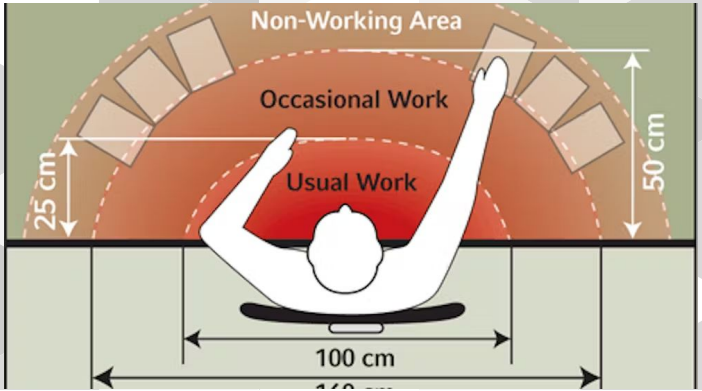
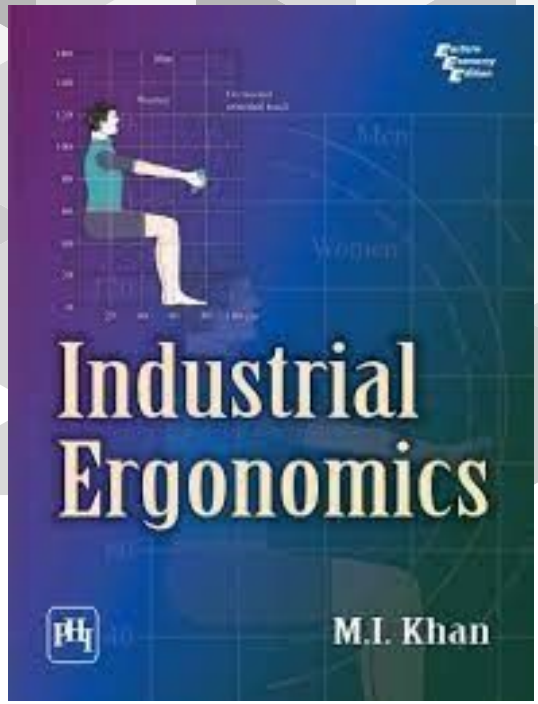
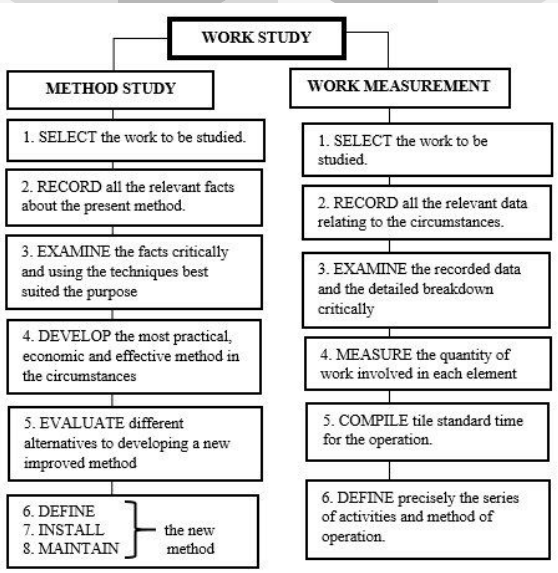






Human Resources Job Design and Work Measurement - 5 October 2022

Review - what we know until now about HR, Job Design, Work Measurement

1. Human resource strategy very important in Production Management.
2. Job expansion - enrich and enlarge
3. Labor planning
4. 5 Core Components of Job Design -Skill variety, Job Identity, Job Significance, Autonomy, Feedback

Objectives

At the end of this lesson, you should be able to:

1. **Define ergonomics**
2. **Determine** where to apply ergonomics
3. **Determine** suitable tools for methods analysis
4. **Identify** four methods to establish labor standards
5. **Determine** standard time in time study
6. **Determine** sample size for a time study
7. **Explain** Predetermined Time Study (PTS) and Work Sampling methods

Define Ergonomics

What is ergonomics ?

Study of man, machines and environment interaction and interfaces

Study of work

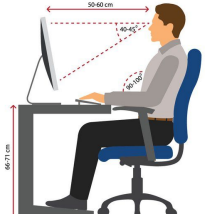
Human factors engineering

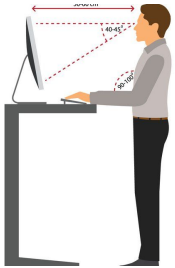
Ergonomics and the Work Environment

- Ergonomics is the study of the interface between man and machine
  - Often called human factors
- Operator input to machines

Google the internet and give one example of ergonomics knowledge being applied in.

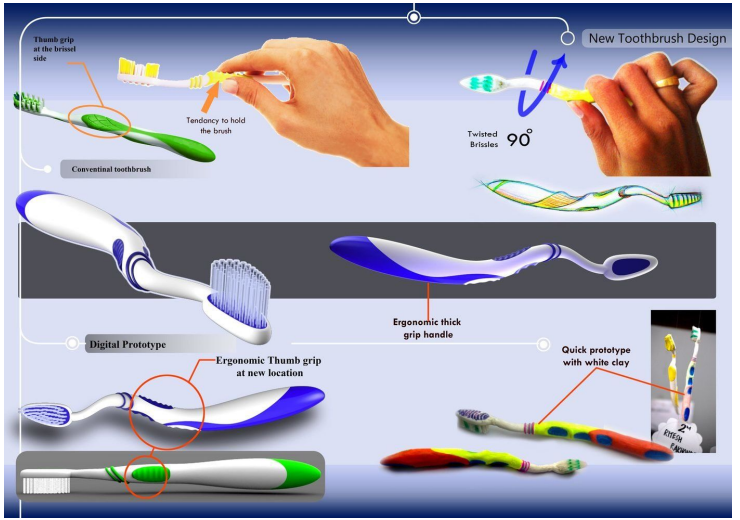
Ergonomic workstation / workspaces



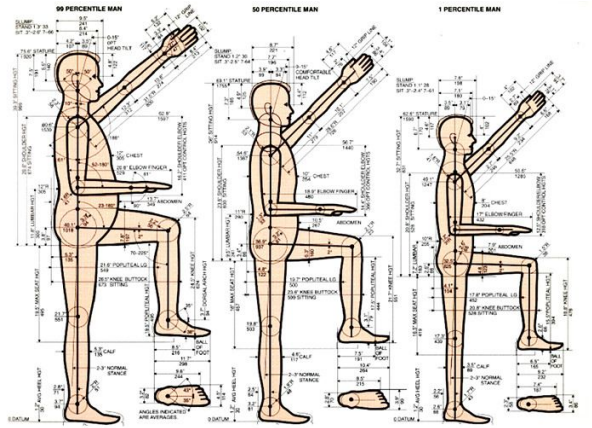


Colour of display units - dials, arrows, gauges, and all control

Ergonomically designed products



Anthropometric data



Ergonomics and Work Environment

Decibel Levels

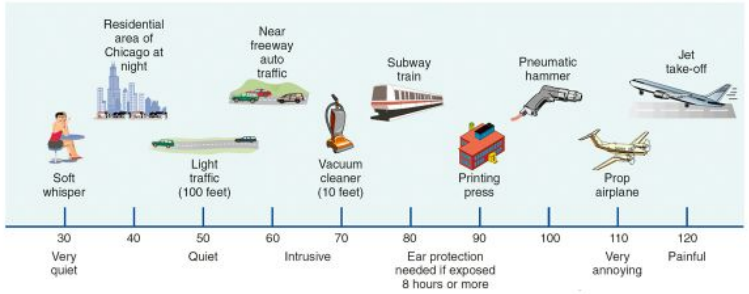
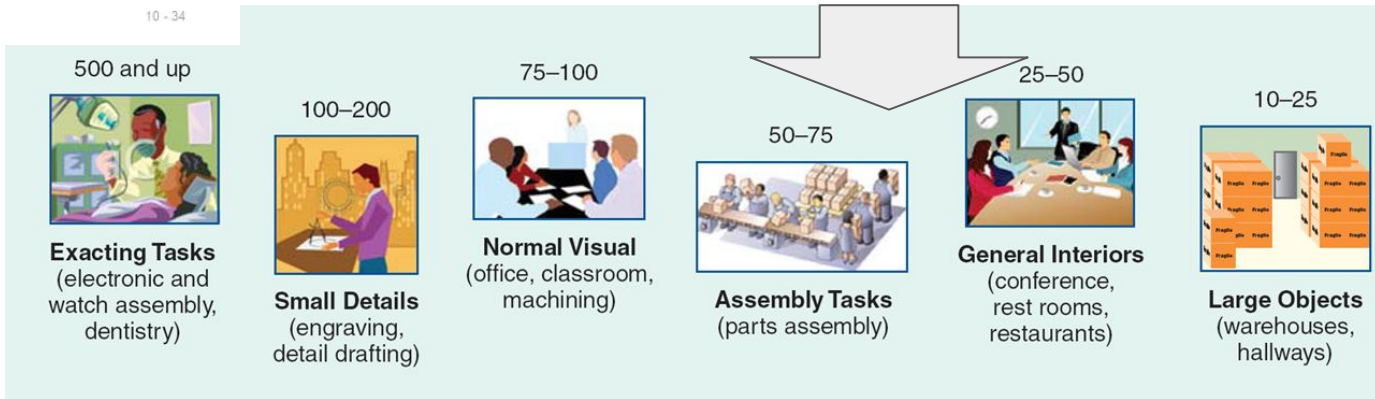


Table 10.4b

Noise - Control methods and use of safety prevention devices

Illumination Levels for different tsks



What is Methods Analysis

Focuses on how task is performed

What is Methods Analysis

What are the three main areas analysed?

1. Movement of individuals or material
2. Activities of human and machine and crew activity
3. Body movement

What are the four techniques commonly used to analyse/visualise most manual work?

1. Flow diagrams
2. Process charts
3. Activity charts
4. Operations charts

What are their main differences?

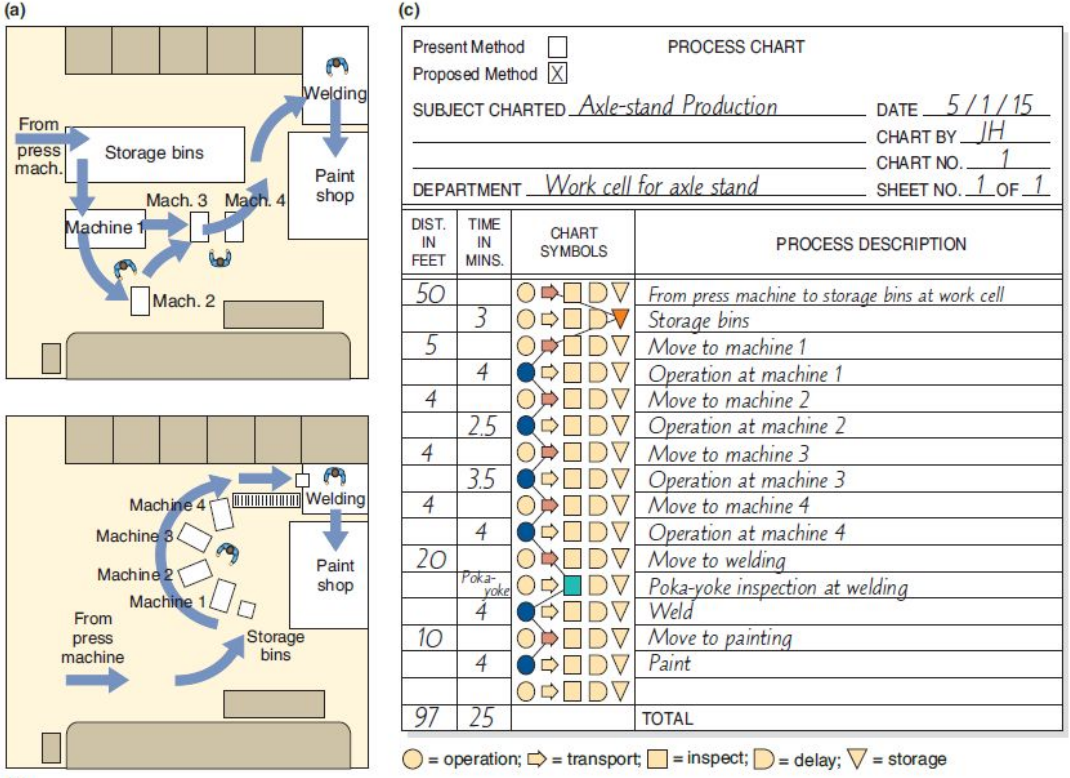


Figure 10.5

Flow Diagrams and Process Chart of Axle-Stand Production at Paddy Hopkirk Factory

(a) Old method; (b) new method; (c) process chart of axle-stand production using Paddy Hopkirk's new method (shown in (b)).

Flow diagram and Process Chart is used for analysing

A. Material flow and worker flow
B. Human and machine activities
C. Body Movement
D. Action Movement

OPERATIONS CHART

SYMBOLS	PRESENT		PROPOSED	
	LH	RH	LH	RH
○ OPERATION	2	3		
⇨ TRANSPORT.	1	1		
□ INSPECTION				
D DELAY	4	3		
▽ STORAGE				

PROCESS: Scooping Ice for Coffee
EQUIPMENT: Scoop
OPERATOR: Starbucks
STUDY NO: _____ ANALYST: CM
DATE: 5 /1 /15 SHEET NO. 1 of 2
METHOD (PRESENT / PROPOSED)
REMARKS: Partial Study

LEFT-HAND ACTIVITY Present / METHOD	DIST.	SYMBOLS	SYMBOLS	DIST.	RIGHT-HAND ACTIVITY Present / METHOD
1 Reach for cup		●⇨□D▽	○⇨□D▽		Idle
2 Grasp cup		●⇨□D▽	○⇨□D▽		Idle
3 Move cup	6"	○➡□D▽	○⇨□D▽		Idle
4 Hold cup		○⇨□D▽	●⇨□D▽		Reach for scoop
5 Hold cup		○⇨□D▽	●⇨□D▽		Grasp scoop
6 Hold cup		○⇨□D▽	○➡□D▽	8"	Move scoop to ice
7 Hold cup		○⇨□D▽	●⇨□D▽		Scoop ice

Figure 10.7

Operations Chart (right-hand/left-hand chart) for Scooping Ice to Coffee Cup

Operations Chart is used for analysing

A. Material flow and worker flow
B. Human and machine activities
C. Body Movement
D. Action Movement

Labor Standards

Define labor standards

What constitutes a fair day’s work?

The uses of labor standards?

REFER SLIDES AND BOOK

Definition of labor standards

Labor standards - represent **amount of time** that it should take an average employee to perform specific job activities under normal working conditions

What are the purpose of labor standards

1.
2.
3.
4.
5.

What are the purpose of labor standards

1. Help determine costs of product - labor costs
2. Protect workers health - optimise working time, stress, etc
3. Allocate payment - determine wages, incentive schemes,
4. Determine number of workers needed
5.

Meaningful Standards Help Determine

1. Labor content of items produced
2. Staffing needs
3. Cost and time estimates
4. Crew size and work balance
5. Expected production
6. Basis of wage-incentive plans
7. Efficiency of employees

What are the 4 ways of determining labor standards?

1.
2.
3.
4.

What are the 4 ways of setting labor standards?

1. Historical experience
2. Time study
3. Predetermined Time Standard
4. Work Sampling

Time Studies

Stopwatch studies

Trained and experienced person establish standard time using 8 steps

Important points

1. Average observed time - mean time of work elements
2. Performance rating - adjusts to a trained worker capability
3. Normal time - average observed time adjusted for pace
4. Standard time - adjustment of normal time to include allowances - personal, fatigue

1. Define the task to be studied (after methods analysis has been conducted).
2. Divide the task into precise elements (parts of a task that often take no more than a few seconds).
3. Decide how many times to measure the task (the number of job cycles or samples needed).
4. Time and record elemental times and ratings of performance.
5. Compute the average observed (actual) time. The **average observed time** is the arithmetic mean of the times for *each* element measured, adjusted for unusual influence for each element:

$$\text{Average observed time} = \frac{\text{Sum of the times recorded to perform each element}}{\text{Number of observations}} \quad (10\text{-}1)$$

6. Determine performance rating (work pace) and then compute the **normal time** for each element.

$$\text{Normal time} = \text{Average observed time} \times \text{Performance rating factor} \quad (10\text{-}2)$$

The performance rating adjusts the average observed time to what a trained worker could expect to accomplish working at a normal pace. For example, a worker should be able to walk 3 miles per hour. He or she should also be able to deal a deck of 52 cards into 4 equal piles in 30 seconds. A performance rating of 1.05 would indicate that the observed worker performs the task slightly *faster* than average. Numerous videos specify work pace on which professionals agree, and benchmarks have been established by the Society for the Advancement of Management. Performance rating, however, is still something of an art.

7. Add the normal times for each element to develop a total normal time for the task.
8. Compute the **standard time**. This adjustment to the total normal time provides for allowances such as *personal* needs, unavoidable work *delays*, and worker *fatigue*:

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}} \quad (10\text{-}3)$$

TABLE 10.1 **Allowance Factors (in percentage) for Various Classes of Work**

1. Constant allowances:
   - (A) Personal allowance 5
   - (B) Basic fatigue allowance 4

2. Variable allowances:
   - (A) Standing allowance 2
   - (B) Abnormal position allowance:
     - (i) Awkward (bending) 2
     - (ii) Very awkward (lying, stretching) 7
   - (C) Use of force or muscular energy in lifting, pulling, pushing

     Weight lifted (pounds):
     - 20 3
     - 40 9
     - 60 17
   - (D) Bad light:
     - (i) Well below recommended 2
     - (ii) Quite inadequate 5
   - (E) Noise level:
     - (i) Intermittent—loud 2
     - (ii) Intermittent—very loud or high pitched 5

Sources: George Kanawaty (ed.), *Introduction to Work Study*, International Labour Office, Geneva, 1992; B. W. Niebel, *Motion and Time Study*, 8th ed. (Homewood, IL: Richard D. Irwin), 1988; and Stephan Konz, *Work Design* (Columbus, Ohio: Grid Publishing, Inc.), 1979.

Go through Example 2

Example 2

USING TIME STUDIES TO COMPUTE STANDARD TIME

Management Science Associates promotes its management development seminars by mailing thousands of individually composed and typed letters to various firms. A time study has been conducted on the task of preparing letters for mailing. On the basis of the following observations, Management Science Associates wants to develop a time standard for this task. The firm's personal, delay, and fatigue allowance factor is 15%.

	OBSERVATIONS (MINUTES)					
JOB ELEMENT	1	2	3	4	5	PERFORMANCE RATING
(A) Compose and type letter	8	10	9	21*	11	120%
(B) Type envelope address	2	3	2	1	3	105%
(C) Stuff, stamp, seal, and sort envelopes	2	1	5*	2	1	110%

APPROACH ▶ Once the data have been collected, the procedure is to:

1. Delete unusual or nonrecurring observations.
2. Compute the *average time* for each element, using Equation (10-1).
3. Compute the *normal time* for each element, using Equation (10-2).
4. Find the total normal time.
5. Compute the *standard time*, using Equation (10-3).

SOLUTION ▶

1. Delete observations such as those marked with an asterisk (*). (These may be due to business interruptions, conferences with the boss, or mistakes of an unusual nature; they are not part of the job element, but may be personal or delay time.)

2. Average time for each job element:

$$\text{Average time for A} = \frac{8 + 10 + 9 + 11}{4} = 9.5 \text{ min}$$

$$\text{Average time for B} = \frac{2 + 3 + 2 + 1 + 3}{5} = 2.2 \text{ min}$$

$$\text{Average time for C} = \frac{2 + 1 + 2 + 1}{4} = 1.5 \text{ min}$$

3. Normal time for each job element:

$$\text{Normal time for A} = (\text{Average observed time}) \times (\text{Performance rating})$$
$$= (9.5)(1.2) = 11.4 \text{ min}$$
$$\text{Normal time for B} = (2.2)(1.05) = 2.31 \text{ min}$$
$$\text{Normal time for C} = (1.5)(1.10) = 1.65 \text{ min}$$

Note: Normal times are computed for each element because the performance rating factor (work pace) may vary for each element, as it did in this case.

4. Add the normal times for each element to find the total normal time (the normal time for the whole job):

$$\text{Total normal time} = 11.40 + 2.31 + 1.65 = 15.36 \text{ min}$$

5. Standard time for the job:

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}} = \frac{15.36}{1 - 0.15} = 18.07 \text{ min}$$

Thus, 18.07 minutes is the time standard for this job.

INSIGHT ▶ When observed times are not consistent they need to be reviewed. Abnormally short times may be the result of an observational error and are usually discarded. Abnormally long times need to be analyzed to determine if they, too, are an error. However, they may *include* a seldom occurring but legitimate activity for the element (such as a machine adjustment) or may be personal, delay, or fatigue time.

LEARNING EXERCISE ▶ If the two observations marked with an asterisk were *not* deleted, what would be the total normal time and the standard time? [Answer: 18.89 min, 22.22 min.]

RELATED PROBLEMS ▶ 10.22–10.25, 10.28a,b, 10.29a, 10.30a (10.41–10.43 are available in MyOMLab)

LO 10.7 *Find* the proper sample size for a time study

Time study requires a sampling process; so the question of sampling error in the average observed time naturally arises. In statistics, error varies inversely with sample size. Thus, to determine just how many "cycles" we should time, we must consider the variability of each element in the study.

To determine an adequate sample size, three items must be considered:

1. How accurate we want to be (e.g., is $\pm 5\%$ of observed time close enough?).
2. The desired level of confidence (e.g., the z-value; is 95% adequate or is 99% required?).
3. How much variation exists within the job elements (e.g., if the variation is large, a larger sample will be required).

TABLE 10.2
Common *z*-Values

DESIRED CONFIDENCE (%)	*Z*-VALUE (STANDARD DEVIATION REQUIRED FOR DESIRED LEVEL OF CONFIDENCE)
90.0	1.65
95.0	1.96
95.45	2.00
99.0	2.58
99.73	3.00

The formula for finding the appropriate sample size, given these three variables, is:

$$\text{Required sample size} = n = \left(\frac{zs}{h\bar{x}}\right)^2 \qquad (10\text{-}4)$$

where
h = accuracy level (acceptable error) desired in percent of the job element, expressed as a decimal (5% = .05)
z = number of standard deviations required for desired level of confidence (90% confidence = 1.65; see Table 10.2 or Appendix I for more z-values)
s = standard deviation of the initial sample
$\bar{x}$ = mean of the initial sample
n = required sample size

Example 3

COMPUTING SAMPLE SIZE

Thomas W. Jones Manufacturing Co. has asked you to check a labor standard prepared by a recently terminated analyst. Your first task is to determine the correct sample size. Your accuracy is to be within ±5% and your confidence level at 95%. The standard deviation of the sample is 1.0 and the mean 3.00.

APPROACH ▶ You apply Equation (10-4).

SOLUTION ▶

$$h = 0.05 \quad \bar{x} = 3.00 \quad s = 1.0$$

$z = 1.96$ (from Table 10.2 or Appendix I)

$$n = \left(\frac{zs}{h\bar{x}}\right)^2$$

$$n = \left(\frac{1.96 \times 1.0}{0.05 \times 3}\right)^2 = 170.74 \approx 171$$

Therefore, you recommend a sample size of 171.

INSIGHT ▶ Notice that as the confidence level required increases, the sample size also increases. Similarly, as the desired accuracy level increases (say, from 5% to 1%), the sample size increases.

LEARNING EXERCISE ▶ The confidence level for Jones Manufacturing Co. can be set lower, at 90%, while retaining the same ±5% accuracy levels. What sample size is needed now? [Answer: $n = 121$.]

RELATED PROBLEMS ▶ 10.26, 10.27, 10.28c, 10.29b, 10.30b (10.44–10.46 are available in MyOMLab)

EXCEL OM Data File **Ch10Ex3.xls** can be found in MyOMLab.

solve Problem 10.25

What is Predetermined Time System?

Basic motions called therbligs

Gilbreth spelled backwards

- Select, grasp, position assemble, etc.
- Time measurement units TMUs = 0.0006 minutes

Predetermined Time Standards

- Divide manual work into small basic elements that have established times
- Can be done in a laboratory away from the actual production operation
- Can be set before the work is actually performed
- No performance ratings are necessary

MTM Table

Figure 10.9

GET and PLACE			DISTANCE RANGE IN IN.	<8	>8 <20	>20 <32
WEIGHT	CONDITIONS OF GET	PLACE ACCURACY	MTM CODE	1	2	3
<2 LB	EASY	APPROXIMATE	AA	20	35	50
		LOOSE	AB	30	45	60
		TIGHT	AC	40	55	70
	DIFFICULT	APPROXIMATE	AD	20	45	60
		LOOSE	AE	30	55	70
		TIGHT	AF	40	65	80
	HANDFUL	APPROXIMATE	AG	40	65	80
>2 LB <18 LB		APPROXIMATE	AH	25	45	55
		LOOSE	AJ	40	65	75
		TIGHT	AK	50	75	85
>18 LB <45 LB		APPROXIMATE	AL	90	106	115
		LOOSE	AM	95	120	130
		TIGHT	AN	120	145	160

MTM Example

Weight – less than 2 pounds
Conditions of GET – easy

Place accuracy – approximate
Distance range – 8 to 20 inches

TABLE 10.3 MTM-HC Analysis: Pouring Tube Specimen

ELEMENT DESCRIPTION	ELEMENT	TIME
Get tube from rack	AA2	35
Uncap, place on counter	AA2	35
Get centrifuge tube, place at sample table	AD2	45
Pour (3 seconds)	PT	83
Place tubes in rack (simo)	PC2	40
		Total TMU 238
.0006 x 238 = Total standard minutes = .14		

What is work sampling method ?

- Estimates percent of time a worker spends on various tasks
- Requires random observations to record worker activity
- Determines how employees allocate their time

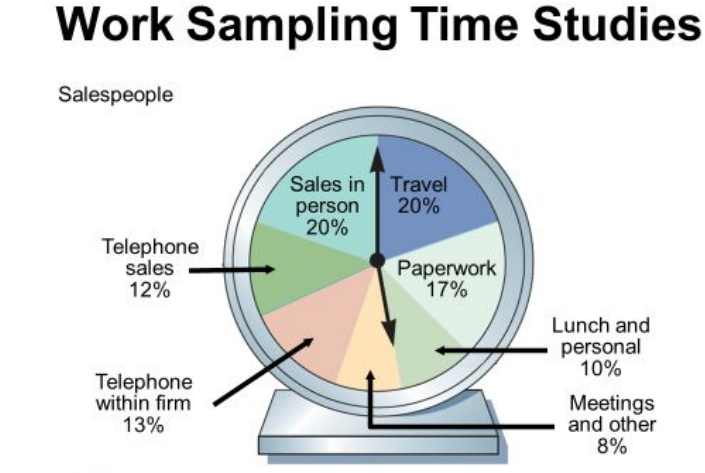


Figure 10.10