Human Resources, Job Design, and Work Measurement

CHAPTER 10

CHAPTER OUTLINE

GLOBAL COMPANY PROFILE: *Rusty Wallace's NASCAR Racing Team*

Alaska Airlines

Alaska Airlines

10 OM STRATEGY DECISIONS

- Design of Goods and Services
- Managing Quality
- Process Strategy
- Location Strategies
- Layout Strategies
- *Human Resources*
- Supply-Chain Management
- Inventory Management
- Scheduling
- Maintenance

CHAPTER 10

GLOBAL COMPANY PROFILE
Rusty Wallace's NASCAR Racing Team

High-Performance Teamwork Makes the Difference Between Winning and Losing

A new century brought new popularity to NASCAR (National Association for Stock Car Auto Racing). Hundreds of millions of TV and sponsorship dollars poured into the sport. With more money, competition increased, as did the rewards for winning on Sunday. The teams, headed by such names as Rusty Wallace, Jeff Gordon, Dale Earnhardt, Jr., and Tony Stewart, are as famous as the New York Yankees, Atlanta Hawks, or Chicago Bears.

Courtesy of the Orlando Sentinel, 2005

This Goodyear tire comes off Rusty Wallace's car and is no longer needed after going around the track for more than 40 laps in a June 19 Michigan International Speedway race.

The race car drivers may be famous, but it's the pit crews who often determine the outcome of a race. Years ago, crews were auto mechanics during the week who simply did double duty on Sundays in the pits. They did pretty well to change four tires in less than 30 seconds. Today, because NASCAR teams find competitive advantage wherever they can, taking more than 16 seconds can be disastrous. A botched pit stop is the equivalent of ramming your car against the wall—crushing all hopes for the day.

On Rusty Wallace's team, as on all the top NASCAR squads, the crewmen who go "over the wall" are now athletes, usually ex-college football or basketball players with proven agility and strength. The Evernham team, for example, includes a former defensive back from Fairleigh Dickinson (who is now a professional tire carrier) and a 300-pound lineman from East Carolina University (who handles the jack). The Chip Ganassi racing team includes baseball players from Wake Forest, football players from University of Kentucky and North Carolina, and a hockey player from Dartmouth.

Tire changers—the guys who wrench lug nuts off and on—are a scarce human resource and average $100,000 a year in salary. Jeff Gordon was reminded of the importance of coordinated

Courtesy of the Orlando Sentinel, 2005

Jamie Rolewicz takes tires from a pile of used tires and puts them onto a cart.

Courtesy of the Orlando Sentinel, 2005

Lap 91—Gas is added and a tire is removed from Rusty Wallace's car.

LEARNING OBJECTIVES

Human Resource Strategy for Competitive Advantage

VIDEO 10.1
The "People" Focus: Human Resources at Alaska Airlines

Good human resource strategies are expensive, difficult to achieve, and hard to sustain. But, like a NASCAR team, many organizations, from Hard Rock Cafe to Alaska Airlines, have demonstrated that sustainable competitive advantage can be built through a human resource strategy. The payoff can be significant and difficult for others to duplicate. Indeed, as the manager at London Four Seasons Hotel has noted, "We've identified that our key *competitive difference is our people*."[1] In this chapter, we will examine some of the tools available to operations managers for achieving competitive advantage via human resource management.

The objective of a human resource strategy is to manage labor and design jobs so people are effectively and efficiently utilized. As we focus on a human resource strategy, we want to ensure that people:

VIDEO 10.2
Human Resources at Hard Rock Cafe

1. Are efficiently utilized within the constraints of other operations management decisions.
2. Have a reasonable quality of work life in an atmosphere of mutual commitment and trust.

By reasonable *quality of work life* we mean a job that is not only reasonably safe and for which the pay is equitable but that also achieves an appropriate level of both physical and psychological requirements. *Mutual commitment* means that both management and employee strive to meet common objectives. *Mutual trust* is reflected in reasonable, documented employment policies that are honestly and equitably implemented to the satisfaction of both management and employee. When management has a genuine respect for its employees and their contributions to the firm, establishing a reasonable quality of work life and mutual trust is not particularly difficult.

Constraints on Human Resource Strategy

STUDENT TIP
An operations manager knows how to build an effective human resource strategy.

As Figure 10.1 suggests, many decisions made about people are constrained by other decisions. First, the product mix may determine seasonality and stability of employment. Second, technology, equipment, and processes may have implications for safety and job content. Third, the location decision may have an impact on the ambient environment in which the employees work. Finally, layout decisions, such as assembly line versus work cell, influence job content.

Technology decisions impose substantial constraints. For instance, some of the jobs in foundries are dirty, noisy, and dangerous; slaughterhouse jobs may be stressful and subject workers to stomach-crunching stench; assembly-line jobs are often boring and mind numbing; and high capital investments such as those required for manufacturing semiconductor chips may require 24-hour, 7-day-a-week operation in restrictive clothing.

We are not going to change these jobs without making changes in our other strategic decisions, so the trade-offs necessary to reach a tolerable quality of work life are difficult. Effective managers consider such decisions simultaneously. The result: a system in which both individual and team performance are enhanced through optimum job design.

We now look at three distinct decision areas of human resource strategy: *labor planning*, *job design*, and *labor standards*.

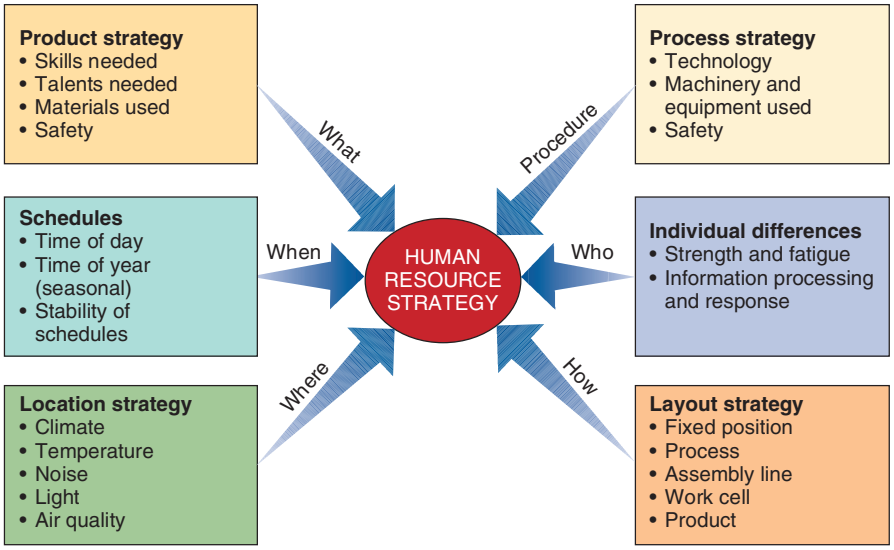


Figure 10.1
Constraints on Human Resource Strategy

Labor Planning

Labor planning is determining staffing policies that deal with (1) employment stability, (2) work schedules, and (3) work rules.

Labor planning
A means of determining staffing policies dealing with employment stability, work schedules, and work rules.

Employment-Stability Policies

Employment stability deals with the number of employees maintained by an organization at any given time. There are two very basic policies for dealing with stability:

1. *Follow demand exactly:* Following demand exactly keeps direct labor costs tied to production but incurs other costs. These other costs include (a) hiring and layoff costs, (b) unemployment insurance, and (c) premium wages to entice personnel to accept unstable employment. This policy tends to treat labor as a variable cost.
2. *Hold employment constant:* Holding employment levels constant maintains a trained workforce and keeps hiring, layoff, and unemployment costs to a minimum. However, with employment held constant, employees may not be utilized fully when demand is low, and the firm may not have the human resources it needs when demand is high. This policy tends to treat labor as a fixed cost.

These policies are only two of many that can be efficient *and* provide a reasonable quality of work life. Firms must determine policies about employment stability.

LO 10.1 *Describe* labor-planning policies

Work Schedules

Although the standard work schedule in the U.S. is still five 8-hour days, many variations exist. A popular variation is a work schedule called flextime. *Flextime* allows employees, within limits, to determine their own schedules. A flextime policy might allow an employee (with proper notification) to be at work at 8 A.M. plus or minus 2 hours. This policy allows more autonomy and independence on the part of the employee. Some firms have found flextime a low-cost fringe benefit that enhances job satisfaction. The problem from the OM perspective is that much production work requires full staffing for efficient operations. A machine that requires three people cannot run at all if only two show up. Having a waiter show up to serve lunch at 1:30 P.M. rather than 11:30 A.M. is not much help either.

Similarly, some industries find that their process strategies severely constrain their human resource scheduling options. For instance, paper manufacturing, petroleum refining, and power stations require around-the-clock staffing except for maintenance and repair shutdown.

Another option is the *flexible workweek*. This plan often calls for fewer but longer days, such as four 10-hour days or, as in the case of light-assembly plants, 12-hour shifts. Working 12-hour shifts usually means working 3 days one week and 4 the next. Such shifts are sometimes called *compressed workweeks*. These schedules are viable for many operations functions—as long as suppliers and customers can be accommodated.

Another option is shorter days rather than longer days. This plan often moves employees to *part-time status*. Such an option is particularly attractive in service industries, where staffing for peak loads is necessary. Banks and restaurants often hire part-time workers. Also, many firms reduce labor costs by reducing fringe benefits for part-time employees.

Job Classifications and Work Rules

Many organizations have strict job classifications and work rules that specify who can do what, when they can do it, and under what conditions they can do it, often as a result of union pressure. These job classifications and work rules restrict employee flexibility on the job, which in turn reduces the flexibility of the operations function. Yet part of an operations manager's task is to manage the unexpected. Therefore, the more flexibility a firm has when staffing and establishing work schedules, the more efficient and responsive it *can* be. This is particularly true in service organizations, where extra capacity often resides in extra or flexible staff. Building morale and meeting staffing requirements that result in an efficient, responsive operation are easier if managers have fewer job classifications and work-rule constraints. If the strategy is to achieve a competitive advantage by responding rapidly to the customer, a flexible workforce may be a prerequisite.

Job Design

Job design
An approach that specifies the tasks that constitute a job for an individual or a group.

Job design specifies the tasks that constitute a job for an individual or a group. We examine five components of job design: (1) job specialization, (2) job expansion, (3) psychological components, (4) self-directed teams, and (5) motivation and incentive systems.

Labor Specialization

Labor specialization (or job specialization)
The division of labor into unique ("special") tasks.

The importance of job design as a management variable is credited to the 18th-century economist Adam Smith. Smith suggested that a division of labor, also known as **labor specialization** (or job specialization), would assist in reducing labor costs of multiskilled artisans. This is accomplished in several ways:

1. *Development of dexterity* and faster learning by the employee because of repetition
2. *Less loss of time* because the employee would not be changing jobs or tools
3. *Development of specialized tools* and the reduction of investment because each employee has only a few tools needed for a particular task

LO 10.2 *Identify* the major issues in job design

The 19th-century British mathematician Charles Babbage determined that a fourth consideration was also important for labor efficiency. Because pay tends to follow skill with a rather high correlation, Babbage suggested *paying exactly the wage needed for the particular skill required*. If the entire job consists of only one skill, then we would pay for only that skill. Otherwise, we would tend to pay for the highest skill contributed by the employee. These four advantages of labor specialization are still valid today.

A classic example of labor specialization is the assembly line. Such a system is often very efficient, although it may require employees to do short, repetitive, mind-numbing jobs. The wage rate for many of these jobs, however, is good. Given the relatively high wage rate for the modest skills required in many of these jobs, there is often a large pool of employees from which to choose.

From the manager's point of view, a major limitation of specialized jobs is their failure to bring the whole person to the job. Job specialization tends to bring only the employee's manual skills to work. In an increasingly sophisticated knowledge-based society, managers want employees to bring their mind to work as well.

OM in Action Using Incentives to Unsnarl Traffic Jams in the OR

Hospitals have long offered surgeons a precious perk: scheduling the bulk of their elective surgeries in the middle of the week so they can attend conferences, teach, or relax during long weekends. But at Boston Medical Center, St. John's Health Center (in Missouri), and Elliot Health System (in New Hampshire), this practice, one of the biggest impediments to a smooth-running hospital, is changing. "Block scheduling" jams up operating rooms, overloads nurses at peak times, and bumps scheduled patients for hours and even days.

Boston Medical Center's delays and cancellations of elective surgeries were nearly eliminated after surgeons agreed to stop block scheduling and to dedicate one OR for emergency cases. Cancellations dropped to 3, from 334, in just one 6-month period. In general, hospitals changing to the new system of spreading out elective surgeries during the week increase their surgery capacity by 10%, move patients through the operating room faster, and reduce nursing overtime.

Robert Daly/OJO Images Ltd/Alamy

To get doctors on board at St. John's, the hospital offered a carrot and two sticks: Doctors who were more than 10 minutes late 10% of the time lost their coveted 7:30 A.M. start times *and* were fined a portion of their fee—with proceeds going to a kitty that rewarded the best on-time performers. Surgeons' late start times quickly dropped from 16% to 5% and then to less than 1% within a year.

Sources: Executive Insight (October 4, 2011); *The Wall Street Journal* (August 10, 2005); and *Hospitals & Health Networks* (September 2005).

Motivation and Incentive Systems

Our discussion of the psychological components of job design provides insight into the factors that contribute to job satisfaction and motivation. In addition to these psychological factors, there are monetary factors. Money often serves as a psychological as well as financial motivator. Monetary rewards take the form of bonuses, profit and gain sharing, and incentive systems.

Bonuses, in cash, stock ownership, or stock options, are often used to reward employees. Almost half of U.S. employees have one or more forms of profit sharing that distributes part of the profit to employees. A variation of profit sharing is gain sharing, which rewards employees for improvements made in an organization's performance. The most popular of these is the Scanlon plan, in which any reduction in the cost of labor is shared between management and labor.

Incentive systems based on individual or group productivity are used throughout the world in a wide variety of applications, including nearly half of the manufacturing firms in America. Production incentives often require employees or crews to produce at or above a predetermined standard. The standard can be based on a "standard time" per task or number of pieces made. Both systems typically guarantee the employee at least a base rate. Incentives, of course, need not be monetary. Awards, recognition, and other kinds of preferences such as a preferred work schedule can be effective. (See the *OM in Action* box "Using Incentives to Unsnarl Traffic Jams in the OR.") Hard Rock Cafe has successfully reduced its turnover by giving every employee—from the CEO to the busboys—a $10,000 gold Rolex watch on their 10th anniversary with the firm.

With the increasing use of teams, various forms of team-based pay are also being developed. Many are based on traditional pay systems supplemented with some form of bonus or incentive system. However, because many team environments require cross training, *knowledge-based* pay systems have also been developed. Under knowledge-based (or skill-based) pay systems, a portion of the employee's pay depends on demonstrated knowledge or skills. At Wisconsin's Johnsonville Sausage Co., employees receive pay raises *only* by mastering new skills such as scheduling, budgeting, and quality control.

Ergonomics and the Work Environment

With the foundation provided by Frederick W. Taylor, the father of the era of scientific management, we have developed a body of knowledge about people's capabilities and limitations. This knowledge is necessary because humans are hand/eye animals possessing exceptional capabilities and some limitations. Because managers must design jobs that can be done, we now introduce a few of the issues related to people's capabilities and limitations.

Ergonomics The operations manager is interested in building a good interface between humans, the environment, and machines. Studies of this interface are known as **ergonomics**. Ergonomics means "the study of work." (*Ergon* is the Greek word for "work.") The term

Ergonomics
The study of the human interface with the environment and machines.

Inacio Pires/Shutterstock

Drivers of race cars have no time to grasp for controls or to look for small hidden gauges. Controls and instrumentation for modern race cars have migrated to the steering wheel itself—the critical interface between man and machine.

keyboard is poorly designed. The photo of the race car steering wheel above shows one innovative approach to critical operator input.

Feedback to Operators Feedback to operators is provided by sight, sound, and feel; it should not be left to chance. The mishap at the Three Mile Island nuclear facility, America's worst nuclear experience, was in large part the result of poor feedback to the operators about reactor performance. Nonfunctional groups of large, unclear instruments and inaccessible controls, combined with hundreds of confusing warning lights, contributed to that failure. Such relatively simple issues make a difference in operator response and, therefore, performance.

An important human factor/ergonomic issue in the aircraft industry is cockpit design. Newer "glass cockpits" display information in more concise form than the traditional rows of round analog dials and gauges. These displays reduce the chance of human error, which is a factor in about two-thirds of commercial air accidents.

The Work Environment The physical environment in which employees work affects their performance, safety, and quality of work life. Illumination, noise and vibration, temperature, humidity, and air quality are work-environment factors under the control of the organization and the operations manager. The manager must approach them as controllable.

Illumination is necessary, but the proper level depends on the work being performed. Figure 10.4(a) provides some guidelines. However, other lighting factors are important. These include reflective ability, contrast of the work surface with surroundings, glare, and shadows.

Noise of some form is usually present in the work area, and most employees seem to adjust well. However, high levels of sound will damage hearing. Figure 10.4(b) provides indications of the sound generated by various activities. Extended periods of exposure to decibel levels above 85 dB are permanently damaging. The Occupational Safety and Health Administration (OSHA) requires ear protection above this level if exposure equals or exceeds eight hours. Even at low levels, noise and vibration can be distracting and can raise a person's blood pressure, so managers make substantial effort to reduce noise and vibration through good machine design, enclosures, or insulation.

Temperature and humidity parameters have also been well established. Managers with activities operating outside the established comfort zone should expect adverse effect on performance.

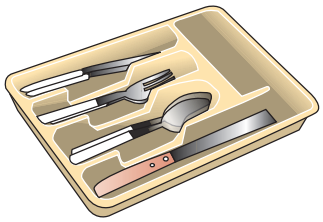
Methods Analysis

Methods analysis focuses on *how* a task is accomplished. Whether controlling a machine or making or assembling components, how a task is done makes a difference in performance, safety, and quality. Using knowledge from ergonomics and methods analysis, methods engineers are charged with ensuring that quality and quantity standards are achieved efficiently and safely. Methods analysis and related techniques are useful in office environments as well as in the factory. Methods techniques are used to analyze:

Methods analysis
A system that involves developing work procedures that are safe and produce quality products efficiently.

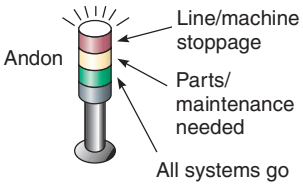
1. **Movement of individuals or material.** The analysis is performed using *flow diagrams* and *process charts* with varying amounts of detail.

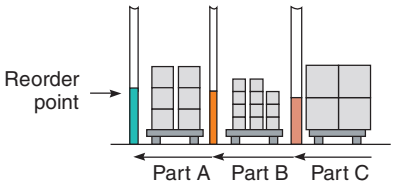
Visual utensil holder encourages housekeeping.



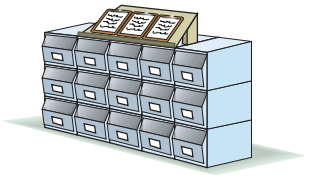
A "3-minute service" clock reminds employees of the goal.

Visual signals at the machine notify support personnel.

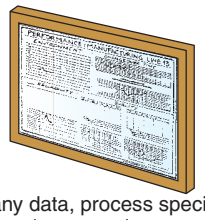




Visual kanbans reduce inventory and foster JIT.



Quantities in bins indicate ongoing daily requirements, and clipboards provide information on schedule changes.



Company data, process specifications, and operating procedures are posted in each work area.

Figure **10.8**

The Visual Workplace

The Visual Workplace

Visual workplace
Uses a variety of visual communication techniques to rapidly communicate information to stakeholders.

A **visual workplace** uses low-cost visual devices to share information quickly and accurately. Well-designed displays and graphs root out confusion and replace difficult-to-understand printouts and paperwork. Because workplace data change quickly and often, operations managers need to share accurate and up-to-date information. Changing customer requirements, specifications, schedules, and other details must be rapidly communicated to those who can make things happen.

The visual workplace can eliminate non-value-added activities by making standards, problems, and abnormalities visual (see Figure 10.8). The visual workplace needs less supervision because employees understand the standard, see the results, and know what to do.

Labor Standards

Labor standards
The amount of time required to perform a job or part of a job.

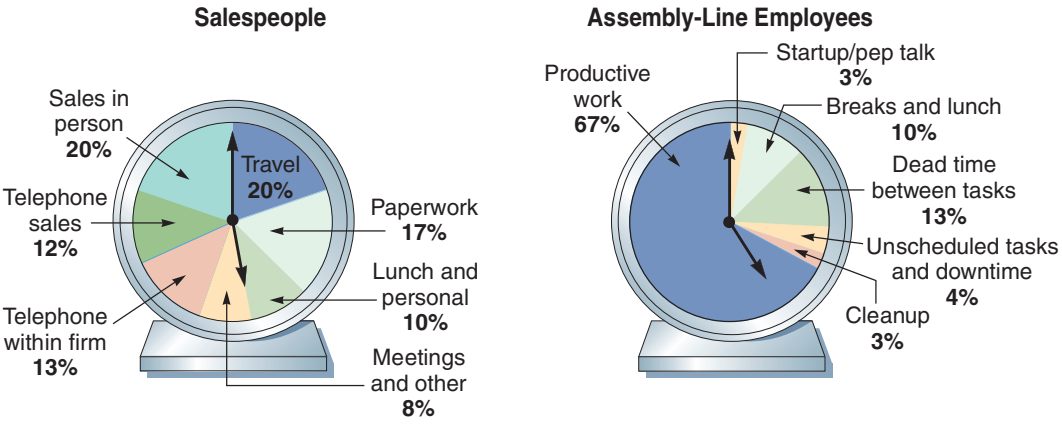
So far in this chapter, we have discussed labor planning and job design. The third requirement of an effective human resource strategy is the establishment of labor standards. **Labor standards** are the amount of time required to perform a job or part of a job, and they exist, formally or informally, for all jobs. Effective manpower planning is dependent on a knowledge of the labor required.

Modern labor standards originated with the works of Frederick W. Taylor and Frank and Lillian Gilbreth at the beginning of the 20th century. At that time, a large proportion of work was manual, and the resulting labor content of products was high. Little was known about what constituted a fair day's work, so managers initiated studies to improve work methods and understand human effort. These efforts continue to this day. Although labor costs are often less than 10% of sales, labor standards remain important and continue to play a major role in both service and manufacturing organizations. They are often a beginning point for determining staffing requirements. With over half of the manufacturing plants in America using some form of labor incentive system, good labor standards are a requirement.

Figure 10.10

Work-Sampling Time Studies

These two work-sampling time studies were done to determine what salespeople do at a wholesale electronics distributor (left) and a composite of several auto assembly-line employees (right).



STUDENT TIP

Mutual trust and commitment cannot be achieved without ethical behavior.

Ethics

Ethics in the workplace presents some interesting challenges. As we have suggested in this chapter, many constraints influence job design. The issues of fairness, equity, and ethics are pervasive. Whether the issue is equal opportunity or safe working conditions, an operations manager is often the one responsible. Managers do have some guidelines. By knowing the law, working with OSHA,[5] MSDS,[6] state agencies, unions, trade associations, insurers, and employees, managers can often determine the parameters of their decisions. Human resource and legal departments are also available for help and guidance through the labyrinth of laws and regulations.

Management's role is to educate employees; specify the necessary equipment, work rules, and work environment; and then enforce those requirements, even when employees think it is not necessary to wear safety equipment. We began this chapter with a discussion of mutual trust and commitment, and that is the environment that managers should foster. Ethical management requires no less.

Summary

Outstanding firms know that their human resource strategy can yield a competitive advantage. Often a large percentage of employees and a large part of labor costs are under the direction of OM. Consequently, an operations manager usually has a major role to play in achieving human resource objectives. A requirement is to build an environment with mutual respect and commitment and a reasonable quality of work life. Successful organizations have designed jobs that use both the mental and physical capabilities of their employees. Regardless of the strategy chosen, the skill with which a firm manages its human resources ultimately determines its success.

Labor standards are required for an efficient operations system. They are needed for production planning, labor planning, costing, and evaluating performance. They are used throughout industry—from the factory to finance, sales, and office. They can also be used as a basis for incentive systems. Standards may be established via historical data, time studies, predetermined time standards, and work sampling.

Key Terms

Labor planning (p. 411)
Job design (p. 412)
Labor specialization (or job specialization) (p. 412)
Job enlargement (p. 413)
Job rotation (p. 413)
Job enrichment (p. 413)
Employee empowerment (p. 413)
Self-directed team (p. 414)
Ergonomics (p. 415)
Methods analysis (p. 417)
Flow diagram (p. 418)
Process chart (p. 418)
Activity chart (p. 418)
Operations chart (p. 418)
Visual workplace (p. 420)
Labor standards (p. 420)
Time study (p. 421)
Average observed time (p. 422)
Normal time (p. 422)
Standard time (p. 422)
Predetermined time standards (p. 425)
Therbligs (p. 426)
Time measurement units (TMUs) (p. 426)
Work sampling (p. 427)

Ethical Dilemma

Johnstown Foundry, Inc., with several major plants, is one of the largest makers of cast-iron water and sewer pipes in the U.S. In one of the nation's most dangerous industries, Johnstown is perhaps one of the most unsafe, with four times the injury rate of its six competitors combined. Its worker death rate is six times the industry average. In a recent 7-year period, Johnstown's plants were also found to be in violation of pollution and emission limits 450 times.

Workers who protest dangerous work conditions claim they are "bull's-eyed"—marked for termination. Supervisors have bullied injured workers and intimidated union leaders. Line workers who fail to make daily quotas get disciplinary actions. Managers have put up safety signs *after* a worker was injured to make it appear that the worker ignored posted policies. They doctor safety records and alter machines to cover up hazards. When the government investigated one worker's death recently, inspectors found the Johnstown policy "was not to correct anything until OSHA found it."

Johnstown plants have also been repeatedly fined for failing to stop production to repair broken pollution controls. Three plants have been designated "high-priority" violators by the EPA. Inside the plants, workers have repeatedly complained of blurred vision, severe headaches, and respiratory problems after being exposed, without training or protection, to chemicals used in the production process. Near one Pennsylvania plant, school crossing guards have had to wear gas masks; that location alone has averaged over a violation every month for 7 years. Johnstown's "standard procedure," according to a former plant manager, is to illegally dump industrial contaminants into local rivers and creeks. Workers wait for night or heavy rainstorms before flushing thousands of gallons from their sump pumps.

Given the following scenarios, what is your position, and what action should you take?

a) On your spouse's recent move to the area, you accepted a job, perhaps somewhat naively, as a company nurse in one of the Johnstown plants. After 2 weeks on the job, you became aware of the work environment noted above.
b) You are a contractor who has traditionally used Johnstown's products, which meet specifications. Johnstown is consistently the low bidder. Your customers are happy with the product.
c) You are Johnstown's banker.
d) You are a supplier to Johnstown.

Mark Winfrey/Shutterstock

Discussion Questions

1. How would you define a good quality of work life?
2. What are some of the worst jobs you know about? Why are they bad jobs? Why do people want these jobs?
3. If you were redesigning the jobs described in Question 2, what changes would you make? Are your changes realistic? Would they improve productivity (not just *production* but *productivity*)?
4. Can you think of any jobs that push the man–machine interface to the limits of human capabilities?
5. What are the five core characteristics of a good job design?
6. What are the differences among job enrichment, job enlargement, job rotation, job specialization, and employee empowerment?
7. Define ergonomics. Discuss the role of ergonomics in job design.
8. List the techniques available for carrying out methods analysis.
9. Identify four ways in which labor standards are set.
10. What are some of the uses to which labor standards are put?
11. How would you classify the following job elements? Are they personal, fatigue, or delay?
    a) The operator stops to talk to you.
    b) The operator lights up a cigarette.
    c) The operator opens his lunch pail (it is not lunch time), removes an apple, and takes an occasional bite.
12. How do you classify the time for a drill press operator who is idle for a few minutes at the beginning of every job waiting for the setup person to complete the setup? Some of the setup time is used in going for stock, but the operator typically returns with stock before the setup person is finished with the setup.
13. How do you classify the time for a machine operator who, between every job and sometimes in the middle of jobs, turns off the machine and goes for stock?
14. The operator drops a part, which you pick up and hand to him. Does this make any difference in a time study? If so, how?

Solved Problems

Virtual Office Hours help is available in MyOMLab.

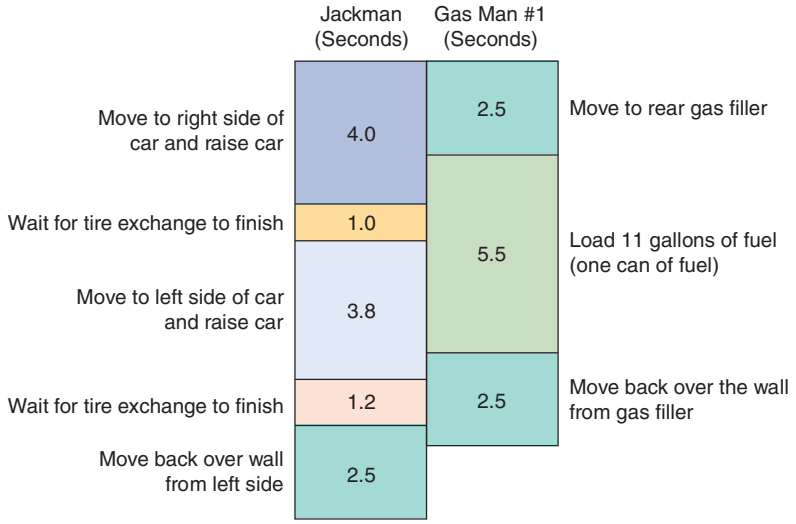
SOLVED PROBLEM 10.1

As pit crew manager for Rusty Wallace's NASCAR team (see the *Global Company Profile* that opens this chapter), you would like to evaluate how your "Jackman" (JM) and "Gas Man #1" (GM #1) are utilized. Recent stopwatch studies have verified the following times:

PIT CREW	ACTIVITY	TIME (SECONDS)
JM	Move to right side of car and raise car	4.0
GM #1	Move to rear gas filler	2.5
JM	Wait for tire	1.0
JM	Move to left side of car and raise car	3.8
GM #1	Load fuel (per gallon)	0.5
JM	Wait for tire	1.2
JM	Move back over wall from left side	2.5
GM #1	Move back over the wall from gas filler	2.5

Use an activity chart similar to the one in Figure 10.6 as an aid.

SOLUTION



SOLVED PROBLEM 10.2

A work operation consisting of three elements has been subjected to a stopwatch time study. The recorded observations are shown in the following table. By union contract, the allowance time for the operation is personal time 5%, delay 5%, and fatigue 10%. Determine the standard time for the work operation.

JOB ELEMENT	OBSERVATIONS (MINUTES)						PERFORMANCE RATING (%)
	1	2	3	4	5	6	
A	.1	.3	.2	.9	.2	.1	90
B	.8	.6	.8	.5	3.2	.7	110
C	.5	.5	.4	.5	.6	.5	80

SOLUTION

First, delete the two observations that appear to be very unusual (.9 minute for job element A and 3.2 minutes for job element B). Then:

$$\text{A's average observed time} = \frac{.1 + .3 + .2 + .2 + .1}{5} = 0.18 \text{ min}$$

$$\text{B's average observed time} = \frac{.8 + .6 + .8 + .5 + .7}{5} = 0.68 \text{ min}$$

$$\text{C's average observed time} = \frac{.5 + .5 + .4 + .5 + .6 + .5}{6} = 0.50 \text{ min}$$

$$\text{A's normal time} = (0.18)(0.90) = 0.16 \text{ min}$$

$$\text{B's normal time} = (0.68)(1.10) = 0.75 \text{ min}$$

$$\text{C's normal time} = (0.50)(0.80) = 0.40 \text{ min}$$

$$\text{Normal time for job} = 0.16 + 0.75 + 0.40 = 1.31 \text{ min}$$

$$\text{Note, the total allowance factor} = 0.05 + 0.05 + 0.10 = 0.20$$

$$\text{Then: Standard time} = \frac{1.31}{1 - 0.20} = 1.64 \text{ min}$$

Problems

Note: PX means the problem may be solved with POM for Windows and/or Excel.

Problem 10.1 relates to Job Design

• **10.1** Rate a job you have had using Hackman and Oldham's core job characteristics (see page 413) on a scale from 1 to 10. What is your total score? What about the job could have been changed to make you give it a higher score?

Problems 10.2–10.12 relate to Methods Analysis

• **10.2** Make a process chart for changing the right rear tire on an automobile.

• **10.3** Draw an activity chart for a machine operator with the following operation. The relevant times are as follows:

Prepare mill for loading (cleaning, oiling, and so on)	.50 min
Load mill	1.75 min
Mill operating (cutting material)	2.25 min
Unload mill	.75 min

••• **10.4** Draw an activity chart (a crew chart similar to Figure 10.6) for a concert (for example, Tim McGraw, Linkin Park, Lil' Wayne, or Bruce Springsteen) and determine how to put together the concert so the star has reasonable breaks. For instance, at what point is there an instrumental number, a visual effect, a duet, a dance moment, that allows the star to pause and rest physically or at least rest his or her voice? Do other members of the show have moments of pause or rest?

Fernando Medina

•• **10.5** Make an operations chart of one of the following:
a) Putting a new eraser in (or on) a pencil
b) Putting a paper clip on two pieces of paper
c) Putting paper in a printer

• **10.6** Develop a process chart for installing a new memory board in your personal computer.

•• **10.7** Using the data in Solved Problem 10.1, prepare an activity chart like the one in the Solved Problem, but a second Gas Man also delivers 11 gallons.

•• **10.8** Prepare a process chart for the Jackman in Solved Problem 10.1.

•• **10.9** Draw an activity chart for changing the right rear tire on an automobile with:
a) Only one person working
b) Two people working

••• **10.10** Draw an activity chart for washing the dishes in a double-sided sink. Two people participate, one washing, the other rinsing and drying. The rinser dries a batch of dishes from the drip rack as the washer fills the right sink with clean but unrinsed dishes. Then the rinser rinses the clean batch and places them on the drip rack. All dishes are stacked before being placed in the cabinets.

••• **10.11** Your campus club is hosting a car wash. Due to demand, three people are going to be scheduled per wash line. (Three people have to wash each vehicle.) Design an activity chart for washing and drying a typical sedan. You must wash the wheels but ignore the cleaning of the interior, because this part of the operation will be done at a separate vacuum station.

•••• **10.12** Design a process chart for printing a short document on a laser printer at an office. Unknown to you, the printer in the hallway is out of paper. The paper is located in a supply room at the other end of the hall. You wish to make five stapled copies of the document once it is printed. The copier, located next to the printer, has a sorter but no stapler. How could you make the task more efficient with the existing equipment?

Problems 10.13–10.46 relate to Labor Standards

• **10.13** If Charlene Brewster has times of 8.4, 8.6, 8.3, 8.5, 8.7, and 8.5 and a performance rating of 110%, what is the normal time for this operation? Is she faster or slower than normal? PX

• **10.14** If Charlene, the worker in Problem 10.13, has a performance rating of 90%, what is the normal time for the operation? Is she faster or slower than normal? PX

•• **10.15** Refer to Problem 10.13.
a) If the allowance factor is 15%, what is the standard time for this operation?
b) If the allowance factor is 18% and the performance rating is now 90%, what is the standard time for this operation? PX

•• **10.16** Claudine Soosay recorded the following times assembling a watch. Determine (a) the average time, (b) the normal time, and (c) the standard time taken by her, using a performance rating of 95% and a personal allowance of 8%.

Assembly Times Recorded

OBSERVATION NO.	TIME (MINUTES)	OBSERVATION NO.	TIME (MINUTES)
1	0.11	9	0.12
2	0.10	10	0.09
3	0.11	11	0.12
4	0.10	12	0.11
5	0.14	13	0.10
6	0.10	14	0.12
7	0.10	15	0.14
8	0.09	16	0.09

• **10.17** A Northeast Airlines gate agent, Chip Gilliken, gives out seat assignments to ticketed passengers. He takes an average of 50 seconds per passenger and is rated 110% in performance. How long should a *typical* agent be expected to take to make seat assignments? PX

• **10.18** After being observed many times, Beverly Demarr, a hospital lab analyst, had an average observed time for blood tests of 12 minutes. Beverly's performance rating is 105%. The hospital has a personal, fatigue, and delay allowance of 16%.
a) Find the normal time for this process.
b) Find the standard time for this blood test. PX

• **10.19** Jell Lee Beans is famous for its boxed candies, which are sold primarily to businesses. One operator had the following observed times for gift wrapping in minutes: 2.2, 2.6, 2.3, 2.5, 2.4. The operator has a performance rating of 105% and an allowance factor of 10%. What is the standard time for gift wrapping? PX

CASE STUDIES

Jackson Manufacturing Company

Kathleen McFadden, vice president of operations at Jackson Manufacturing Company, has just received a request for quote (RFQ) from DeKalb Electric Supply for 400 units per week of a motor armature. The components are standard and either easy to work into the existing production schedule or readily available from established suppliers on a JIT basis. But there is some difference in assembly. Ms. McFadden has identified eight tasks that Jackson must perform to assemble the armature. Seven of these tasks are very similar to ones performed by Jackson in the past; therefore, the average time and resulting labor standard of those tasks is known.

The eighth task, an *overload* test, requires performing a task that is very different from any performed previously, however. Kathleen has asked you to conduct a time study on the task to determine the standard time. Then an estimate can be made of the cost to assemble the armature. This information, combined with other cost data, will allow the firm to put together the information needed for the RFQ.

To determine a standard time for the task, an employee from an existing assembly station was trained in the new assembly process. Once proficient, the employee was then asked to perform the task 17 times so a standard could be determined. The actual times observed (in minutes) were as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2.05	1.92	2.01	1.89	1.77	1.80	1.86	1.83	1.93	1.96	1.95	2.05	1.79	1.82	1.85	1.85	1.99

The worker had a 115% performance rating. The task can be performed in a sitting position at a well-designed ergonomic work-station in an air-conditioned facility. Although the armature itself weighs 10.5 pounds, there is a carrier that holds it so that the operator need only rotate the armature. But the detail work remains high; therefore, the fatigue allowance should be 8%. The company has an established personal allowance of 6%. Delay should be very low. Previous studies of delay in this department average 2%. This standard is to use the same figure.

The workday is 7.5 hours, but operators are paid for 8 hours at an average of $12.50 per hour.

Discussion Questions

In your report to Ms. McFadden, you realize you will want to address several factors:

1. How big should the sample be for a statistically accurate standard (at, say, the 99.73% confidence level and accuracy of ±5%)?
2. Is the sample size adequate?
3. How many units should be produced at this workstation per day?
4. What is the cost per unit for this task in direct labor cost?

Source: Professor Hank Maddux, Sam Houston State University

The "People" Focus: Human Resources at Alaska Airlines

Video Case 

With thousands of employees spread across nearly 100 locations in the United States, Mexico, and Canada, building a committed and cohesive workforce is a challenge. Yet Alaska Airlines is making it work. The company's "people" focus states:

> *While airplanes and technology enable us to do what we do, we recognize this is fundamentally a people business, and our future depends on how we work together to win in this extremely competitive environment. As we grow, we want to strengthen our small company feel . . . We will succeed where others fail because of our pride and passion, and because of the way we treat our customers, our suppliers and partners, and each other.*

Managerial excellence requires a committed workforce. Alaska Airlines' pledge of respect for people is one of the key elements of a world-class operation.

Effective organizations require talented, committed, and trained personnel. Alaska Airlines conducts comprehensive training at all levels. Its "Flight Path" leadership training for all 10,000 employees is now being followed by "Gear Up" training for 800 front-line managers. In addition, training programs have been developed for Lean and Six Sigma as well as for the unique requirements for pilots, flight attendants, baggage, and ramp personnel. Because the company only hires pilots into first officer positions—the right seat in the cockpit, it offers a program called the "Fourth Stripe" to train for promotion into the captain's seat on the left side, along with all the additional responsibility that entails (see exterior and interior photos of one of Alaska Airlines' flight simulators on the opening page of this chapter).

Customer service agents receive specific training on the company's "Empowerment Toolkit." Like the Ritz-Carlton's famous customer service philosophy, agents have the option of awarding customers hotel and meal vouchers or frequent flier miles when the customer has experienced a service problem.

Because many managers are cross-trained in operational duties outside the scope of their daily positions, they have the ability to pitch in to ensure that customer-oriented processes go smoothly. Even John Ladner, Director of Seattle Airport Operations, who is a fully licensed pilot, has left his desk to cover a flight at the last minute for a sick colleague.

Along with providing development and training at all levels, managers recognize that inherent personal traits can make a huge difference. For example, when flight attendants are hired, the ones who are still engaged, smiling, and fresh at the end of a very long interview day are the ones Alaska wants on the team. Why? The job requires these behaviors and attitudes to fit with the Alaska Airlines team—and smiling and friendly flight attendants are particularly important at the end of a long flight.

Visual workplace tools also complement and close the loop that matches training to performance. Alaska Airlines makes

full use of color-coded graphs and charts to report performance against key metrics to employees. Twenty top managers gather weekly in an operations leadership meeting, run by Executive VP of Operations, Ben Minicucci, to review activity consolidated into visual summaries. Key metrics are color-coded and posted prominently in every work area.

Alaska's training approach results in empowered employees who are willing to assume added responsibility and accept the unknowns that come with that added responsibility.

Discussion Questions*

1. Summarize Alaska Airlines' human resources focus in your own words.
2. Why is employee empowerment useful to companies such as Alaska Airlines?
3. What tools discussed in the chapter might be employed to enhance the company's training and performance efforts? Why?

*Before answering these questions, you may wish to view the video that accompanies this case.

Hard Rock's Human Resource Strategy

Video Case 

Everyone—managers and hourly employees alike—who goes to work for Hard Rock Cafe takes Rock 101, an initial 2-day training class. The Hard Rock value system is to bring a fun, healthy, nurturing environment into the Hard Rock Cafe culture. This initial course and many other courses help employees develop both personally and professionally. The human resource department plays a critical role in any service organization, but at Hard Rock, with its "experience strategy," the human resource department takes on added importance.

Long before Jim Knight, manager of corporate training, begins the class, the human resource strategy of Hard Rock has had an impact. Hard Rock's strategic plan includes building a culture that allows for acceptance of substantial diversity and individuality. From a human resource perspective, this has the benefit of enlarging the pool of applicants as well as contributing to the Hard Rock culture.

Creating a work environment above and beyond a paycheck is a unique challenge. Outstanding pay and benefits are a start, but the key is to provide an environment that works for the employees. This includes benefits that start for part-timers who work at least 19 hours per week (while others in the industry start at 35 hours per week); a unique respect for individuality; continuing training; and a high level of internal promotions—some 60% of the managers are promoted from hourly employee ranks. The company's training is very specific, with job-oriented interactive DVDs covering kitchen, retail, and front-of-the-house service. Outside volunteer work is especially encouraged to foster a bond between the workers, their community, and issues of importance to them.

Applicants also are screened on their interest in music and their ability to tell a story. Hard Rock builds on a hiring criterion of bright, positive-attitude, self-motivated individuals with an employee bill of rights and substantial employee empowerment. The result is a unique culture and work environment, which no doubt contributes to the low turnover of hourly people—one-half the industry average.

The layout, memorabilia, music, and videos are important elements in the Hard Rock "experience," but it falls on the waiters and waitresses to make the experience come alive. They are particularly focused on providing an authentic and memorable dining experience. Like Alaska Airlines, Hard Rock is looking for people with a cause—people who like to serve. By succeeding with its human resource strategy, Hard Rock obtains a competitive advantage.

Discussion Questions*

1. What has Hard Rock done to lower employee turnover to half the industry average?
2. How does Hard Rock's human resource department support the company's overall strategy?
3. How would Hard Rock's value system work for automobile assembly line workers? (*Hint:* Consider Hackman and Oldham's core job characteristics.)
4. How might you adjust a traditional assembly line to address more "core job characteristics"?

*Before answering these questions, you may wish to view the video that accompanies this case.

- **Additional Case Studies:** Visit MyOMLab for these free case studies:
  Chicago Southern Hospital: Examines the requirements for a work-sampling plan for nurses.
  The Fleet That Wanders: Requires a look at ergonomic issues for truck drivers.

Endnotes

1. *Four Seasons Magazine*, Annabell Shaw, Jan. 3, 2011.
2. See "Motivation Through the Design of Work," in Jay Richard Hackman and Greg R. Oldham, eds., *Work Redesign* (Reading, MA: Addison-Wesley, 1980); and A. Thomas, W. C. Buboltz, and C. Winkelspecht, "Job Characteristics and Personality as Predictors of Job Satisfaction," *Organizational Analysis*, 12, no. 2 (2004): 205–219.
3. MTM is really a family of products available from the Methods Time Measurement Association. For example, MTM-HC deals with the health care industry, MTM-C handles clerical activities, MTM-M involves microscope activities, MTM-V deals with machine shop tasks, and so on.
4. A. S. Helms, B. W. Shaw, and C. A. Lindner, "The Development of Laboratory Workload Standards through Computer-Based Work Measurement Technique, Part I," *Journal of Methods-Time Measurement* 12: 43. Used with permission of MTM Association for Standards and Research.
5. The Occupational Safety and Health Administration (OSHA) is a federal government agency whose task is to ensure the safety and health of U.S. workers.
6. Material safety data sheets (MSDSs) contain details of hazards associated with chemicals and give information on their safe use.

Chapter 10 *Rapid* Review

Main Heading	Review Material	MyOMLab
HUMAN RESOURCE STRATEGY FOR COMPETITIVE ADVANTAGE (pp. 410–411)	*The objective of a human resource strategy is to manage labor and design jobs so people are effectively and efficiently utilized.* *Quality of work life* refers to a job that is not only reasonably safe with equitable pay but that also achieves an appropriate level of both physical and psychological requirements. *Mutual commitment* means that both management and employees strive to meet common objectives. *Mutual trust* is reflected in reasonable, documented employment policies that are honestly and equitably implemented to the satisfaction of both management and employees.	Concept Questions: 1.1–1.4 **VIDEO 10.1** The "People" Focus: Human Resources at Alaska Airlines **VIDEO 10.2** Human Resources at Hard Rock Cafe
LABOR PLANNING (pp. 411–412)	■ **Labor planning**—A means of determining staffing policies dealing with employment stability, work schedules, and work rules. *Flextime* allows employees, within limits, to determine their own schedules. *Flexible* (or *compressed*) *workweeks* often call for fewer but longer workdays. *Part-time status* is particularly attractive in service industries with fluctuating demand loads.	Concept Questions: 2.1–2.4
JOB DESIGN (pp. 412–415)	■ **Job design**—Specifies the tasks that constitute a job for an individual or group. ■ **Labor specialization** (or **job specialization**)—The division of labor into unique ("special") tasks. ■ **Job enlargement**—The grouping of a variety of tasks about the same skill level; horizontal enlargement. ■ **Job rotation**—A system in which an employee is moved from one specialized job to another. ■ **Job enrichment**—A method of giving an employee more responsibility that includes some of the planning and control necessary for job accomplishment; vertical expansion. ■ **Employee empowerment**—Enlarging employee jobs so that the added responsibility and authority are moved to the lowest level possible. ■ **Self-directed team**—A group of empowered individuals working together to reach a common goal.	Concept Questions: 3.1–3.4
ERGONOMICS AND THE WORK ENVIRONMENT (pp. 415–417)	■ **Ergonomics**—The study of the human interface with the environment and machines. The physical environment affects performance, safety, and quality of work life. Illumination, noise and vibration, temperature, humidity, and air quality are controllable by management.	Concept Questions: 4.1–4.4
METHODS ANALYSIS (pp. 417–419)	■ **Methods analysis**—A system that involves developing work procedures that are safe and produce quality products efficiently. ■ **Flow diagram**—A drawing used to analyze movement of people or material. ■ **Process chart**—A graphic representation that depicts a sequence of steps for a process. ■ **Activity chart**—A way of improving utilization of an operator and a machine or some combination of operators (a crew) and machines. ■ **Operations chart**—A chart depicting right- and left-hand motions.	Concept Questions: 5.1–5.4 Problems: 10.2, 10.6, 10.8 Virtual Office Hours for Solved Problem: 10.1
THE VISUAL WORKPLACE (p. 420)	■ **Visual workplace**—Uses a variety of visual communication techniques to rapidly communicate information to stakeholders.	Concept Questions: 6.1–6.4
LABOR STANDARDS (pp. 420–430)	■ **Labor standards**—The amount of time required to perform a job or part of a job. Labor standards are set in four ways: (1) historical experience, (2) time studies, (3) predetermined time standards, and (4) work sampling. ■ **Time study**—Timing a sample of a worker's performance and using it as a basis for setting a standard time. ■ **Average observed time**—The arithmetic mean of the times for each element measured, adjusted for unusual influence for each element. $\text{Average observed time} = \frac{\text{Sum of the times recorded to perform each elemen}}{\text{Number of observations}}$ (10-1) ■ **Normal time**—The average observed time, adjusted for pace: $\text{Normal time} = (\text{Average observed time}) \times (\text{Performance rating factor})$ (10-2)	Concept Questions: 7.1–7.4 Problems: 10.13–10.46 Virtual Office Hours for Solved Problems: 10.2–10.6

Chapter 10 *Rapid* Review *continued*

Main Heading	Review Material	MyOMLab
	■ **Standard time**—An adjustment to the total normal time; the adjustment provides allowances for personal needs, unavoidable work delays, and fatigue: $$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}} \quad (10\text{-}3)$$ *Personal time allowances* are often established in the range of 4% to 7% of total time. $$\text{Required sample size} = n = \left(\frac{zs}{h\bar{x}}\right)^2 \quad (10\text{-}4)$$ $$n = \left(\frac{zs}{e}\right)^2 \quad (10\text{-}5)$$ $$s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{\Sigma(\text{Each sample observation} - \bar{x})^2}{\text{Number in sample} - 1}} \quad (10\text{-}6)$$ ■ **Predetermined time standards**—A division of manual work into small basic elements that have established and widely accepted times. The most common predetermined time standard is *methods time measurement* (MTM). ■ **Therbligs**—Basic physical elements of motion. ■ **Time measurement units (TMUs)**—Units for very basic micromotions in which 1 TMU = 0.0006 min or 100,000 TMUs = 1 hr. ■ **Work sampling**—An estimate, via sampling, of the percent of the time that a worker spends on various tasks. Work sampling sample size for a desired confidence and accuracy: $$n = \frac{z^2 p(1-p)}{h^2} \quad (10\text{-}7)$$	ACTIVE MODEL 10.1
ETHICS (p. 430)	Management's role is to educate the employee; specify the necessary equipment, work rules, and work environment; and then enforce those requirements.	Concept Questions: 8.1–8.2

Self Test

■ **Before taking the self-test,** refer to the learning objectives listed at the beginning of the chapter and the key terms listed at the end of the chapter.

LO 10.1 When product demand fluctuates and yet you maintain a constant level of employment, some of your cost savings might include:
- **a)** reduction in hiring costs.
- **b)** reduction in layoff costs and unemployment insurance costs.
- **c)** lack of need to pay a premium wage to get workers to accept unstable employment.
- **d)** having a trained workforce rather than having to retrain new employees each time you hire for an upswing in demand.
- **e)** all of the above.

LO 10.2 The difference between *job enrichment* and *job enlargement* is that:
- **a)** enlarged jobs contain a larger number of similar tasks, while enriched jobs include some of the planning and control necessary for job accomplishment.
- **b)** enriched jobs contain a larger number of similar tasks, while enlarged jobs include some of the planning and control necessary for job accomplishment.
- **c)** enriched jobs enable an employee to do a number of boring jobs instead of just one.
- **d)** all of the above.

LO 10.3 The work environment includes these factors:
- **a)** Lighting, noise, temperature, and air quality
- **b)** Illumination, carpeting, and high ceilings
- **c)** Enough space for meetings and videoconferencing
- **d)** Noise, humidity, and number of coworkers
- **e)** Job enlargement and space analysis

LO 10.4 *Methods analysis* focuses on:
- **a)** the design of the machines used to perform a task.
- **b)** how a task is accomplished.
- **c)** the raw materials that are consumed in performing a task.
- **d)** reducing the number of steps required to perform a task.

LO 10.5 The least preferred method of establishing labor standards is:
- **a)** time studies.
- **b)** work sampling.
- **c)** historical experience.
- **d)** predetermined time standards.

LO 10.6 The allowance factor in a time study:
- **a)** adjusts normal time for errors and rework.
- **b)** adjusts standard time for lunch breaks.
- **c)** adjusts normal time for personal needs, unavoidable delays, and fatigue.
- **d)** allows workers to rest every 20 minutes.

LO 10.7 To set the required sample size in a time study, you must know:
- **a)** the number of employees.
- **b)** the number of parts produced per day.
- **c)** the desired accuracy and confidence levels.
- **d)** management's philosophy toward sampling.

Answers: LO 10.1. e; LO 10.2. a; LO 10.3. a; LO 10.4. b; LO 10.5. c; LO 10.6. c; LO 10.7. c.