of hand of the operator
	Inspection: Not used
	Delay: Idling time of the hand of the operator
	Storage: Represent the work is held by the hand

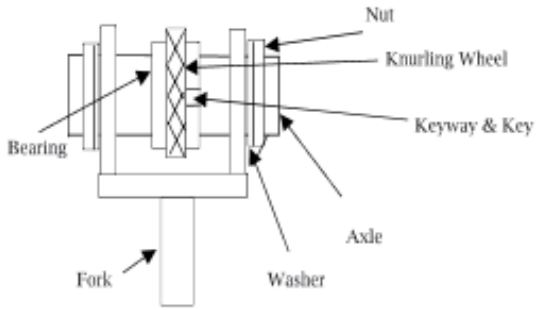
Method Study - Two handed Process Chart

TWO-HANDED PROCESS CHART

Chart No. 1 | Sheet 1 of 1 | Drawing: Knurling Wheel Assembly

Components
Knurling wheel
Axle with bearing
Y-shaped fork
Two nuts
Two washers
Key

Summary:	LH	RH
Operations	6	12
Transport	2	5
Delay	1	0
Storage	15	7



LEFT HAND ACTIVITIES	RIGHT HAND ACTIVITIES
Holds axle	Picks up knurling wheel
Holds axle	Moves knurling wheel to axle
Holds axle	Fits knurling wheel over bearing
Holds axle	Picks up key
Holds axle	Moves key to axle
Holds axle	Fits key in the key way
Holds axle	Picks up Y-shaped fork
Holds axle	Moves fork to axle
Holds axle	Fixes right hand of fork on axle
Holds axle	Picks up one washer
Holds axle	Moves washer to axle right side
Holds axle	Fixes washer on axle
Holds axle	Picks up one nut
Holds axle	Moves nut to right hand of axle
Holds axle	Fixes the nut on right side of axle
Passes axle to right hand	Receives axle from left hand
Fixes left end of fork	Holds axle
Picks up one washer	Holds axle
Moves washer to left end of axle	Holds axle
Fixes washer on axle	Holds axle
Picks up nut	Holds axle
Moves nut to axle left side	Holds axle
Fixes nut on left of axle	Holds axle
Idles	Drops the assembly into bin

Courtesy: Production and Operations Management by Dr. Panneerselvam

CAT-I: Discussion

CAT-I: Discussion

Winter2021-22 (Total strength: 78 – Attended: 78)

Average (Mean)	19
Max Marks	30
No of Students <15	19
Pass Percentage %	75.6

SHARAN KARTHIK.P - 30

PRIYESH SINGH SENGAR - 30

NAREN AADHITHYA . R - 30

NANDHA RAM S - 30

KALAVADIA AYUSH ANILBHAI - 30

ANVAY MANISH LIMAYE - 30

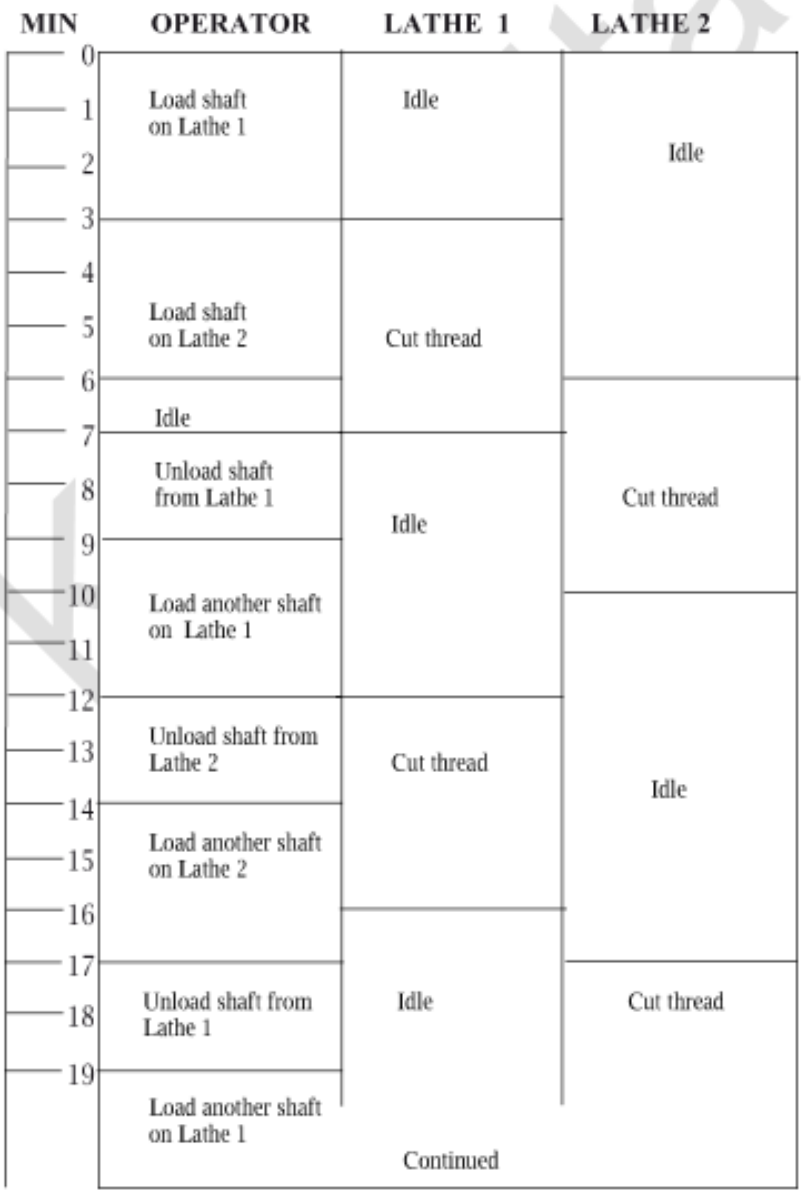
Method Study - Multiple Activity Chart

- Activities of more than one worker or equipment are recorded
- Common time scale is adapted to show the inter-relationship
- Evaluate the Idle time of workers and equipment
- Find out the number of machines can be handled by a worker
- Find out the number of workers required in a team to do the job
- Useful in scheduling/balancing team work
- Symbols used

Method Study - Multiple Activity Chart

- **Types**
  - ✓ Man - Machine Chart
  - ✓ Man – Multi-machine Chart
  - ✓ Multi - Man Chart
  - ✓ Multi - Man Machine Chart

Method Study - Multiple Activity Chart



Courtesy: Production and Operations Management by Dr. Panneerselvam

Method Study – SIMO Chart

- Simultaneous Motion Cycle Chart
- Two handed process chart
- Records the Micro motions (Therblings) of both hands
- Uses common time scale
- Explore the possibility of removing or eliminating the unproductive micro motions and then re-sequencing

Method Study – SIMO Chart

Micro motion Study

Dept..... Film No.....

Analysis Sheet

Operation: Finish hand fillings

Charted By.....

Date..... Operator.....

S.No.	Left hand description	Therblig	Time	Therblig	Right hand
1.	Searching and lifting	SH,H	0.2		
2.			0.4	U	Opening the vice
3.	Clamping workpiece	PP	0.8	PP	clamping work piece in the vice piece in the vice.
4.			1.0	TL	Take the file
5.	Do the hand filling operation.	U	2.0	U	Do the hand filing Operation.
6.			2.2	TL	Taking the micrometer
7.	Check the dimension	I	3.0	I	Check the dimension
8.			3.2	U	Open the vice
9.	Remove the work piece	TL		3.4	

https://www.engineeringnotes4u.com/2019/08/simo-simultaneous-motion-cycle-chart.html

Method Study – SIMO Chart

➢ Therblings (18 Motions)

Symbol	Name	Abbreviation
	Search	Sh
	Find	F
	Select	ST
	Grasp	G
	Hold	H
	Transport Loaded	TL
	Transport Empty	TE
	Position	P

Symbol	Name	Abbreviation
	Assemble	A
	Use	U
	Disassemble	DA
	Inspect	I
	Preposition	PP
	Release Load	RL
	Unavoidable Delay	UD
	Avoidable Delay	AD
	Plan	Pn
	Rest	R

Time study

Time Study

- Also known as Work Measurement
- Important for planning & controlling the operations
- Time study is defined as "The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance."

British Standard Institute

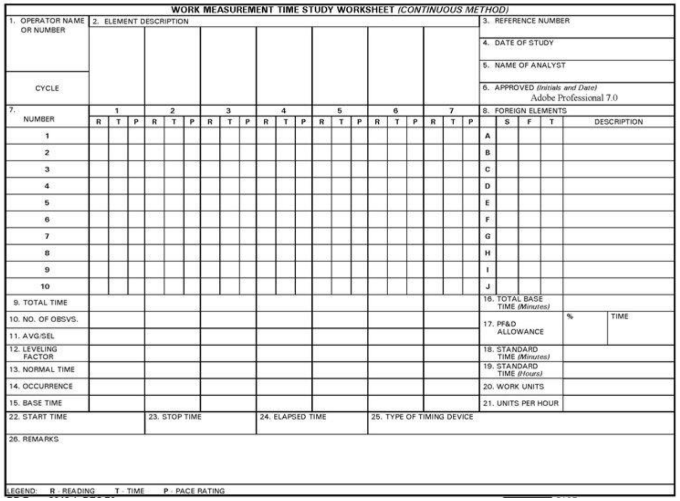
Time Study - Equipment

Stop watch

Tachometer

Spring Balance

Time study Board



WORK MEASUREMENT TIME STUDY WORKSHEET *(CONTINUOUS METHOD)*

1. OPERATOR NAME OR NUMBER
2. ELEMENT DESCRIPTION
3. REFERENCE NUMBER
4. DATE OF STUDY
5. NAME OF ANALYST
6. APPROVED *(Initials and Date)*

Adobe Professional 7.0

CYCLE

7. NUMBER

NUMBER	1			2			3			4			5			6			7		
	R	T	P	R	T	P	R	T	P	R	T	P	R	T	P	R	T	P	R	T	P
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

9. TOTAL TIME
10. NO. OF OBSVS.
11. AVG/SEL
12. LEVELING FACTOR
13. NORMAL TIME
14. OCCURRENCE
15. BASE TIME

8. FOREIGN ELEMENTS

	S	F	T	DESCRIPTION
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				

16. TOTAL BASE TIME *(Minutes)*
17. PF&D ALLOWANCE — % — TIME
18. STANDARD TIME *(Minutes)*
19. STANDARD TIME *(Hours)*
20. WORK UNITS
21. UNITS PER HOUR
22. START TIME
23. STOP TIME
24. ELAPSED TIME
25. TYPE OF TIMING DEVICE
26. REMARKS

LEGEND: R - READING T - TIME P - PACE RATING

Tine study form

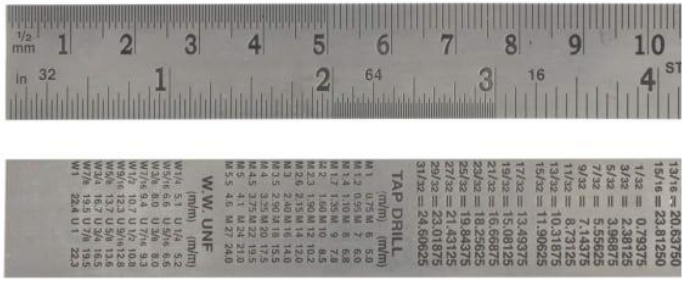
Time Study - Equipment

Pencils and Erasers

Calculator

Measuring Tape

Micrometer



Steel Rule

Time Study - Steps involved

- **Step-1:**
  - ✓ Select the work to be studied
  - ✓ Record all the necessary information about the job
    - Product
    - Process
    - Operator
    - Working conditions

Time Study - Steps involved

- **Step-2:**
  - ✓ Record the method by breaking down the operation into elements and sequence of motions
  - ✓ Element is a part of a specified activity made of one or more fundamental motions selected for ease of observation and timing

Time Study - Steps involved

- **Step-3:**
  - ✓ Record the skill and competence of the operator
  - ✓ This is to ensure that qualified worker is permitted to work which is to be timed
  - ✓ **Qualified worker:** Average worker - neither very skilled nor unskilled, neither highly experience nor inexperienced
  - ✓ Measurement is made at normal level

Time Study - Steps involved

- **Step-4:**
  - ✓ Record the time for each element of operation using stopwatch or by any time measuring device
  - ✓ Repeat the process for pre-determined number of times
  - ✓ The rate of the worker is to be compared with pre-conceived concept of standard rating

Time Study - Steps involved

- **Step-5:**
  - ✓ Calculate the basic time (cycle time) by computing the average
  - ✓ Calculation has to be performed for each element
  - ✓ **Normal Time = Basic Time x Performance Rating**

Time Study - Steps involved

- **Step-6:**
  - ✓ Determine the allowances to be included
  - ✓ With the allowance, calculate the standard time
  - ✓ **Standard Time = Normal Time x Allowances Factor**

$$\textbf{Allowances Factor} = \frac{100}{100 - Allownace\ in\ \%}$$

Time Study - Performance Rating/Efficiency

- Performance rating is defined as "the process during which the time study engineer compares the performance of the operator under observation with the observer's own concept of proper (normal) performance.

  - Society of Advanced Management

$$\text{Performance Rating} = \frac{\boldsymbol{Observed\ Performace}}{\boldsymbol{Normal\ Performance}} \textbf{ x 100}$$

- Used to standardize the time and fix up the target of an element or job

Time Study - Problems

- In a welding shop, a direct time study was done on a welding operation. One inexperienced industrial engineer and one experienced industrial engineer conducted the study simultaneously. They agreed precisely on cycle time but their opinion on rating the worker differed. The experienced engineer rated the worker 100% and the other engineer rated the worker 120%. They used a 10% allowance.

Cycle Time (in minutes)	No. of Times observed
20	2
24	1
29	1
32	1

Time Study - Problems

- From the statements,
- (a) Determine the standard time using the experienced industrial engineer's worker rating
- (b) Find the standard time using the worker rating of inexperienced industrial engineer.
- (c) Comment on the reliability of time study engineers

Time Study - Problems

(a) Rating the worker at 100 per cent by the experienced Industrial engineer

$$\text{Cycle Time } (CT) = \frac{20 \times 2 + 24 \times 1 + 29 \times 1 + 32 \times 1}{5}$$

$$= 25 \text{ minutes.}$$

$$\text{Normal Time } (NT) = CT \times PR$$

$$= 25 \times 100\% = 25 \text{ minutes}$$

$$\text{Standard Time } (ST) = (NT)/(1 - \%A)$$

$$= 25/(1 - 0.10) = 27.78 \text{ minutes}$$

Time Study - Problems

(b) Rating the worker at 120 per cent by the inexperienced Industrial Engineer

Cycle Time (CT) = 25 minutes

Normal Time (NT) = $CT \times PR$

= $25 \times 120\% = 30$ minutes

Standard Time (ST) = $NT/(1 - \%A) = 30/(1 - 0.10)$

= 33.33 min.

(c) Comment

The results in part (a) and part (b) show differences in normal time and standard time. The task of estimating performance rating of a worker requires certain experience. So, we can rely on the results obtained by the experienced industrial engineer. Rating exercise is an art. So, the consistency in rating skill can be improved by repeatedly seeing rating films and/or by attending short courses on performance rating.

Time Study - Problems

The time study data for drilling three holes in a connecting link rod is given in Table.

Calculate the standard time for drilling of one connecting rod.

The job description is :

(*a*) Drilling machine pillar type, and drilling machine capacity 25 mm diameter.

(*b*) Drill Jig is used for holding the hob on machine.

(*c*) Pieces to be drilled are lying in a bin near the machine.

(*d*) After drilling, the job is put in another bin lying near the machine.

Use the following information in calculating standard time. 10 connecting rods have been machined. Rating factor 110 per cent.

Time Study - Problems

Part Name : Connecting Link Rod											Part No. W-020-25-110		
Machine Name : Hand feed drilling machine											Deptt. Machine shop		
Operator : Mr. XYZ											Date : 10 April, 2005		
Experience on Job : 5											Years		
Begin		Finish				Elapsed Time :					Unit Selected		
Elements	**Speed**	**Feed**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
1. Pick-up job from bin			0.06	0.05	0.07	0.05	0.06	0.07	0.05	0.05	0.06	0.05	0.057 min
2. Tighten drill jig			0.13	0.12	0.10	0.10	0.18*	0.19*	0.10	0.11	0.10	0.10	0.108 min
3. Drilling three holes			0.40	0.41	0.40	0.38	0.39	0.38	0.59*	0.56*	0.38	0.37	0.390 min
4. Unclampling of job			0.07	0.07	0.06	0.07	0.08	0.16*	0.06	0.07	0.07	0.07	0.068 min
5. Remove from Jig and placed in a bin			0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.024 min
6.													
7.													
8.													
9.													
10.													
												Total	0.647 min

Average time for 1 cycle	0.647 min.
Rating	110%
Normal time	0.712 min.
Personal allowance	—
Fatigue allowance	—
Other allowance	—
Total allowance	25% of normal time
Standard time	0.89 min.

Tools, Jigs and Fixtures used, if any

(* indicates extreme value, not considered in the calculation of average)

Drilling Jig. No. _____

Observation taken by Mr. ABC

Time Study - Problems

Total average cycle time = 0.057 + 0.108 + 0.390 + 0.068 + 0.024
= 0.647 min.

Rating factor = 110 percent

Normal time = 0.647 × 1.10
= 0.712 min.

Allowances = 25 percent of normal time
= 0.712 × 25/100
= 0.178 min.

Standard time for drilling of 1 connecting rod = Normal time + allowances
= 0.712 + 0.178
= 0.890 min.

Time Study - Performance Rating/Efficiency

- **Different systems of Performance Rating**
  - ✓ Westinghouse System of Rating
  - ✓ Synthetic Rating
  - ✓ Objective Rating
  - ✓ Skill and Effort Rating
  - ✓ Physiological Evaluation of Performance Level

Time Study - Performance Rating/Efficiency

Westinghouse System of Rating

- The factors considered are
  - ✓Skill
  - ✓Effort
  - ✓Condition
  - ✓Consistency

Time Study - Performance Rating/Efficiency

Westinghouse System of Rating

- Westinghouse Performance rating table

Factor → Grade ↓	Skill (1)	Effort (2)	Conditions (3)	Consistency (4)
Super (1)/Excessive(2)/ Ideal(3)/Perfect(4)	$A_1 = +0.15$ $A_2 = +0.13$	$A_1 = +0.13$ $A_2 = +0.12$	$A = +0.06$	$A = +0.04$
Excellent	$B_1 = +0.11$ $B_2 = +0.08$	$B_1 = +0.10$ $B_2 = +0.08$	$B = +0.04$	$B = +0.03$
Good	$C_1 = +0.06$ $C_2 = +0.03$	$C_1 = +0.05$ $C_2 = +0.02$	$C = 0.02$	$C = 0.01$
Average	D = 0.00	D = 0.00	$D = 0.00$	$D = 0.00$
Fair	$E_1 = -0.04$ $E_2 = -0.10$	$E_1 = -0.04$ $E_2 = -0.08$	$E = -0.03$	$E = -0.02$
Poor	$F_1 = -0.16$ $F_2 = -0.22$	$F_1 = -0.12$ $F_2 = -0.17$	$F = -0.07$	$F = -0.04$

Time Study - Performance Rating/Efficiency

Westinghouse System of Rating

- To find the Westinghouse rating, the actuals are compared and suited with one of the ratings in each of the factors listed in the table and then summed up
- Rating factor = $1 \pm$ Westinghouse Rating
- Normal time = Observed time x Rating factor
- **Standard Time = Normal Time x Allowances Factor**

$$\textbf{Allowances Factor} = \frac{\mathbf{100}}{\mathbf{100} - \boldsymbol{Allownace\ in}\ \%}$$

Time Study - Allowances

- Most controversial part of the time study
- Purpose of allowance is to add enough time to the basic time of the production to enable the average worker to meet the standard while performing at a normal pace

Basic Time + **Allowance** = **Standard Time**

- **Types of Allowances**
  - ✓ Relaxation Allowance
  - ✓ Interference Allowance
  - ✓ Process Allowance
  - ✓ Contingency Allowance
  - ✓ Special Allowance

Time Study - Allowances

Relaxation Allowance

- Considered for manual work, irrespective of the nature of the job
- Expressed in % of Basic Time

Time Study - Allowances

- **Compensating Rest Allowance:**
  - ✓ Provided to recover from physiological effects of carrying out specified conditions and to attend the personal needs
  - ✓ The amount of allowance depends on the nature of job

Time Study - Allowances

- **Fatigue Allowance**:
  - ✓ Intended to compensate for the physiological and psychological effects of carrying out specified work under specified conditions

Time Study - Allowances

- **Personal Need Allowance:**
  - ✓Provided to cater for personal needs

Time Study - Allowances

Interference Allowance

- Provided when the operator is working on more machines
- Applicable for machine or process controlled jobs
- Interference may occur due to settings, positioning, etc. of the machine which may influence the skill and effort of the operator.
- Machine controlled element $\rightarrow$ Not always added in calculating the standard time
- This allowance varies in proportion based on the number of machines allotted to the operator

Time Study - Allowances

Process Allowance

- Prominent when the operator works on more machines and becomes idle
- **Example**:
  - ✓ Idle after loading the job in an automated machine
  - ✓ Idle after welding operation to allow the component to cool

Process Allowance Chart	
5% of the normal time	Automated Machine
10% of the Normal Time	Power operated Machine
15% of the Normal Time	Similar type of work load
20% of the Normal Time	Short cycle load (0.2 min)
25% of the Normal time	Heavy work load (30 kg)

Time Study - Allowances

Contingency Allowance

- Provided for small unavoidable delays and for occasional minor extra work
- Expressed in % of Basic Time
- Less than 5% of Basic time is the recommended value

Time Study - Allowances

Special Allowance

- Provided for some special conditions
- **Examples:**
  - ✓Start-up, Shut down and Tooling
  - ✓Setup and Change over
  - ✓Learning, Training and Implementation

Ergonomics

End of Module-4

Time Study - Performance Rating/Efficiency

Synthetic Rating

- Records the actual time of performance for the element
- **Performace times for such elements have been standardized - called as "Predetermined Motion Time Standard (PMTS) Values**
- PMTS values for the elements can be noted from the table

$$\text{Rating Factor} = \frac{PMTS\ value for\ the\ element\ in\ minutes}{Average\ Actual\ Time\ for\ the\ same\ element\ in\ minutes}$$

- Average rating factor is then calculated based on the rating factor calculated for the elements having PMTS values
- Normal Time = Actual Time x Average Rating

Time Study - Performance Rating/Efficiency

Objective Rating

- **Base Time Calculation:**
- The pace of the operator is rated against an objective pace standard
- Objective pace standard is same for all the jobs irrespective of the job difficulty and its limiting effect on pace

Base Time = Rated Pace x Observed Time

- **Normal Time Calculation:**
- Taking into account the Job difficult factor or job complexity, normal time is calculated

Normal Time = Base Time x Job Difficult Factor

Time Study - Performance Rating/Efficiency

Objective Rating

- **Job Difficult Factor**

Sl. No.	Description	Ref. Letter	Conditions	Percent Adjustment
1	Amount of body used	A	Finger used loosely	0
		B	Wrist and Fingers	1
		C	Elbow, wrist and fingers	2
		D	Arm, etc.	5
		E_1	Trunk, etc.	8
		E_2	List with leg from floor	10
2	Food pedals	F	No pedals or one pedal with fulcrum under foot	0
		G	Pedal or pedals with fulcrum outside the foot	5
3	Bi-manualness	H_1	Hands help each other or alternate	0
		H_2	Hands work simultaneously doing the same work	18

Time Study - Performance Rating/Efficiency

Objective Rating

- **Job Difficult Factor**

Sl. No.	Description	Ref. Letter	Conditions	Percent Adjustment
4	Eye hand coordination	I	Rough work, mainly feet	2
		J	Moderate vision	2
		K	Constant but not closed	4
		L	Watchful, fairly close	7
		M	Within 1/64"	10
5	Handling requirements	N	Can be handled roughly	0
		O	Only groll control	2
		P	Must be controlled but may be squeezed	3
		Q	Handle carefully	4
		R	Fragile	5
6	Weight		Identified by the actual weight for resistance	

Time Study - Performance Rating/Efficiency

Skill and Effort Rating

- Also known as Bedaux System
- Calculate the work rate or speed of the worker's movement and how fast he is performing the motions
- Both the movement and the skill of the worker need not to be considered
- Standard Minute, called as Unit B is used which is composed of work component and relaxation component

Time Study - Performance Rating/Efficiency

Skill and Effort Rating

- Steps involved:
- Divide the operation into smallest measureable elements
- Note down the time taken for each element
- Calculate the average time after performing sufficient observations
- Consider Relaxation factor

Light work	1.10 to 1.20
Medium work	1.20 to 1.35
Heavy work	1.35 to 1.50
Very heavy work	1.50 to 3.00

Time Study - Performance Rating/Efficiency

Skill and Effort Rating

- Calculate B value using

No. of B's per work element = [Observed time x Speed of the work x Relaxation allowance] (60 x 60)

- This is for human effort

Time Study - Performance Rating/Efficiency

Physiological Evaluation of Performance Level

- Based on the relation between the physical work and the amount of oxygen consumed
- Find out the changes in heartbeat for various physical works
- Most reliable measure of muscular activity
- This method is not currently used