CHAPTER 10

Human Resources, Job Design, and Work Measurement

DISCUSSION QUESTIONS

1. One would expect that elements of Maslow's needs hierarchy, Herzberg's Dual Factor theory, and Hackman and Oldham's core job characteristics would be contained in the answer.

2. Jobs have been considered "bad" because they are physically dangerous, "dirty," or "noisy"; psychologically repulsive, too mo-notonous; present too great a physical or intellectual challenge; or offend an individual's preferences with regard to general lifestyle or employment. Students should be encouraged not to identify a particular "right" job, but to try to identify precisely what issues relevant to the job appeal to or offend him or her. Note the core job characteristics of Hackman and Oldham: skill variety, job identity in job significance, autonomy, feedback.

3. Again, there is no set answer to this question. The important considerations are:

- The changes suggested should address the reasons that the original job was considered "bad"—not merely make the job different.
- The changes must be realistic—resources must exist or must be able to be developed that would allow implementation of the suggested job changes.
- The student should be encouraged to consider the difference between "production" and "productivity."

4. Jobs that can push the man-machine interface to the limit of man's capacity usually require a high rate of information processing, a high rate and accuracy of physical response, or both. Examples would be found in terms of pilots of high-performance jet or rocket-powered aircraft, crane operators, and a safety monitor for working at a nuclear power station.

5. The student should be encouraged to include Hackman and Oldham's five core job characteristics of skill variety, job identity, job significance, autonomy, and feedback.

6. *Job enrichment* relates primarily to increasing the cognitive or intellectual requirements for the job, often by increasing authority and responsibility.

Job enlargement relates primarily to an increase in the number of tasks to be performed.

Job rotation implies a formal arrangement for job switching among a particular group of workers within a specific set of jobs. Usually the workers are cross-trained on all or most jobs within the set.

Job specialization implies the opposite of job enrichment or job enlargement, where the job becomes narrow and the range of responsibility and authority restricted.

Employee empowerment is the practice of enriching jobs so that employees accept responsibility for a variety of decisions normally associated with staff specialists.

Teams often satisfy empowerment, core job characteristics, and higher level needs.

7. Ergonomics is the study of human factors, the study of work. Ergonomics can make work safer, less damaging, by redesign to tools, workspaces, and worker motions.

8. Techniques for methods analysis include: flow diagrams, process charts, activity charts, and operations charts.

9. Labor standards are set in four ways: historical experience, time studies, predetermined time standards, and work sampling.

10. Labor standards are used to:

1. Determine labor content of items produced
2. Determine staffing needs of organizations
3. Determine cost and time estimates prior to production
4. Determine crew size and work balance
5. Determine production expected
6. Determine the basis of wage-incentive plans
7. Determine efficiency of employees and supervision

11. Classify as follows:

a) The operator stops to talk to you: do not include (delay)
b) The operator lights up a cigarette: do not include (personal)
c) Operator opens lunch pail: do not include (personal)

12. Waiting time: waiting time is included in an allowance as delay.

13. Material movement or replenishment: include in the standard unless a separate materials handling group exists.

14. Operator drops a part, you pick it up and hand it to him: do not include. Outside help or interference distorts the results of the study.

ACTIVE MODEL EXERCISE

ACTIVE MODEL 10.1: Work Sampling

1. Scroll over the graph to determine what the sample size should be if $p = 30\%$.

933

2. Based on the graph, what value of p requires the largest sample size?

0.5

3. Use the scrollbar to determine what happens to the sample size as the number of standard deviations, z, increases?

The sample size increases.

4. Use the scrollbar to determine what happens to the sample size as the acceptable error, h, increases?

The sample size decreases.

ETHICAL DILEMMA

McWane Inc. is an interesting company—a repeat polluter, a dangerous workplace, a tough management team, privately held—yet it is a major philanthropic family in Birmingham and is respected for what it has given the city culturally. It also claims to be "cleaning up its act" in response to the terrible publicity it has received over the years. Students should use the Internet to update the 2003–2004 *New York Times* and *The Wall Street Journal* articles sourced. This will make for a lively classroom discussion.

(a) *A new company nurse at McWane*. Should she contact OSHA, quit, force the issue with management? These are usually no-win situations for employees.

(b) *A purchase of McWane's products*. Do you insist on ethics in your supply chain? This is an issue facing U.S. clothing makers whose factories are in China, Bangladesh, and Vietnam. Public opinion usually forces companies to insist their suppliers follow the same code of ethics they apply internally.

(c) *McWane's banker*. Do you intrude on your good customer's business ethics or keep your eyes and ears closed, hoping the attorneys and accountants handle the bad press?

(d) *A supplier to McWane*. Do you tell McWane you will not sell them $10 million in material per month because you don't approve of their treatment of employees and the environment? Are you responsible to your shareholders to make a profit or set standards for a customer's ethics?

END-OF-CHAPTER PROBLEMS

10.1

Process Chart

Charted by ______

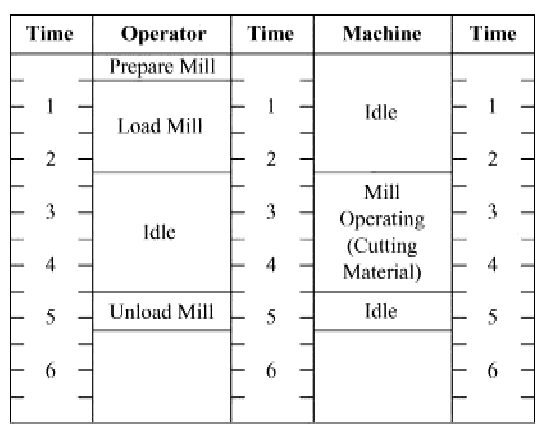
Date: ______ Sheet ___ of ___

Problem: ______

Summary	
○ Operation	26
⇨ Transport	4
□ Inspect	2
▷ Delay	
▽ Store	
Vert. Dist.	
Hor. Dist.	24
Time (min)	24.4

Distance (ft)	Time (mins)	Chart Symbols	Process Description
	1.0	○⇨□▷▽	Park auto
	0.1	○⇨□▷▽	Set parking brake
	0.1	○⇨□▷▽	Set gear shift to park
	0.1	○⇨□▷▽	Turn off engine
	0.2	○⇨□▷▽	Exit vehicle
8	0.1	○⇨□▷▽	Move to trunk of auto
	0.3	○⇨□▷▽	Open trunk
	1.0	○⇨□▷▽	Remove jack and spare tire
7		○⇨□▷▽	Move jack and spare tire to just forward of right rear wheel
2	0.2	○⇨□▷▽	Position jack for lifting
	0.5	○⇨□▷▽	Inspect position of jack
	0.5	○⇨□▷▽	Remove hubcap
	2.2	○⇨□▷▽	Raise vehicle on jack until stress is off springs
	0.5	○⇨□▷▽	Loosen lug nuts
	2.0	○⇨□▷▽	Raise car on jack until wheel is off ground
	1.5	○⇨□▷▽	Remove lug nuts
	0.5	○⇨□▷▽	Remove wheel
	0.5	○⇨□▷▽	Set wheel under vehicle
	0.75	○⇨□▷▽	Mount rear wheel
	0.6	○⇨□▷▽	Start lug nuts, hand tighten
	0.1	○⇨□▷▽	Rotate wheel
	1.2	○⇨□▷▽	Tighten lug nuts
	1.5	○⇨□▷▽	Lower vehicle on jack until wheel touches ground
	1.0	○⇨□▷▽	Remove wheel with flat tire from beneath vehicle
	0.75	○⇨□▷▽	Re-tighten lug nuts
	0.50	○⇨□▷▽	Inspect lug nuts
	1.5	○⇨□▷▽	Lower vehicle on jack so that jack may be removed
	1.0	○⇨□▷▽	Remove jack
7	0.2	○⇨□▷▽	Move wheel with flat to rear of vehicle
	1.5	○⇨□▷▽	Place wheel with flat in trunk
	1.3	○⇨□▷▽	Place jack in trunk
	0.2	○⇨□▷▽	Close trunk

10.2



10.3 This problem is probably best solved by students who have experienced one of these concerts! Of major importance in the solution is that everything be coordinated (both performers *and* sets may have to be changed; performers may have to change costume, etc.) and that *all* performers be allowed time to recuperate.

10.4

Operations Chart
Process: Change Eraser

Analyst: ______
Date: ______
Sheet: 1 of 2
Method: (Present) Proposed
Remarks:

Summary						
Symbol	**Present**				**Diff.**	
	LH	**RH**	**LH**	**RH**	**LH**	**RH**
○ Operations	1	8				
⇨ Transports	3	8				
□ Inspections	1					
D Delays	15	4				
▽ Storage						
Totals	20	20				

Left Hand	Dist	Symbol	Symbol	Dist	Right Hand
1 Reach for pencil		⇨	D		Idle
2 Grasp pencil		○	D		Idle
3 Move to work area		⇨	⇨		Move to pencil top
4 Hold pencil		D	○		Grasp pencil top
5 Hold pencil		D	○		Remove pencil top
6 Hold pencil		D	⇨		Set top aside
7 Hold pencil		D	⇨		Reach for old eraser
8 Hold pencil		D	○		Grasp old eraser
9 Hold pencil		D	○		Remove old eraser
10 Hold pencil		D	⇨		Set aside old eraser

Operations Chart
Process: Change Eraser

Analyst: ______
Date: ______
Sheet: 2 of 2
Method: (Present) Proposed
Remarks:

Summary						
Symbol	**Present**				**Diff.**	
	LH	**RH**	**LH**	**RH**	**LH**	**RH**
○ Operations						
⇨ Transports						
□ Inspections						
D Delays						
▽ Storage						
Totals						

Left Hand	Dist	Symbol	Symbol	Dist	Right Hand
11 Hold pencil		D	⇨		Reach for new eraser
12 Hold pencil		D			Grasp new eraser
13 Hold pencil		D	⇨		Move to pencil
14 Hold pencil		D	○		Insert new eraser
15 Hold pencil		D	⇨		Reach for pencil top
16 Hold pencil		D	○		Grasp pencil top
17 Hold pencil		D	⇨		Move to pencil
18 Hold pencil		D	○		Assemble
19 Inspect		□	D		Idle
20 Set aside pencil		⇨	D		Idle

The operations chart presented here as a solution to part (a) is typical of left-hand/right-hand charts, containing numerous small motions. Placing a paper clip on a set of papers is somewhat simpler, but contains many of the same motions. Adding paper to a printer might be more complex, and might require more mechanical dexterity or strength, but it too could be analyzed with a chart analogous to this one.

10.5

Process Chart	**Summary**		
Charted by ______	○	Operation	14
Date: ______ Sheet 1 of 1	⇨	Transport	4
Problem: adding a memory board to your computer	□	Inspect	1
	D	Delay	
	▽	Store	
		Vert. Dist.	
		Hor. Dist.	68
		Time (min)	24.7

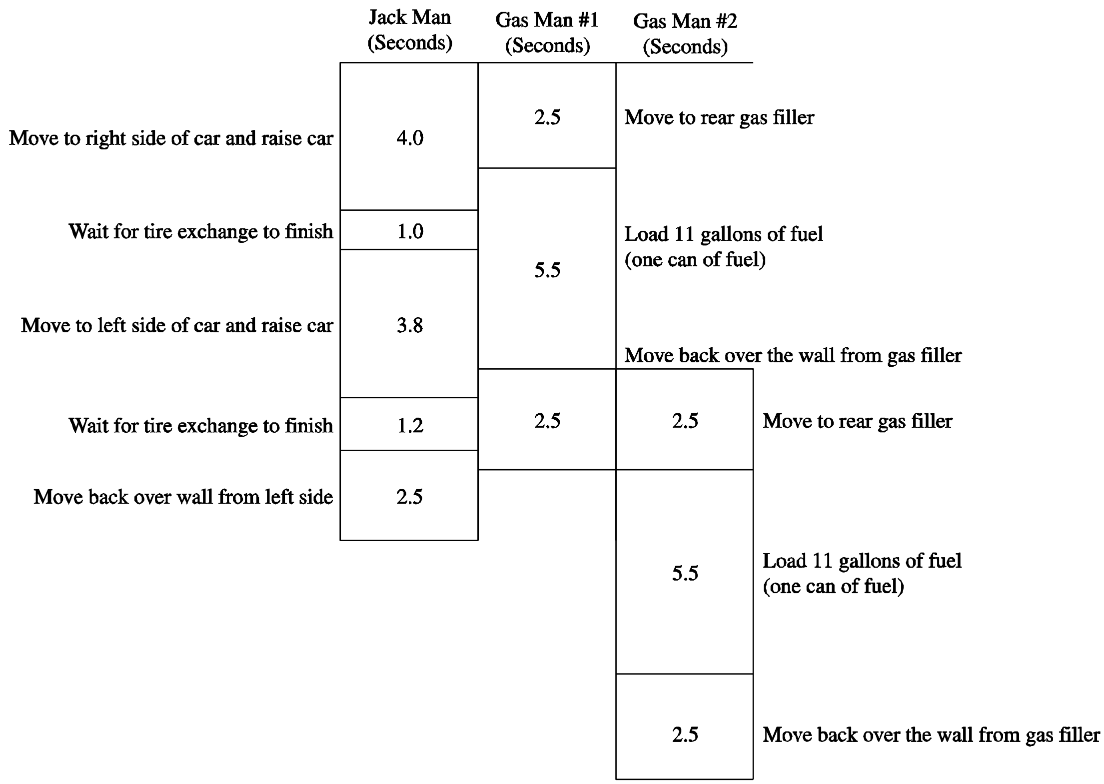
Distance (ft)	**Time (mins)**	**Chart Symbols**	**Process Description**
	0.2	○⇨□D▽	Turn computer off
	2.0	○⇨□D▽	Disconnect all cables
30	1.0	○⇨□D▽	Move computer to table top
	1.5	○⇨□D▽	Remove screws from cover
	1.0	○⇨□D▽	Remove cover
3	0.1	○⇨□D▽	Set cover on floor
	0.5	○⇨□D▽	Find board to be replaced
5	0.2	○⇨□D▽	Bring box with new board to table
	1.0	○⇨□D▽	Unpack new board
	1.0	○⇨□D▽	Remove old board
	1.5	○⇨□D▽	Insert new board
	1.5	○⇨□D▽	Set jumpers
	1.5	○⇨□D▽	Set DIP switches
	1.3	○⇨□D▽	Replace cover
	1.5	○⇨□D▽	Replace screws in cover
30	0.7	○⇨□D▽	Move computer to desktop
	2.5	○⇨□D▽	Install cabling
	0.2	○⇨□D▽	Turn on computer
	5.5	○⇨□D▽	Test new memory

10.6 The important point raised by this question is that actual ratings will depend on both the job and the psychological needs of the individual student. Students should be encouraged to evaluate the degree to which they require each of the psychological components cited by Hackman and Oldham; then to evaluate *several* jobs.

The following two examples are offered:

Job Characteristic	**Example 1: Fast-Food Kitchen Staff**	**Example 2: College Professor**	
Skill variety	3	5	Changes that might lead to higher
Job Identity	4	9	score: for the fast-food worker, job
Job Significance	3	8	enlargement would lead to greater job
Autonomy	4	9	variety. For the college professor,
Feedback	7	6	more frequent performance reviews.
Total	20	37	

10.7



Times are based on those in Solved Problem 10.1. One could make the case that more (or less) overlap is possible between Gas Man #1 and Gas Man #2. Rules may also limit the number of "over the wall" crew allowed. This could change when the Gas Man #2 could start.

10.8

Process Chart	Summary	
Charted by H. Molano	○ Operation	2
Date: ________ Sheet 1 of 1	⇨ Transport	3
Problem : Pit Crew Jack Man	□ Inspect	
	D Delay	2
	▽ Store	
	Vert. Dist	
	Hor. Dist	
	Time (seconds)	12.5

Distance (ft)	Time (seconds)	Chart Symbols	Process Description
15	2.0	○⇨□D▽	Move to right side of car
	2.0	○⇨□D▽	Raise car
	1.0	○⇨□D▽	Wait for tire exchange to finish
10	1.8	○⇨□D▽	Move to left side of car
	2.0	○⇨□D▽	Raise car
	1.2	○⇨□D▽	Wait for tire exchange to finish
5	2.5	○⇨□D▽	Move back over wall from left side

10.9 (a) **One-Person Activity chart**

	Operator #1		Operator #2	
	Time	%	Time	%
Work	13	100	—	—
Idle	0	0	—	—

Operation: Changing right rear tire
Equipment: ______
Operation: One person
Study No. 1 Analyst: JS

Subject John Jones		**Date**
Present	Sheet 1	Chart
Proposed	of 1	by JS

Time	Operator #1	Time	Operator #2	Time
	Park vehicle			
	Remove jack and spare from trunk			
	Move jack and tire to side of vehicle			
	Jack up vehicle			
	Remove hubcap			
	Remove lug nuts			
	Remove wheel with flat tire			
	Mount wheel with spare tire			
	Replace lug nuts			
	Lower vehicle on jack			
	Place jack and wheel with flat tire in trunk			

(b) **Two-Person Activity chart**

	Operator #1		Operator #2	
	Time	%	Time	%
Work	12	92	3	30
Idle	1	8	9	70

Operation: Changing right rear tire
Equipment: ______
Operation: Two-person crew
Study No. 1 Analyst: JS

Subject John Jones and Mary Smith		**Date**
Present	Sheet 1	Chart
Proposed	of 1	by JS

Time	Operator #1	Time	Operator #2	Time
	Park vehicle		Idle	
	Remove jack and spare from trunk		Idle	
	Idle		Move jack and tire to side of vehicle	
	Jack up vehicle		Idle	
	Remove hub cap		Idle	
	Remove lug nuts		Idle	
	Remove wheel with flat tire		Idle	
	Idle		Mount wheel with spare tire	
	Replace lug nuts		Idle	
	Lower vehicle on jack		Idle	
	Place jack and wheel with flat tire in trunk		Replace hubcap	

Note that there is little or no time to be saved by assigning two people to change the tire since there are few tasks in the process that can be done simultaneously.

10.10

Activity chart

	Operator#1		Operator#2	
	Time	%	Time	%
Work	11.75	84	11.75	84
Idle	2.25	16	2.25	16

Operations ___ Wash and dry dishes __________
Equipment ___ Sink, Drip Rack, Towels, Soap__________
Operator __________
Study no ____1_ Analyst ___ HSM __________

Subject:					Date:
Present (Proposed) Dept. Housecleaning			Sheet 1 of 1		Chart by Hank
Notes	Time	Operator #1	Time	Operator #2	Time
	0	Fill sink w/ dishes		Idle	
	1	Fill sink w/ soap/water		Idle	
	2	Wash dishes (2 Min)		Idle	
				Rinse/drip rack (1 min)	
	3	Fill sink w/ dishes (1 min)		Dry and stack dishes (3 min)	
	4	Wash dishes			
	5				
	6	Fill sink w/ dishes		Rinse/drip rack	
	7	Wash dishes		Dry and stack	
	8				
	9	Let water out (1 min)			
	10	Rinse sink (1 min)		Rinse/drip rack	
	11			Dry and stack	
	12				
	13				
	14	Put dishes away		Put dishes away	

Washing takes about 2 minutes. Rinsing about 1 minute. Drying about 3 minutes. There appear to be no interferences except waiting for the dryer at the beginning and for the washer at the end. Both work approximately the same amount of the time so utilizations are equal. Individual responses may vary.

10.11 One way to do this is to divide the parts of the car between the three people. For example, A can do the wheels and the top. B does the right side and hood, grill and bumper. C does the left side, trunk, and rear grill, lights, and bumper. Notes can be added under that column to give specific instructions and details.

MULTIPLE ACTIVITY CHART

Chart No. 101A Sheet No. 1 Of: 1

PRODUCT:

PROCESS: Washing Cars

MACHINES:

OPERATIVE: CLOCK NO:

CHARTED BY: DATE: 10/10/03

SUMMARY	Present	Proposed	Saving
CYCLE			
Man			
Machine			
WORKIN			
Man			
Machine			
IDLE			
Man			
Machine			
UTILIZAT			
Man			
Machine			

TIME	CREW A	CREW B	CREW C	NOTES
1:00	SPRAY WHEELS	REFILL BUCKET	RINSE WASH TOWELS	
2:00	SCRUB WHEEL 1	SPRAY RIGHT SIDE AND HOOD	IDLE	
3:00	SCRUB WHEEL 2	WASH FRONT GRILL AND BUMPER	SPRAY TRUNK AND RIGHT SIDE	
4:00	SCRUB WHEEL 3	WASH HOOD	WASH TRUNK	
5:00	SCRUB WHEEL 4	WASH RT. FRONT FENDER	WASH REAR LF FENDER	
6:00	RINSE WHEELS	WASH RT. DOORS	WASH LT. DOORS	
6:30	SPRAY TOP	WASH RT. REAR FENDER	WASH LF. FRONT FENDER	
8:00	WASH TOP	WASH RT. WINDOWS	WASH REAR LIGHTS AND BUMPER	
9:00	WASH WINDSHIELD AND REAR WINDOW	SPRAY FRONT OF CAR	WASH LF. WINDOWS	
10:00	IDLE	SPRAY REAR OF CAR	IDLE	
11:00	DRY WHEELS	DRY HOOD AND BUMPER	DRY TRUNK AND REAR BUMPER	
12:00	DRY TOP	DRY RIGHT SIDE	DRY LEFT SIDE	
13:00	DRY WINDSHIELD AND REAR WINDOW	DRY RIGHT WINDOWS	DRY LEFT WINDOWS	

10.12 An example process chart is shown below:

Present Method [X]
Proposed Method [ ]

PROCESS CHART

SUBJECT CHARTED ___ Printing and Copying Document ___

DEPARTMENT ___ Clerical ___

DATE ___
CHART BY ___HSM___
CHART NO. ___1___
SHEET NO. 1 OF 1

Distance (Ft)	Time (Mins)	Chart Symbols	Process Description
	0.25	● ⇨ □ D ▽	Click on print command
50	0.25	○ ➡ □ D ▽	Move to printer
	0.50	○ ⇨ □ ◗ ▽	Wait for printing
	0.10	○ ⇨ ■ D ▽	Read error message
100	0.50	○ ➡ □ D ▽	Move to supply room
	0.25	● ⇨ □ D ▽	Locate correct paper
100	0.50	○ ➡ □ D ▽	Move to printer
	0.50	● ⇨ □ D ▽	Place paper in printer
	0.50	○ ⇨ □ ◗ ▽	Wait for printing
	1.00	○ ⇨ ■ D ▽	Inspect document
10	0.20	○ ➡ □ D ▽	Move to copier
	0.50	● ⇨ □ D ▽	Program copier
	1.00	○ ⇨ □ ◗ ▽	Wait for copies
	0.25	● ⇨ □ D ▽	Retrieve copies
50	0.25	○ ➡ □ D ▽	Move to office
	0.25	● ⇨ □ D ▽	Layout copies on desk
	1.00	● ⇨ □ D ▽	Staple copies

After analysis via a process chart above, encourage student to use some imagination. Additional short elements (open package, open printer tray, etc.) may be appropriate. Some ideas for improved efficiency include: Move printer adjacent to computer, move limited paper storage to a shelf adjacent to the printer; place stapler on the table adjacent to the copier; don't wait for the printed copies, keep working until the printer is finished.

A more aggressive (and expensive) solution is to have a sophisticated copier that takes the place of the printer (direct from computer to copier) that does multiple sorted copies and staples them.

10.13 NT = Avg × PR = 8.5 × 1.10 = 9.35 seconds; worker is faster than normal

10.14 NT = Avg × PR = 8.5 × 0.90 = 7.65 seconds; worker is slower than normal

10.15 (a) $ST = \frac{NT}{1-AF} = \frac{9.35}{1-0.15} = 11$ seconds

(b) $ST = \frac{NT}{1-AF} = \frac{7.65}{1-0.18} = 9.33$ seconds

10.16 (a) Average time $= \frac{\text{Sum of times}}{\text{Number of cycles}} = \frac{1.74}{16}$

$= 0.10875 \text{ minutes} = 6.525 \text{ seconds}$

(b) Normal time = (Average time) × (Performance rating factor)

$= 6.525 \times 95\% = 6.2$ seconds

(c) Standard time $= \frac{\text{Normal time}}{1 - \text{Allowance factor}}$

$= \frac{6.2}{1-8\%} = \frac{6.2}{92\%} = 6.739$ seconds

10.17 NT = Average observed cycle time × PR = (50) × (1.10) = 55 seconds

10.18 (a) Normal time = 12 minutes × 1.05 = 12.6 minutes

(b) Standard time $= \frac{\text{Normal time}}{1 - \text{Allowance fraction}}$

$= \frac{12.6}{1-0.16} = 15$ minutes

10.19 $\text{Avg} = \frac{2.2+2.6+2.3+2.5+2.4}{5} = 2.4$ minutes

$NT = 2.4 \times 1.05 = 2.52$

$ST = \frac{2.52}{1-0.10} = 2.8$ minutes

10.20 (a) Normal time = 12 seconds × 1.00 = 12.0 seconds

(b) Standard time $= \frac{\text{Normal time}}{1 - \text{Allowance factor}}$

$= \frac{12.0}{1-0.15} = 14.12$ seconds

10.21 Normal time = 5.3 minutes × 1.05 = 5.565 minutes

Allowance Fraction $= \frac{\text{Personal} + \text{Fatigue} + \text{Delay}}{60 \text{ minutes}}$

$= \frac{3+2+1}{60} = \frac{6}{60} = 0.10$

Standard time $= \frac{\text{Normal time}}{1 - \text{Allowance factor}}$

$= \frac{5.565}{1-0.10} = 6.183$ minutes

10.22

Element	Rating	Observation (minutes par cycle) 1	2	3	4	5	Average	Normal
Check mini-bar	100%	1.5	1.6	1.4	1.5	1.5	1.5	1.50
Make one bed	90%	2.3	2.5	2.1	2.2	2.4	2.3	2.07
Vacuum	120%	1.7	1.9	1.9	1.4	1.6	1.7	2.04
Clean bath	100%	3.5	3.6	3.6	3.6	3.2	3.5	3.50
								9.11

Normal time for process = 9.11

Standard time for process $= \frac{\text{Normal time for process}}{1 - \text{Allowance factor}} = \frac{9.11}{1-0.10} = 10.12$ minutes

10.23

Job Element	Observed Time (minutes)						Perf. Rating
Typing letter	2.5	3.5	2.8	2.1	2.6	3.3	85%
Typing envelope	0.8	0.8	0.6	0.8	3.1[a]	0.7	100%
Stuffing envelope	0.4	0.5	1.9[a]	0.3	0.6	0.5	95%
Sealing, sorting	1.0	2.9[b]	0.9	1.0	4.4[b]	0.9	125%

[a] Disregard—secretary stopped to answer the phone.

[b] Disregard—interruption by supervisor.

Calculating average observed cycle time:

$$\text{Element } 1 = \frac{2.5+3.5+2.8+2.1+2.6+3.3}{6} = \frac{16.8}{6} = 2.8 \text{ minutes}$$

$$\text{Element } 2 = \frac{0.8+0.8+0.6+0.8+0.7}{5} = \frac{3.7}{5} = 0.74 \text{ minutes}$$

$$\text{Element } 3 = \frac{0.4+0.5+0.3+0.6+0.5}{5} = \frac{2.3}{5} = 0.46 \text{ minutes}$$

$$\text{Element } 4 = \frac{1.0+0.9+1.0+0.9}{4} = \frac{3.8}{4} = 0.95 \text{ minutes}$$

Calculating normal time for each task element:

Normal time = Observed cycle time × Peformance rating

Element 1 = 2.80 × 0.85 = 2.38 minutes
Element 2 = 0.74 × 1.00 = 0.74 minutes
Element 3 = 0.46 × 0.95 = 0.44 minutes
Element 4 = 0.95 × 1.25 = 1.19 minutes

10.23 (Contd)

Normal time for the process:

Normal time for process = Sum of normal times for elements
= 2.38 + 0.74 + 0.44 + 1.19
= 4.75 minutes

Standard time for process:

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance factor}} = \frac{4.75}{1-0.12} = 5.40 \text{ minutes}$$

10.24 Allowance = 23%

Job Element	Performance Rating	Observations (minutes) 1	2	3	4	5
1	97%	1.5	1.8	2.0	1.7	1.5
2	105%	0.6	0.4	0.7	3.7	0.5
3	86%	0.5	0.4	0.6	0.4	0.4
4	90%	0.6	0.8	0.7	0.6	0.7

The first thing to notice is that observation 4 of job element 2 is personal time and should be ignored.

10.24 (Contd)

(a) As shown below, normal time = 3.24 minutes.

Job Element	Performance Rating	Observations 1	2	3	4	5	Average Actual Time	Normal Time
1	97%	1.5	1.8	2.0	1.7	1.5	1.70	1.65
2	105%	0.6	0.4	0.7		0.5	0.55	0.58
3	86%	0.5	0.4	0.6	0.4	0.4	0.46	0.40
4	90%	0.6	0.8	0.7	0.6	0.7	0.68	0.61
								3.24

(b) $\text{Standard time} = \dfrac{\text{Normal time}}{1 - \text{Allowance}}$

$$\text{Standard time} = \frac{3.24}{1-0.23} = \frac{3.24}{0.77} = 4.208 \text{ minutes}$$

10.25 (a,b)

Task Element	Performance Rating	Observations (minutes) (actual time) 1	2	3	4	5	Solutions: Actual Time Average	Normal Time
1	110%	0.5	0.4	0.6	0.4	0.4	0.46	0.506
2	95%	0.6	0.8	0.7	0.6	0.7	0.68	0.646
3	90%	0.6	0.4	0.7	0.5	0.5	0.54	0.486
4	85%	1.5	1.8	2.0	1.7	1.5	1.70	1.445
							Total	3.083

(a) Normal time = 3.083 minutes

(b) $$\text{Standard time} = \frac{\text{Normal time}}{1 - \text{Total allowance}} = \frac{3.083}{1.0-0.20} = 3.85 \text{ minutes}$$

10.26 Initial sample: 3.5, 3.2, 4.1, 3.6, 3.9

$$\bar{x} = 3.5 + 3.2 + 4.1 + 3.6 + 3.9 = \frac{18.3}{5} = 3.66$$

$$s = \sqrt{\frac{\Sigma(\text{Sample observation} - \bar{x})^2}{n-1}} = \sqrt{\frac{0.492}{5-1}} = \sqrt{0.123} = 0.35$$

$$n = \left(\frac{zs}{h\bar{x}}\right)^2 = \left(\frac{1.96 \times 0.35}{0.05 \times 3.66}\right)^2$$

$$= \left(\frac{.686}{.183}\right)^2 = 3.76^2 = 14.13, \text{ or 15 observations.}$$

10.27 $n = \left(\frac{zs}{h\bar{x}}\right)^2 = \left(\frac{(2.58)(1.28)}{(0.05)(3.20)}\right)^2 = \left(\frac{3.30}{0.16}\right)^2 = 426$

where $z = 2.58,\ s = 1.28,\ h = 0.05,\ \bar{x} = 3.20$

Sample size 45 is not adequate. They need 381 more observations.

10.28

Element	Observed Time (minutes)					Perf. Rating
Prepare daily reports	35	40	33	42	39	120%
Photocopy results	12	10	36[a]	15	13	110%
Label and package reports	3	3	5	5	4	90%
Distribute reports	15	18	21	17	45[b]	85%

[a] Photocopying machine broken (included in delay factor).
[b] Power outage (included in delay factor).

Calculating average observed cycle time:

$$\text{Element } 1 = \frac{35+40+33+42+39}{5} = \frac{189}{5} = 37.8 \text{ minutes}$$

$$\text{Element } 2 = \frac{12+10+15+13}{4} = \frac{50}{4} = 12.5 \text{ minutes}$$

$$\text{Element } 3 = \frac{3+3+5+5+4}{5} = \frac{20}{5} = 4.0 \text{ minutes}$$

$$\text{Element } 4 = \frac{15+18+21+17}{4} = \frac{71}{4} = 17.75 \text{ minutes}$$

(a) *Calculating normal time for each task element:*

Normal time = Observed time × Performance rating

Element 1 = 37.80 × 1.20 = 45.36 minutes

Element 2 = 12.50 × 1.10 = 13.75 minutes

Element 3 = 4.00 × 0.90 = 3.6 minutes

Element 4 = 17.75 × 0.85 = 15.09 minutes

Normal time for the process:

Normal time for process = Sum of normal times for elements
= 45.36 + 13.75 + 3.6 + 15.09
= 77.8 minutes

(b) *Standard time for the process:*

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance factor}}$$

$$= \frac{77.8}{1 - 0.15} = 91.53 \text{ minutes}$$

(c) *Sample size*:

From the equations relating to a normal distribution, we know that: $n = \left(\frac{zs}{h\bar{x}}\right)^2$, $h = 0.05,\ z = 1.96.$

Job Element	Mean Cycle Time	S^2	S	Sample*
Prepare daily reports	37.80	13.70	3.7	15
Photocopy results	12.50	4.33	2.1	44
Label and package reports	4.00	1.00	1.0	96*
Distribute reports	17.75	6.25	2.5	31
Sample size for the entire task must be at least 96 samples.				

*All fractional sample sizes are rounded to the next highest integer value.

$$** \left[\frac{(1.96)(1)}{(.05)(4)}\right]^2 = \left(\frac{1.96}{.2}\right)^2 = (9.8)^2 = 96$$

10.29 (a)

Job Element	Observed Time (seconds)					Perf. Rating
Grasp and place bag	8	9	8	11	7	110%
Fill bag	36	41	39	35	112[a]	85%
Seal bag	15	17	13	20	18	105%
Place bag on conveyor	8	6	9	30[b]	35[b]	90%

[a] Bag breaks open, include as part of delay in allowance factor.
[b] Conveyor jams, include as part of delay in allowance factor.

Note: If bags break open with any regularity, then these observations *would* be included in the time for this element . . . it would be part of the element and task.

Calculating average observed time:

$$\text{Element } 1 = \frac{8 + 9 + 8 + 11 + 7}{5} = \frac{43}{5} = 8.6 \text{ seconds}$$

$$\text{Element } 2 = \frac{36 + 41 + 39 + 35}{4} = \frac{151}{4} = 37.75 \text{ seconds}$$

$$\text{Element } 3 = \frac{15 + 17 + 13 + 20 + 18}{5} = \frac{83}{5} = 16.6 \text{ seconds}$$

$$\text{Element } 4 = \frac{8 + 6 + 9}{3} = \frac{23}{3} = 7.67 \text{ seconds}$$

Calculating normal time for each task element:

Normal time = Observed time × Performance rating

Element 1 = 8.60 × 1.10 = 9.46 seconds

Element 2 = 37.75 × 0.85 = 32.09 seconds

Element 3 = 16.60 × 1.05 = 17.43 seconds

Element 4 = 7.67 × 0.90 = 6.90 seconds

Normal time for the process:

Normal time for process = Sum of normal times for elements
= 9.46 + 32.09 + 17.43 + 6.90
= 65.88 seconds

Standard time for process:

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance factor}}$$

$$= \frac{65.88}{1 - 0.23} = 85.56 \text{ seconds}$$

(b) Calculating Sample Size

Job Element	Mean ($\bar{X}$)	Desired Accuracy (*h*)	Std. Dev. Required (*Z*)	Std. Dev. of Sample (*S*)	Samples Required
Grasp and place bag	8.60	0.05	2.58	1.52	83
Fill bag	37.75	0.05	2.58	2.75	14
Seal bag	16.60	0.05	2.58	2.70	70
Place bag on conveyor	7.67	0.05	2.58	1.54	107

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

$$n = \left(\frac{2.58 \times 1.52}{0.05 \times 8.6}\right)^2 = 83 \text{ samples for grasp and place bag}$$

$$n = \left(\frac{2.58 \times 2.75}{0.05 \times 37.75}\right)^2 = 14 \text{ samples for fill bag}$$

$$n = \left(\frac{2.58 \times 2.7}{0.05 \times 16.6}\right)^2 = 70 \text{ samples for seal bag}$$

$$n = \left(\frac{2.58 \times 1.54}{0.05 \times 7.67}\right)^2 = 107 \text{ samples for place bag on conveyor}$$

There fore, if all cycles must be studied together (the typical case), 107 cycles must be studied.

10.30 (a)

Job Element	Observed Time (minutes)							Performance Rating
Select correct muffler	4	5	4	6	4	15*	4	110%
Remove old muffler	6	8	7	6	7	6	7	90%
Weld/Install new muffler	15	14	14	12	15	16	13	105%
Check/inspect work	3	4	24*	5	4	3	18*	100%
Complete paperwork	5	6	8	—	7	6	7	130%

*Employee stopped to talk to boss—exclude (personal time).

Calculating average observed time:

$$\text{Element } 1 = \frac{4+5+4+6+4+4}{6} = \frac{27}{6} = 4.5 \text{ minutes}$$

$$\text{Element } 2 = \frac{6+8+7+6+7+6+7}{7} = \frac{47}{7} = 6.71 \text{ minutes}$$

$$\text{Element } 3 = \frac{15+14+14+12+15+16+13}{7} = \frac{99}{7} = 14.14 \text{ minutes}$$

$$\text{Element } 4 = \frac{3+4+5+4+3}{5} = \frac{19}{5} = 3.8 \text{ minutes}$$

$$\text{Element } 5 = \frac{5+6+8+7+6+7}{6} = \frac{39}{6} = 6.5 \text{ minutes}$$

Calculating normal time for each task element:

Normal time = Observed time × Performance rating

$$\text{Element } 1 = 4.50 \times 1.10 = 4.95 \text{ minutes}$$
$$\text{Element } 2 = 6.71 \times 0.90 = 6.04 \text{ minutes}$$
$$\text{Element } 3 = 14.14 \times 1.05 = 14.85 \text{ minutes}$$
$$\text{Element } 4 = 3.80 \times 1.00 = 3.8 \text{ minutes}$$
$$\text{Element } 5 = 6.50 \times 1.30 = 8.45 \text{ minutes}$$

Normal time for the process:

$$\text{Normal time for process} = \text{Sum of normal times for elements} = 4.95 + 6.04 + 14.85 + 3.8 + 8.45 = 38.09 \text{ minutes}$$

Standard time for process:

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance factor}} = \frac{38.09}{1 - 0.20} = 47.6 \text{ minutes (rounded)}$$

(b) *Calculating sample size:*

Job Element	Mean Observed Time ($\bar{X}$)	Desired Accuracy (h)	Std. Dev. Required (Z)	Std. Dev. of Sample (S)	Samples Required
Select correct muffler	4.50	0.05	1.96	0.836	53
Remove old muffler	6.71	0.05	1.96	0.755	20
Weld/Install new muffler	14.14	0.05	1.96	1.345	14
Check/inspect work	3.80	0.05	1.96	0.836	75
Complete paperwork	6.50	0.05	1.96	1.048	40

$$n = \left(\frac{zs}{h\bar{x}}\right)^2 = \left[\frac{(1.96)(0.836)}{(0.05)(3.8)}\right]^2 = 75$$

Element 4 required a sample of 75, thus the sample size for the study is 75.

10.31 Sample size $= \dfrac{Z^2 p(1-p)}{h^2} = \dfrac{2.0^2 \times .15 \times .85}{.04^2} = 319.$

Therefore, minimum sample size is 319 samples.

10.32 $n = \left(\dfrac{Z}{h}\right)^2 p(1-p) = \left(\dfrac{2.33}{0.05}\right)^2 (0.2)(0.8) = 347.45 = 348$ (rounded up)

10.33

(a) Standard time in minutes per chair = 480 minutes per day/ 130 chairs

= 3.69 minutes

(b) Total allowances = 18% (6 + 6 + 6 = 18)
Normal time = Standard time × (1 − Allowance time)
Therefore:
3.69 × (1 − .18) = 3.69 × .82 = 3.026 minutes = Normal time

10.34 858 + 220 + 85 = 1,163

$$\% \text{ spent working} = \frac{858}{1{,}163} = 0.738 = 73.8\%$$

10.35 (a) $\dfrac{250}{300} = .833 = 83.3\%$

(b) $n = \dfrac{Z^2 p(1-p)}{h^2}$

= (at 95% confidence level and 3% acceptable error)

$$n = \frac{(1.96)^2(0.167)(0.833)}{(0.03)^2}$$

$$= \frac{(3.84)(0.167)(0.833)}{0.0009} = 593.7 \cong 594$$

(c) The sample size was only about half the desired size.

10.36

	Motion	TMU's
1	Reach 4 inches for the pencil	6
2	Grasp pencil	2
3	Move pencil 6 inches	10
4	Position the pencil	20
5	Insert the pencil into the sharpener	4
6	Sharpen the pencil	120
7	Disengage the pencil	10
8	Move the pencil 6 inches	10
		182

Given that 1 TMU = 0.0006 minutes: Time = 182 × 0.0006 = 0.1092 minutes (6.55 seconds)

10.37 Tell the supervisor that delay was over 8% and the sample size was adequate (for a 95% confidence and 3% acceptable error):

Delay:

$$\frac{105}{1200} = 0.0875 = 8.75\%$$

Sample size:

$$n = \frac{(1.96)^2(0.0875)(1-0.0875)}{(0.03)^2}$$

$$= \frac{(3.84)(0.0875)(0.9125)}{0.0009} = 341$$

10.38

(a) Minutes available per day = 6 hours − 2 hours
= 4 × 60 min. = 240 min.

(b) Minutes of room cleaning required
200 room @ 30 min. each = 6,000 minutes
200 room @ 15 min. each = 3,000 minutes
Total of 9,000 minutes = 150 hours

(c) Each employee can clean 8 rooms (4 hr/.5 hr = 8)
Each employee can refresh 16 rooms
(4 hr/.25 hr = 16)

$$\text{Total housekeepers needed today} = \frac{9{,}000 \text{ min.}}{240 \text{ min.}} = 37.5 \approx 38$$

(d) 400 room @ .5 hr each = 200 hr
200/4 = 50 employees required to thoroughly clean all 400 rooms.

ADDITIONAL HOMEWORK PROBLEMS

Here are solutions to additional homework problems that appear on our Web site www.myomlab.com.

10.39

$$\text{Avg observed cycle time} = \frac{8.4 + 8.6 + 8.3 + 8.5 + 8.7 + 8.5}{6} = 8.5 \text{ seconds}$$

10.40 (a) Normal time = 10 minutes × 1.10 = 11 minutes

(b)
$$\text{Allowance fraction} = \frac{\text{Personal + Fatigue + Extra}}{60 \text{ minutes}} = \frac{5+3+2}{60} = \frac{10}{60} = 0.167$$

$$\text{Standard time} = \frac{\text{Normal time}}{1 - \text{Allowance fraction}} = \frac{11}{1-0.167} = 13.2 \text{ minutes}$$

Element	Rating	Observations (minutes per cycle) 1	2	3	4	5	Average Time	Normal Time
1	100%	1.5	1.6	1.4	0.1*	1.5	1.5	1.50
2	90%	2.3	2.5	2.1	2.2	2.4	2.3	2.07
3	120%	1.7	1.9	1.9	1.4	1.6	1.7	2.04
4	100%	3.5	3.6	3.6	3.6	3.2	3.5	3.50

10.41

*Disregard—possible error

$$ST = \frac{1.5 + 2.07 + 2.04 + 3.5}{1 - .10} = 10.122 \text{ minutes}$$

10.42 *Measurement data:*

Element	Observations (seconds/cycle) 1	2	3	4	5	6	Performance Rating
1	13.0	11.0	14.0	16.0	51.0*	15.0	100%
2	3.0*	21.0	25.0	73.0*	26.0	23.0	110%
3	3.0	3.3	3.1	2.9	3.4	2.8	100%

*Disregard—may be unusual observations—check to see if times are legitimate.

Calculating average observed cycle time:

$$\text{Element 1} = \frac{13+11+14+16+15}{5} = \frac{69}{5} = 13.8 \text{ seconds}$$

$$\text{Element 2} = \frac{21+25+26+23}{4} = \frac{95}{4} = 23.75 \text{ seconds}$$

$$\text{Element 3} = \frac{3.0+3.3+3.1+2.9+3.4+2.8}{6} = \frac{18.5}{6} = 3.08 \text{ seconds}$$

Calculating normal time for each task element:

Normal time = Observed cycle time × Performance rating

Element 1 = 13.80 × 1.00 = 13.8 seconds

Element 2 = 23.75 × 1.10 = 26.125 seconds

Element 3 = 3.08 × 1.00 = 3.08 seconds

Normal time for the process:

Normal time for process = sum of normal times for elements = 13.8 + 26.125 + 3.08 = 43.0 seconds

Standard time for process:

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance fraction}} = \frac{43}{1-0.15} = 50.6 \text{ seconds}$$

10.43 *Measurement data:*

Element	Performance Rating	Observations (seconds/cycle) 1	2	3	4	5	6	7
1	90%	1.80	1.70	1.66	1.91	1.85	1.77	1.60
2	100%	6.90	7.30	6.80	7.10	15.30*	7.00	6.40
3	115%	3.00	9.00*	9.50*	3.80	2.90	3.10	3.20
4	90%	10.10	11.10	12.30	9.90	12.00	11.90	12.00

*Disregard—unusual observation (reevaluate prior to including)

Calculating average observed cycle time:

$$\text{Element 1} = \frac{1.80 + 1.70 + 1.66 + 1.91 + 1.85 + 1.77 + 1.60}{7} = \frac{12.29}{7} = 1.76 \text{ minutes}$$

$$\text{Element 2} = \frac{6.9 + 7.3 + 6.8 + 7.1 + 7.0 + 6.4}{6} = \frac{41.5}{6} = 6.92 \text{ minutes}$$

$$\text{Element 3} = \frac{3.0 + 3.8 + 2.9 + 3.1 + 3.2}{5} = \frac{16}{5} = 3.2 \text{ minutes}$$

$$\text{Element 4} = \frac{10.1 + 11.1 + 12.3 + 9.9 + 12.0 + 11.9 + 12.0}{7} = \frac{79.3}{7} = 11.33 \text{ minutes}$$

Calculating normal time for each task element:

Normal time = Observed cycle time × Performance rating

Element 1 = 1.76 × 0.90 = 1.58 minutes

Element 2 = 6.92 × 1.00 = 6.92 minutes

Element 3 = 3.20 × 1.15 = 3.68 minutes

Element 4 = 11.33 × 0.90 = 10.20 minutes

Normal time for the process:

Normal time for process = sum of normal times for elements

= 1.58 + 6.92 + 3.68 + 10.20

= 22.37 minutes

Standard time for process:

$$\text{Standard time for process} = \frac{\text{Normal time for process}}{1 - \text{Allowance fraction}} = \frac{22.37}{1 - 0.25} = 29.8 \text{ minutes}$$

10.44

$$n = \left(\frac{ZS}{h\bar{X}}\right)^2 = \left(\frac{(3.0)(1.25)}{(0.05)(5)}\right)^2$$

= 225. Sample size of 225 is required.

10.45

$\bar{X}$ = Average task time = 1.5 minutes

S = Standard deviation of the cycle = 0.0707

$$n = \left(\frac{ZS}{h\bar{X}}\right)^2 = \left(\frac{(2.58)(0.0707)}{(0.05)(1.5)}\right)^2 = \left(\frac{0.1824}{0.075}\right)^2$$

= 5.9 ≈ 6 observations are required.

10.46

$$n = \left(\frac{ZS}{h\bar{X}}\right)^2; \; s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$$

$$s = \sqrt{\frac{(2.2-2.4)^2 + (2.6-2.4)^2 + (2.3-2.4)^2 + (2.5-2.4)^2 + (2.4-2.4)^2}{5-1}}$$

$$= \sqrt{\frac{0.04 + 0.04 + 0.01 + 0.01 + 0}{4}} = 0.158$$

$z_{95.45} = 2, \; \bar{x} = 2.4, \; h = 0.10$

10% accuracy:

$$n = \left(\frac{2(0.158)}{0.10(2.4)}\right)^2 = 1.734 \rightarrow 2 \text{ observations}$$

5% accuracy:

$$n = \left(\frac{2(0.158)}{0.05(2.4)}\right)^2 = 6.9 \rightarrow 7 \text{ observations}$$

CASE STUDY

JACKSON MANUFACTURING CO.

1. Actual observed cycle times

x	$\bar{x}$	$x - \bar{x}$	$(x - \bar{x})^2$
2.05	1.90	0.1488	0.0221
1.92	1.90	0.0188	0.0004
2.01	1.90	0.1088	0.0118
1.89	1.90	–0.0112	0.0001
1.77	1.90	–0.1312	0.0172
1.80	1.90	–0.1012	0.0102
1.86	1.90	–0.0412	0.0017
1.83	1.90	–0.0712	0.0051
1.93	1.90	0.0288	0.0008
1.96	1.90	0.0588	0.0035
1.95	1.90	0.0488	0.0024
2.05	1.90	0.1488	0.0221
1.79	1.90	–0.1112	0.0124
1.82	1.90	–0.0812	0.0066
1.85	1.90	–0.0512	0.0026
1.85	1.90	–0.0512	0.0026
1.99	1.90	0.0888	0.0079

$\bar{x} = 1.90$ $\quad$ $0.1296 = \Sigma(x - \bar{x})^2$

$h = 0.05, n = 17, z = 3$

$$\text{Std. dev.} = 0.0899 = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}} = \sqrt{\frac{0.1296}{16}}$$

$$\text{Sample size required} = \left(\frac{zs}{h\bar{x}}\right)^2 = \left(\frac{3 \times 0.0899}{.05 \times 1.9}\right)^2 = 8.07 \approx 9$$

This can be rounded up to 9 for statistical accuracy.

2. A sample size of 17 is more than adequate, given the low variation in cycle times; indeed, a sample size of 8 or 9 would be adequate.

3. Available time = 7.5 × 60 = 450 minutes

Observed cycle time = 1.90; normal time = 1.90 × 1.15 = 2.185

$$\text{Std. time} = \frac{2.185}{1-.16} = \frac{2.185}{.84} = 2.60 \text{ minutes}$$

$$\text{Number of units processed} = \frac{450}{2.60} = 173.10 \approx 173$$

4. $100 = ($12.50 × 8.0) = total cost per day

$$\text{So,} \quad \frac{\$100}{173} = \$.578 \text{ per unit}$$

VIDEO CASE STUDY

HARD ROCK'S HUMAN RESOURCE STRATEGY

There is an 8-minute video, available from Prentice Hall, filmed specifically for this text that can be shown at this time.

1. Hard Rock has lower employee turnover than the industry due to its
   - thorough screening at hiring
   - tolerant, even accepting culture of diversity
   - great benefit package
   - effective indoctrination and training, empowerment
   - focus on team work and even outside volunteer work.

2. The human resource department supports the overall theme restaurant strategy (the experience economy concept) by aggressive screening, including an evaluation of how the employee will contribute to the Hard Rock experience. The human resource department at Hard Rock recognizes that they are responsible for a critical element in Hard Rock's strategy. So they must recruit and retain the human capital that is necessary to fulfill that mission and strategy.

3. An automobile assembly line probably allows less opportunity for creativity and individual expression than a waiter or waitress at Hard Rock, although both organizations can probably put motivated well-trained personnel to good use.

4. The job design literature is rich with many improvements that can be made in the traditional assembly line. The Hackman and Oldham core job characteristics can, with a little imagination, be applied to the assembly line. Job rotation can aid *Skill Variety*; helping employees see the fruits of their labor in the finished product will help with *Job Identity* and *Job Significance*; providing opportunity for self-direction by adding planning and control tasks to the job can contribute to *Autonomy*; and *Supervisory Feedback* is easy for the tuned-in supervisor. All these are further augmented by *job enlargement, job enrichment*, Maslow's *self-actualization,* and Hertzberg's motivators, such as *responsibility, the work itself, recognition, advancement,* and *achievement.* And, of course, the hygiene factors of *security, status, working conditions, pay, interpersonal relations, supervision,* and *company policy and administration* can all play a positive role in the quality of life on the job/assembly line. Note: Maslow's hierarchy and Hertzberg's dual factors are not discussed in the chapter.

ADDITIONAL CASE STUDIES

1 CHICAGO SOUTHERN HOSPITAL

1. Sampling Plan:
   - Do studies on all shifts (probably four shifts; three each day plus the weekend shift) to get data on workload differences by shift. Then cross-check with other studies by function (intensive care, maternity, postoperation, etc.). If identifiable differences are present, then judgments will need to be made about additional studies.
   - It may well be that major differences exist, suggesting that more extensive studies be made.
   - Generate a random sample of which nurse to sample when using a true random device, such as the random number table provided in the text in Appendix III.
   - Perform an adequate number of samples (per question 2).

2. $$\text{Sample size} = n = \frac{Z^2 \times p(1-p)}{h^2} = \frac{(1.96)^2 \times (0.15)(0.85)}{(0.04)^2}$$

$$= \frac{3.84 \times 0.1275}{0.0016} = \frac{0.49}{0.0016} = 306.13 \Rightarrow 306$$

Note: The sample size will change if the 15% vs. 85% is not close to accurate. This difference may suggest that a larger sample be taken.

3. By structuring the study across different nurses, different shifts, and different hospital processes (areas/functions), there should be an adequately diverse cross section. Some postsample check to ensure a mix of nurses, shifts, and functions should be made.

2 KARSTADT vs JCPENNEY

The case examines the differences in work ethic between a German department store employee and an American department store employee.

Key Points

- Andreas Drauschke and Angie Clark hold positions at similar levels in department stores, and receive similar pay. However, Drauschke, who works in Germany, works far fewer hours than Clark, who works in the U.S.
- In fact, Drauschke works just 37 hours a week, and receives six weeks vacation each year, while Clark works at least 44 hours a week, and takes off only a week at a time. Clark notes that Germans see leisure time as being more important than work time.
- The difference between the German work style and the American work style extends in to other areas. For example, turnover at the German store is all but nonexistent, while at the American store it is 40 percent a year. In addition, German employees receive extensive training, while workers at the American store receive minimal instruction.
- Many employees at the American store also have a second job, however Drauschke values his free time, and works no longer than absolutely necessary. His view point is shared by other Germans who fiercely protested the recent mandate that department stores would stay open one evening each week. Germany also prohibits working second jobs during vacation time.

* These cases can be found on our Companion Web site, www.pearsonhighered.com/heizer.

1. *How does the work culture in the United States differ from that in Germany?*
Human resource management (HRM) refers to the activities directed at attracting, developing, and maintaining an effective workforce to achieve an organization's objectives. Students will probably conclude that at least in the retailing industry, American HR managers spend less time both in recruiting and selecting managers, and preparing them for their jobs than their German counterparts. As a result, turnover is very high in the U.S. as compared to Germany. While the case does not provide information regarding how employees in either country are evaluated, the total compensation package received by Germans seems to be preferable to that which American workers receive.
2. *What do you see as the basic advantages and disadvantages of each system?*
Most students will probably suggest that the extensive effort that appears to go into selecting and training German workers is a clear advantage of the German system. Students taking this perspective are likely to support their contention by pointing to the high turnover rate in the U.S. as compared to Germany. Many students may see the restriction faced by German workers regarding second jobs as being an intrusion in an individual's private life, and therefore see it as a disadvantage. Finally, most students will probably agree that the compensation package received by German workers is far more likely to improve employee morale than the package received by American workers.
3. *If you were the top operations executive for an international department store chain with stores in both Germany and the United States, what basic issues would you need to address regarding corporate human resource policies?*
A primary issue that would have to be addressed is the difference in compensation packages between the U.S. and Germany. German workers have shorter work weeks and far more vacation time than their American counterparts, yet receive similar pay. A second issue that would have to be addressed is the difference in worker training and development. German department stores may spend two or three years preparing employees, while American stores might spend just two or three days. Furthermore, recruiting and selection issues would have to be addressed, not only because German employees frequently complete an apprentice program prior to becoming full-time employees, and thus require very careful selection, but also because turnover is much higher in the U.S. than in Germany.
4. *Are retailing employee issues different than other industries?*
Most students will probably suggest that the issues outlined in question 3 above are probably important in all industries. One area that might be different is the issue of turnover. While turnover is very high in U.S. retailing, it is likely to be less of a problem in industries where workers receive extensive training and/or belong to unions.
5. *Under which system would you prefer to work?*
Most students will probably suggest that the German work system is preferable than the American work system. Students taking this perspective will probably point out that American workers frequently appear to be stressed out on the job and do not have enough time with family. Other students, however, might object to some of the constraints of the German system, such as the prohibition of second jobs during vacation time. Students taking this perspective are likely to suggest that there should be no limits to working as hard as possible in order to get ahead.

Additional Case Application

Case question 3 asks students to identify issues that would be faced by an American operations manager who worked for an international department store chain with branches in both the U.S. and Germany. Students can carry this exercise one step further by holding a round table discussion reading compensation packages. Each student can be assigned to take on the role of either the American executive, a German worker, or an American worker.

Source: R.W. Griffin and M.W. Pustay, *International Business* 2nd ed. (Reading, MA, Addison-Wesley), 1999. Solution appears on page 347–349 of *Instructor's Manual* by V. Horton and S.K. Sokoya.

3 THE FLEET THAT WANDERS

Can you imagine an analytical approach to documenting the problems reported by drivers?

We often use this case to explain that not all problems of this nature are behavioral. Indeed, this is a true case designed to show students that, based on what is known about human factors, the situation can be studied analytically. The design methodology for documenting Mr. Southard's case was to put monitors on the truck drivers to provide a record of their cardiovascular activity. Most of the drivers were doing day drives, that is, going and returning on the same day, thus the design called for monitoring a number of trips by each driver over the same routes using both the new and old trucks. In this way, comparisons could be made between the work required to drive each truck as shown on the records from each driver. Additionally, the steering wheel on each truck was fitted with sensors to record the amount of motion required to control each kind of truck. The hypothesis was that the truck that required more work would also require greater steering wheel movement. The measure of steering wheel movement was used as evidence to validate the work implied by the record of cardiovascular activity.

There were, of course, some difficulties with this design. It was expensive to outfit the trucks and drivers with the monitoring devices. The cooperation of the drivers was needed because the use of the monitors constituted an invasion of privacy. In addition, on longer trips, the cardiovascular sensors needed to be removed before, and reattached after, every break or delivery stop.

Note: This can make for an excellent classroom exercise and discussion.