chapter 7

Operations Management and Quality

Ben Stansall/AFP/Getty Images/Newscom

There isn't a "perfect" way to produce a product or service; just be flexible. An **open mind and** the willingness to try new things drive efficient **operations** and lead to innovation.

learning objectives

After reading this chapter, you should be able to:

7-1 **Explain** the meaning of *operations* and discuss the growth in the services and goods sectors of the U.S. economy.

7-2 **Identify** the three kinds of utility created by operations and the characteristics that distinguish service operations from goods production.

7-3 **Explain** how companies with different business strategies are best served by having different operations capabilities.

7-4 **Identify** the major factors that are considered in operations planning.

7-5 **Discuss** the information contained in four kinds of operations schedules—the master operations schedule, detailed schedule, staff schedule, and project schedule.

7-6 **Discuss** the two key activities required for operations control.

7-7 **Identify** the activities and underlying objectives involved in total quality management.

7-8 **Explain** how a supply chain strategy differs from traditional strategies for coordinating operations among firms.

Passengers and Airlines: Friends or Foes?[1]

Poor treatment by airlines has customers in an uproar because the many services that go into their flight experiences continue to deteriorate. Disturbances include everything from higher fares, inconvenient scheduling activities and discourteous airline personnel before getting to the airport, to unpleasant surprises at the airport such as overbooked flights, rude gate agents, additional baggage fees, long waits, and inaccurate information. Although airlines continue to eliminate onboard services, those that remain are available, increasingly, only with add-on fees. Because planes land late, departing passengers miss their connecting flights and are left stranded, often with little or no assistance from airline personnel. As to the customers' problems—the airlines don't seem to care.

As the list of service complaints grows, so too are the feelings of helplessness and frustration among customers. Little wonder, then, the number of passengers on U.S. airlines in 2009 dropped, with fewer flyers than any time since 2004, as poor economic conditions were aided by equally poor service quality in the airlines industry. With so many complaints, it is hardly a surprise that one 2011 poll shows that more U.S. passengers hold a negative, rather than positive view of airlines.

Why is all this happening? The airlines say they have to cut services and start charging for "extras" to stay profitable, or else go out of business. Although it's true for some in the industry, it should be noted that some airlines are "getting it right." Better-performing airlines are proving that good service quality need not be sacrificed to remain profitable. Among larger carriers, Southwest Airlines has demonstrated consistently that the two elements to airline success—high-quality service and profitability—go hand in hand. Southwest's service quality has attracted a loyal customer following. Passenger testimonials cite Southwest's refusal to charge extra for baggage, for booking flights on the phone, or for changing flights. They receive exceptionally high ratings for baggage handling (fewer lost bags), orderly boarding practices, and consistent on-time performance.[2] Southwest had the fewest number of consumer complaints for the most recent three consecutive years in the U.S. Department of Transportation's (DOT) official reports. They made the "2012 Customer Service Hall of Fame," ranking 10th among some 150 companies from 15 industries in *MSN Money*'s annual survey.[3] Along with quality, profitability continues to grow, while other airlines are operating at a loss. The company has been profitable for 42 consecutive years, all the more impressive with their emphasis not only on financial performance and productivity, but their social responsibility to their employees, customers, communities, and the environment.[4]

Airline quality ratings are well-documented, using measurements from airport operations records and from customer

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what's in it for me?

Perhaps you are like the thousands of airline customers disrupted by inconvenience and mistreatment and have been disappointed or irritated in a good or service that you bought. Or, alternatively, you have been pleasantly surprised by a new product you purchased or smiled at excellent service. In either case you'll find it easy to relate to the topics in this chapter. We'll explore the numerous ways companies align their operations processes with their business plans, and discuss how these decisions contribute to a firm's ability to create a high-quality product. Gaining an appreciation for the many steps it takes to bring high-quality goods and services to market will help make you a smarter consumer and more effective employee. And if you're a manager, understanding that production activities are pliable and should be reoriented to better support new business strategies will help you redefine your company and its marketplace over time.

complaints on numerous service activities. At the DOT, for example, the Aviation Consumer Protection Division gathers data on flight delays, mishandled baggage, oversales (number of confirmed passengers denied boarding), and customer complaints (on cancellations, misconnections, delays, baggage, fares, ticketing mistakes, and rude or unhelpful employees). Airlines are ranked each month, from top (fewest complaints) to bottom on each service activity, and Southwest Airlines is at or near the top consistently.[5] Several other well-known brands, near the bottom, seem to have little interest in improving. Many passengers are left wondering, "Why don't more airlines adopt the Southwest model?" (After studying the content in this chapter you should be able to answer a set of discussion questions found at the end of the chapter.)

OBJECTIVE 7-1
Explain
the meaning of *operations* and discuss the growth in the services and goods sectors of the U.S. economy.

What Does *Operations* Mean Today?

Although you're not always aware of it, as a customer you are constantly involved in business activities that provide goods and services to customers. You wake up to the sound of your favorite radio station, and on your bus ride to work or school, you are messaging on a smart phone. Your instructors, the bus driver, the messaging provider, and the morning radio announcer all work in **service operations** (or **service production**). They provide intangible and tangible service products, such as entertainment, transportation, education, and communications services. Firms that make only tangible products—radios, smart phones, buses, textbooks—are engaged in activities for **goods operations** (or **goods production**).

Service Operations (Service Production) *activities producing intangible and tangible products, such as entertainment, transportation, and education*

Goods Operations (Goods Production) *activities producing tangible products, such as radios, newspapers, buses, and textbooks*

Operations (Production) *activities involved in making products—goods and services—for customers*

The term **operations** (or **production**) refers to all the activities involved in making products—goods and services—for customers. In modern societies, much of what we need or want, from health care to fast food, is produced by service operations. As a rule, managers in the service sector give more consideration to the human element in operations (as opposed to the equipment or technology involved), because success or failure depends often on provider-customer contact. As we saw with airlines in the opening story, employees who deal directly with customers affect customer feelings about the service. As we will see, a key difference between goods and services operations is the customer's involvement in service operations.

Len Wilcox/Alamy

Sebastien Bozon/AFP/Getty Images

General Electric (GE) can be classified as both a goods producer (e.g., of the GE Wind Turbine) and a service provider (e.g., commercial finance).

Although companies are typically classified as either goods producers or service providers, the distinction is often blurred. Consider General Electric (GE). When you think of GE, you may first think of appliances and jet engines. However, GE is not just a goods producer. According to its annual report, GE's "growth engines"—its most vibrant business activities—are service operations, including insurance and real estate, consumer and commercial finance, investment, transportation services, and healthcare information, which account for more than 70 percent of the company's revenues.[6]

Growth in the Services and Goods Sectors

Historically, agriculture was the dominant sector in the early years of the United States. Thereafter, manufacturing grew, becoming the economic backbone from the nineteenth century into the mid-twentieth century. Services then began a rapid climb in economic importance in terms of both number of employees and percentage of gross domestic product (GDP)—the value of all goods and services produced by the economy, excluding foreign income. The outsourcing of U.S. manufacturing to other countries became a major concern in recent decades, so that by the year 2000, employment in the goods-producing sector (mining, construction, and manufacturing) was only about 20 percent of private sector employment versus 80 percent in services. Still, as recently as 2014 the United States remained the world's second largest exporter of manufactured goods, trailing only China and ahead of both Germany and Japan.

Of course, both goods and service industries are important, but as you can see from Figure 7.1, employment has risen significantly in the service sector and has leveled off at just 11 to 12 percent in goods-producing industries for years 2003 through 2014. Much of this growth comes from e-commerce, business services, health care, amusement and recreation, and education.

By 2011, the service sector's growth generated about 68 percent of private-sector national income. As Figure 7.2 shows, the service sector's greater percentage of GDP has hovered above 65 percent in recent years. At the same time, the smaller 11 percent of the workforce in goods-producing jobs produced 32 percent of national income.

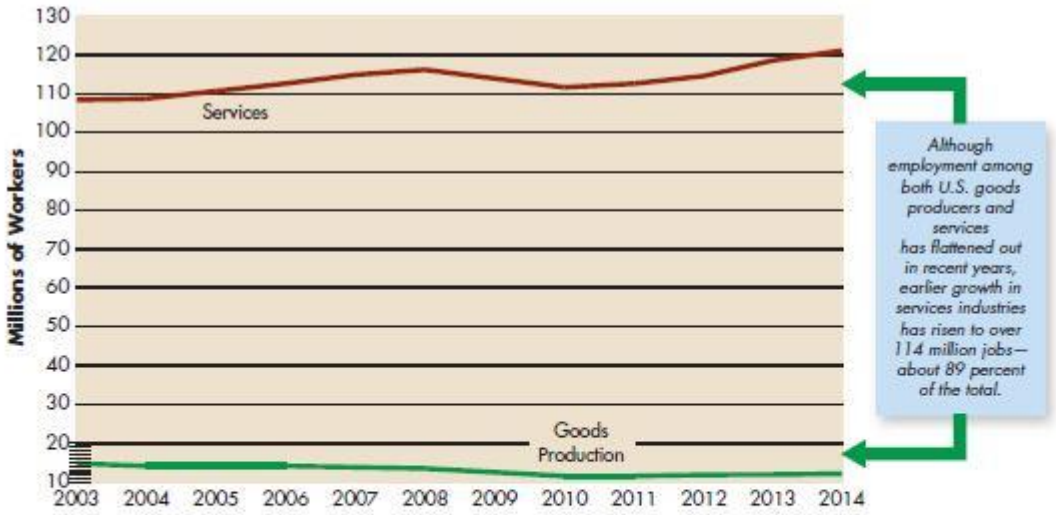

FIGURE 7.1 Employment in Goods and Services Sectors
Source: http://data.bls.gov/timeseries/CES0700000001?data_tool=XGtable http://www.data.bls.gov/cgi-bin/surveymost, accessed March 1, 2015.

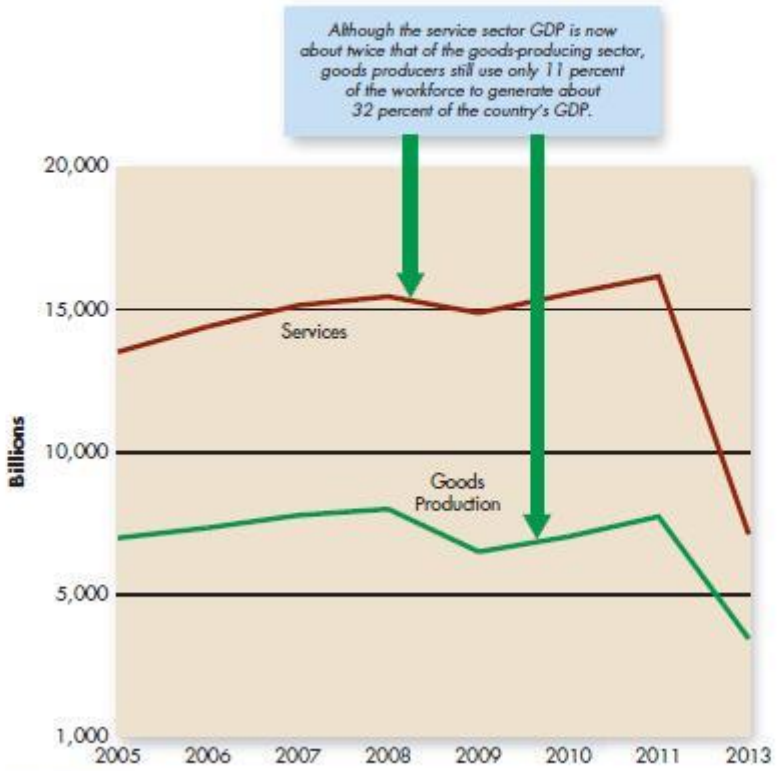

FIGURE 7.2 GDP from Goods and Services
Source: http://useconomy.about.com/od/grossdomesticproduct/f/GDP_Components.htm, accessed March 1, 2015.

Globally, U.S. manufacturing faces intense competition from other nations. A recent international survey of industrial executives ranks China as the most competitive manufacturing country, followed by Germany (second), the United States (third), Canada (seventh), and Japan (tenth).[7]

OBJECTIVE 7-2
Identify
the three kinds of utility created by operations and the characteristics that distinguish service operations from goods production.

Creating Value Through Operations

To understand a firm's production processes, we need to know what kinds of benefits its production provides, both for itself and for its customers. Production provides businesses with economic results: profits, wages, and goods purchased from other companies. At the same time, it adds customer value by providing **utility**—the ability of a product to satisfy a want or need—in terms of form, time, and place:

Utility *product's ability to satisfy a human want or need*

- Production makes products available: By converting raw materials and human skills into finished goods and services, production creates *form utility*, as when Regal Cinemas combines building materials, theater seats, and projection equipment to create an entertainment venue.
- When a theater offers midday, afternoon, and evening shows seven days a week, it creates *time utility*; that is, it adds customer value by making products available when consumers want them.
- When a theater offers a choice of 15 movies, all under one roof, at a popular location, it creates *place utility*: It makes products available where they are convenient for consumers.

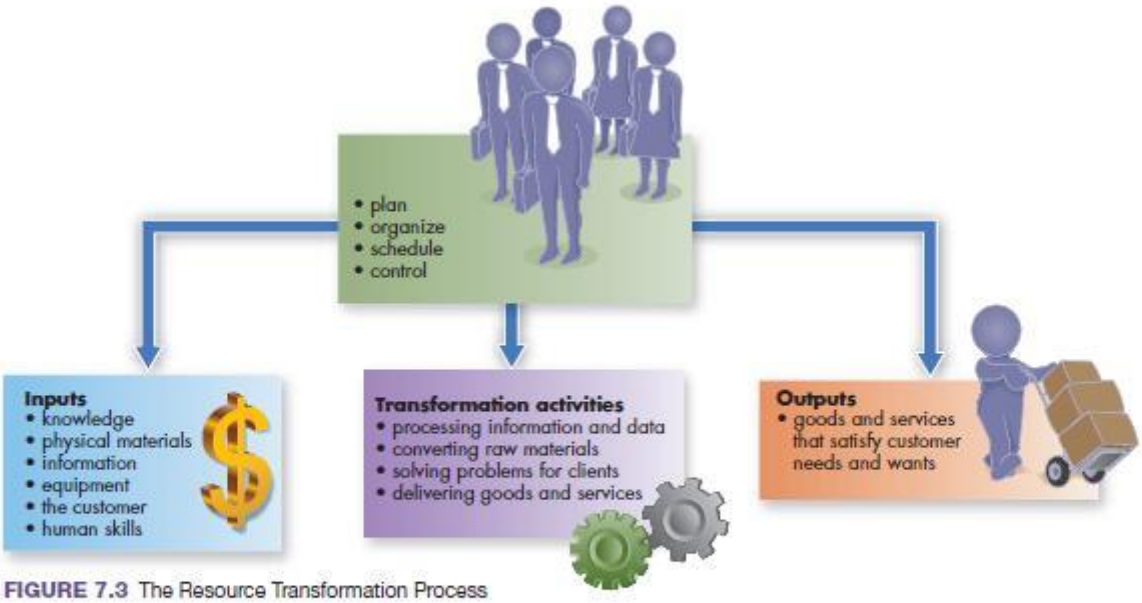

FIGURE 7.3 The Resource Transformation Process

Creating a product that customers value is no accident; it results from organized effort. **Operations (production) management** is the systematic direction and control of the activities that transform resources into finished services and goods that create value for and provide benefits to customers. In overseeing production, operations (production) managers are responsible for ensuring that operations activities create what customers want and need.

Operations (Production) Management *systematic direction and control of the activities that transform resources into finished products that create value for and provide benefits to customers*

As Figure 7.3 shows, **Operations (Production) Managers** draw up plans to transform resources into products. First, they bring together basic resources: knowledge, physical materials, information, equipment, the customer, and human skills. Then, they put them to effective use in a facility where the service is provided or the physical good is produced. As demand for a product increases, operations managers schedule and control work to produce the required amount. Finally, they control costs, quality levels, inventory, and facilities and equipment. In some businesses, often in small startup firms such as sole proprietorships, the operations manager is one person. Typically, however, different employees work together to complete these different responsibilities.

Operations (Production) Managers *managers responsible for ensuring that operations activities create value and provide benefits to customers.*

Some operations managers work in service "factories," such as FedEx package-sorting depots, whereas others work in factories making smart phones; still others work in offices, restaurants, hospitals, and stores. Farmers are operations managers who create utility by transforming soil, seeds, fuel, and other inputs into soybeans, milk, and other outputs. They may hire crews of workers to plant and harvest, opt instead for automated machinery, or prefer some combination of workers and machinery. These types of decisions affect costs and determine the kinds of buildings and equipment farmers include in their operations and the quality and quantity of the goods they produce.

Differences between Service and Goods Manufacturing Operations

Both service and manufacturing operations transform raw materials into finished products. In service operations, however, the raw materials, or inputs, are not things like glass or steel. These service inputs are people who have either unsatisfied needs or possessions needing care or alteration. In service operations, finished products or outputs are people with needs met and possessions serviced.

There are several obvious differences between service and manufacturing operations. Four aspects of service operations can make service production more complicated than simple goods production: (1) interacting with customers, (2) the intangible

and unstorable nature of some services, (3) the customer's presence in the process, and (4) service quality considerations.

Interacting with Customers Manufacturing operations emphasize outcomes in terms of physical goods, like a new jacket. But the products of most *service* operations are really combinations of goods and services—both making a pizza *and* delivering (serving) it. Service workers need different skills. For example, gas company employees may need strong interpersonal skills to calm frightened customers who have reported gas leaks. In contrast, factory workers who install gas pipes in manufactured homes without any customer contact don't need such skills.

Services Can Be Intangible and Unstorable Two prominent characteristics—*intangibility* and *unstorability*—set services apart from physical goods:

- ***Intangibility.*** Services often can't be touched, tasted, smelled, or seen, but they're still there. An important satisfier for customers, therefore, is the *intangible* value they receive in the form of pleasure, gratification, or a feeling of safety. For example, if you hire an attorney to handle a legal matter, you purchase not only the intangible quality of legal expertise but also the equally intangible reassurance that help is at hand.
- ***Unstorability.*** Many services, such as trash collection, transportation, child care, and house cleaning, can't be produced ahead of time and then stored for high-demand periods. If a service isn't used when available, it's usually wasted. Services, then, are typically characterized by a high degree of *unstorability*.

Customers' Presence in the Operations Process Because service operations transform customers or their possessions, the customer is often present in the operations process. To get a haircut, for example, most of us have to go to a hair salon. As participants in the operations process, customers can affect it. As a customer, you expect the salon to be conveniently located (place utility), to be open for business at convenient times (time utility), to provide safe and comfortable facilities, and to offer high-quality grooming (form utility) at reasonable prices (value for money spent). Accordingly, the manager sets hours of operation, available services, and an appropriate number of employees to meet her customer requirements. But what happens if a customer, scheduled for only a haircut, also asks for additional services, such as highlights or a shave when he or she arrives? In this case, the service provider must quickly adjust the service activities to provide customer satisfaction. High customer contact has the potential to affect the process significantly. The manufacturers who produce the salon's scissors, on the other hand, don't have to worry if a customer makes a last-minute change in demands.

Intangibles Count for Service Quality Consumers use different measures to judge services and goods because services include intangibles, not just physical objects. Most service managers know that quality of work and quality of service are not necessarily the same thing. Your car, for example, may have been flawlessly repaired (quality of work), but you'll probably be unhappy with the service if you're forced to pick it up a day later than promised because the work wasn't finished on time (quality of service).

Operations Processes

Operations Process *set of methods and technologies used to produce a good or a service*

To better understand the diverse kinds of production in various firms and industries, it is helpful to classify production according to differences in operations processes. An **operations process** is a set of methods and technologies used to produce a good or a service. Banks, for example, use two processes—document shredding and data encryption—to protect confidential information. Automakers use precision painting methods (equipment and materials) to produce a glittering paint finish.

Pasfregoe Inc/Blend Images/Getty Images

Because service operations transform customers or their possessions, the customer is often present in the operations process. For example, customers who want their hair cut or colored must go in person to a hair salon in order to receive this service.

We can classify goods production into broad groupings, by asking whether its operations process has a "make-to-order" or a "make-to-stock" emphasis. We can classify services according to the extent of customer contact required.

Goods Production Processes: Make-to-Order versus Make-to-Stock Processes Clothing, such as evening gowns, is available either off-the-shelf in department stores or custom-made at a designer or tailor shop. The designer or tailor's **make-to-order operations** respond to one-of-a-kind gown requirements, including unique patterns, materials, sizes, and shapes, depending on customers' characteristics. **Make-to-stock operations**, in contrast, produce standard gowns in large quantities to be stocked on store shelves or in displays for mass consumption. The production processes are quite different for the two settings, including procedures for designing gowns; planning for materials purchases; equipment and work methods for cutting, sewing, and assembling gowns; and employee skills for production.

Make-to-Order Operations *activities for one-of-a-kind or custom-made production*

Make-to-Stock Operations *activities for producing standardized products for mass consumption*

Service Production Processes: Extent of Customer Contact In classifying services, we may ask whether we can provide a service without the customers' being present in the production system. In answering this question, we classify services according to *extent of customer contact*.

Low-Contact Systems Consider the postal delivery operations at your local U.S. post office. Postal employees gather mail from mailboxes, sort it, and send it on its delivery journey to addressees. This operation is a **low-contact system**: Customers are not in contact with the post office while the service is performed. They can receive the service—mail sent and mail received—without setting foot in the processing center. Gas and electric companies, auto repair shops, and lawn-care services are other examples of low-contact systems.

Low-Contact System *level of customer contact in which the customer need not be part of the system to receive the service*

High-Contact Systems Think about your local public transit system. The service is transportation; when you purchase transportation, you board a bus or train. For example, the Bay Area Rapid Transit (BART) system, which connects San Francisco with outlying suburbs is, like all public transit systems, a **high-contact system**: To receive the service, the customer must be part of the system. Thus, managers must worry about the cleanliness of trains, safety of passengers, and the usability of its ticket kiosks. By contrast, a firm that ships coal is less concerned with the appearance of its trains since no paying passengers are riding on them. A coal-shipping firm is a low-contact system.

High-Contact System *level of customer contact in which the customer is part of the system during service delivery*

Business Strategy as the Driver of Operations

OBJECTIVE 7-3
Explain
how companies with different business strategies are best served by having different operations capabilities.

There is no one standard way for doing production, either for services or for goods. Rather, it is a flexible activity that can be molded into many shapes to give quite different operations capabilities for different purposes. How, then, do companies go about selecting the kind of production that is best for them? They aim to adopt the kind of production that achieves the firm's larger business strategy in the most efficient way possible.

The Many Faces of Production Operations

Consider the four firms listed in Table 7.1. Two are in goods production (Toyota and 3M), and the other two (Save-a-Lot and FedEx) are in services. These successful companies have contrasting business strategies and, as we shall see, they have chosen different operations capabilities. Each company has identified a business strategy that it uses for attracting customers in its industry. More than 40 years ago, Toyota chose *quality* as the strategy for competing in selling autos. Save-A-Lot grocery stores, in contrast to others in the grocery industry, offer customers *lower prices*. The *flexibility* strategy at 3M emphasizes new product development in an ever-changing line of products for home and office. FedEx captures the overnight delivery market by emphasizing delivery *dependability*.

Business Strategy Determines Operations Capabilities

Successful firms design their operations to support the company's business strategy.[8] In other words, managers adjust production operations to support the firms' target markets. Because our four firms use different business strategies, we should expect to see differences in their operations, too. The top-priority **operations capability (production capability)**—the special ability that production does especially well to outperform the competition—is listed for each firm in Table 7.2, along with key operations characteristics for implementing that capability. Each company's operations capability matches up with its business strategy so that the firm's activities—from top to bottom—are focused in a particular direction.

Operations Capability (Production Capability) *special ability that production does especially well to outperform the competition*

For example, because Toyota's top priority focuses on quality, its operations, the resource inputs for production, the transformation activities, and the outputs from production are devoted first and foremost to that characteristic. Its car designs and production processes emphasize appearance, reliable performance, and desirable features at a reasonable price. All production processes, equipment, and training are designed

table 7.1 Business Strategies that Win Customers for Four Companies

Company	Strategy for Attracting Customers	What the Company Does to Implement Its Strategy
Toyota	Quality	Cars perform reliably, have an appealing fit and finish, and consistently meet or exceed customer expectations at a competitive price
Save-A-Lot	Low price	Foods and everyday items offered at savings up to 40 percent less than conventional food chains
3M	Flexibility	Innovation, with more than 55,000 products in a constantly changing line of convenience items for home and office
FedEx	Dependability	Every delivery is fast and on time, as promised

table 7.2 Operations Capabilities and Characteristics for Four Companies

Operations Capability	Key Operations Characteristics
Quality (Toyota)	• High-quality standards for materials suppliers • Just-in-time materials flow for lean manufacturing • Specialized, automated equipment for consistent product buildup • Operations personnel are experts on continuous improvement of product, work methods, and materials
Low Cost (Save-A-Lot)	• Avoids excessive overhead and costly inventory (no floral departments, sushi bars, or banks that drive up costs) • Limited assortment of products, staples, in one size only for low-cost restocking, lower inventories, and less paperwork • Many locations; small stores—less than half the size of conventional grocery stores—for low construction and maintenance costs • Reduces labor and shelving costs by receiving and selling merchandise out of custom shipping cartons
Flexibility (3M)	• Maintains some excess (expensive) production capacity available for fast startup on new products • Adaptable equipment and facilities for production changeovers from old to new products • Hires operations personnel who thrive on change • Many medium- to small-sized manufacturing facilities in diverse locations, which enhances creativity
Dependability (FedEx)	• Customer automation: uses electronic and online communications tools with customers to shorten shipping time • Wireless information system for package scanning by courier, updating of package movement, and package tracking by customer • Maintains a company air force, global weather forecasting center, and ground transportation for pickup and delivery, with backup vehicles for emergencies • The 25 automated regional distribution hubs process 3.5 million packages per day for next-day deliveries

to build better cars. The entire culture supports a quality emphasis among employees, suppliers, and dealerships. Had Toyota instead chosen to compete as the low-price car in the industry, as some successful car companies do, then a cost-minimization focus would have been appropriate, giving Toyota's operations an altogether different form. Toyota's operations support its chosen business strategy, and did it successfully until quality problems arose in 2008. Soon thereafter, the commitment to quality intensified. By 2012, Toyota had regained its position as the world's top-selling auto maker. Before the 2008 downturn, the company had more than 35 consecutive years of increasing sales for which quality was the foundation for greatness.

Expanding into Additional Capabilities Finally, it should be noted that excellent firms learn, over time, how to achieve more than just one competence. The firms in Table 7.1 eventually became excellent in several capabilities. Aside from dependability, FedEx is also noted for world-class service quality and cost containment. Regarding quality, FedEx was honored in the "2014 Customer Service Hall of Fame," ranking 8th for service quality among 150 companies in *MSN Money*'s annual survey. To reduce costs, the company eliminates jobs that become unnecessary with advances in technology, sells off its older inefficient airplanes, and reduces the number of flights by re-routing its air and ground fleets.

OBJECTIVE 7-4
Identify the major factors that are considered in operations planning.

Operations Planning

Let's turn now to a discussion of production activities and resources that are considered in every business organization. Like all good managers, we start with planning. Managers from many departments contribute to decisions about operations. As Figure 7.4 shows, however, no matter how many decision makers are involved, the process is a logical sequence of decisions.

The business plan and forecasts developed by top managers provide guidance for long-term operations plans. Covering a two- to five-year period, the operations plan anticipates the number of plants or service facilities and the amount of labor, equipment, transportation, and storage needed to meet future demand for new and existing products. The planning activities fall into five categories: *capacity*, *location*, *layout*, *quality*, and *methods planning*.

Capacity Planning

Capacity *amount of a product that a company can produce under normal conditions*

The amount of a product that a company can produce under normal conditions is its **capacity**. A firm's capacity depends on how many people it employs and the number and size of its facilities. A supermarket's capacity for customer checkouts, for instance, depends on its number of checkout stations. A typical store has excess capacity—more cash registers than it needs—on an average day, but on Saturday morning or during the three days before Thanksgiving, they'll all be running at full capacity.

Long-range capacity planning considers both current and future requirements. If capacity is too small for demand, the company must turn away customers, a situation that cuts into profits and alienates both customers and salespeople. If capacity greatly exceeds demand, the firm is wasting money by maintaining facilities that are too large, keeping excess machinery online, or employing too many workers.

The stakes are high in capacity decisions: While expanding fast enough to meet future demand and to protect market share from competitors, managers must also

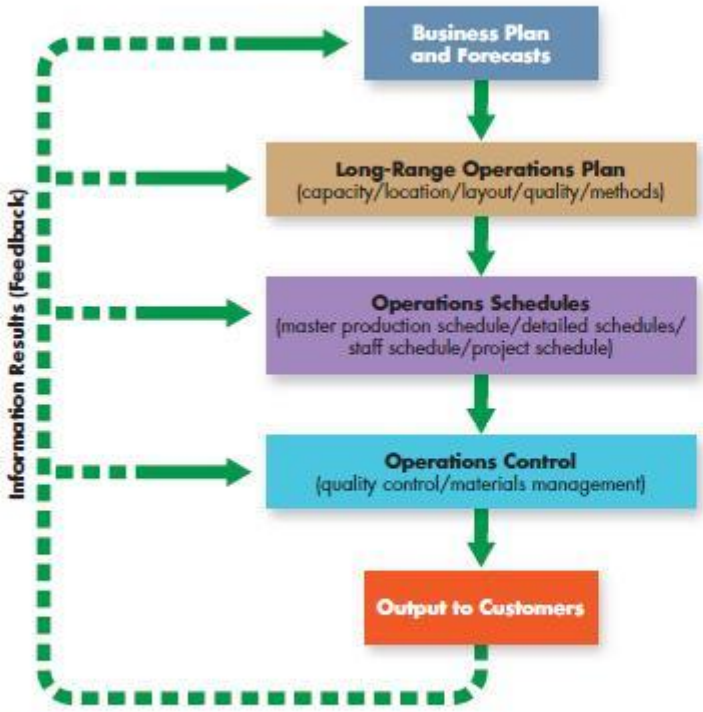

FIGURE 7.4 Operations Planning and Control

entrepreneurship and new ventures

Nothing Like a Home-Cooked Meal


Monkey Business/Fotolia

It wasn't that long ago that families sat down at the dinner table every night for a home-cooked meal. Restaurant dining was reserved for special occasions and even prepared meals were the exception. Well, those days are long gone. Today, many families eat out or bring home take out several nights a week. And singles and couples without children are even more likely to do so. Stephanie Allen, a caterer from Washington state, was surprised to find herself in exactly this situation. Allen and a friend started to get together one Saturday a month to prepare a bunch of freezable meals that they could heat up with little preparation. Word of their strategy spread and Allen, along with partner Tina Kuna, started Dream Dinners in 2002. The company quickly expanded in the Seattle area and became a franchise the following year. A little more than 10 years late, they have 86 locations in 25 states.

Interested? Well, having a healthy, nutritious, and tasty dinner is easier than you think. Each location establishes a list of monthly menu options catering to a wide variety of palates. For example, you can chose between making herb crusted flank steak, sweet cider bbq chicken, pizza burger sliders on pretzel buns, soy glazed salmon, Rio Grande chicken fajitas, or terra-cotta chicken with pita and hummus. All the shopping is done ahead of time by Dream Dinners, with special attention to price and quality. Ingredients have been chopped and sliced, and laminated recipe cards tell would-be chefs how to assemble a tasty meal in a zippered bag or foil pan. Depending upon the store location, there may be one or more work stations with ingredients, and patrons move around the workstation selecting the items on their recipe cards in the prescribed quantities. When you're all done, just load your meals into a cooler and head home to put them in the freezer, where they will wait until you are ready for a delicious home-cooked meal. The cost of a meal varies based on the ingredients, but an average meal is about $5 per person, far less than a restaurant meal, and right in your own kitchen.[9]

consider the costs of expanding. When markets are growing, greater capacity is desirable. In troubled times, however, existing capacity may be too large and too expensive to maintain, requiring a reduction in size.

Location Planning

Because location affects production costs and flexibility, sound location planning is crucial for factories, offices, and stores. Depending on its site, a company may be able to produce low-cost products, or it may find itself at a cost disadvantage relative to its competitors.

Consider the reasons why Slovakia has become known as "Detroit East." Even during the worldwide slowdown in car sales resulting from the Great Recession, Slovakia's auto production held constant. And during the 2012 Euro-zone economic crisis it produced more cars per capita—including Volkswagen SUVs, Peugeot Citroens, and Kias—than most other Euro-zone countries. Its auto factories remain well-positioned to increase volume as the worldwide economy improves. The central European country is an ideal place to produce cars. It has a good railroad system and nearby access to the Danube River, meaning economical transportation for incoming materials and outgoing cars once auto factories are in operation. The area also has skilled, hard-working laborers, and wages lower than those of surrounding countries.[10]

In contrast to manufacturing, consumer services concentrate on being located near customers. Thus, fast-food restaurants, such as Taco Bell and McDonald's, are located near areas with high traffic, such as college campuses, hospital cafeterias, and shopping malls. At retail giant Walmart, managers of the company's huge distribution centers regard Walmart outlets as their customers. To ensure that truckloads of

merchandise flow quickly to stores, distribution centers are located near the hundreds of Walmart stores that they supply, not near the companies that supply them.

Layout Planning

Layout is the physical location or floor plan for service centers, machinery, equipment, customers, and supplies. It determines whether a company can respond efficiently to demand for more and different products or whether it finds itself unable to match competitors' speed and convenience. Among the many layout possibilities, three well-known alternatives—*(1) process layouts (or custom-products layouts), (2) product layouts (or same-steps layouts),* and *(3) fixed-position layouts*—are presented here to illustrate how different layouts serve different purposes for operations.

Process Layout (Custom-Product Layout) *physical arrangement of production activities that groups equipment and people according to function*

Process Layouts In a **process layout** (also called **custom-product layout**), which is well suited to *make-to-order shops* (or *job shops*) specializing in custom work, equipment and people are grouped according to function. FedEx Office stores (formerly Kinko's Copy Centers), for example, use custom-products layouts to accommodate a variety of custom jobs. Specific activities or processes, such as photocopying, faxing, computing, binding, and laminating, are performed in separate, specialized areas of the store. Walk-in customers—local individuals and small-business clients—move from area-to-area using the self-service they need.

Product Layout (Same-Steps Layout) *physical arrangement of production steps designed to make one type of product in a fixed sequence of activities according to its production requirements*

Assembly Line Layout *a same-steps layout in which a product moves step by step through a plant on conveyor belts or other equipment until it is completed*

The main advantage of process layouts is flexibility—at any time, the shop can process individual customer orders, each requiring different kinds of work. Depending on its work requirements, a client being served or a job being processed may flow through three activity areas, another through just one area, and still others through four or more work zones. Figure 7.5 shows the process layout of a service provider—a medical clinic. The path taken through the facility reflects the unique treatments for one patient's visit. Goods producers such as machine shops, woodworking and print shops, dry cleaning stores, as well as health clinics and physical fitness studios are among the many facilities using custom-products layouts.

Product Layouts A **product layout** (also called a **same-steps layout** or **assembly line layout**) is set up to provide one type of service or make one type of product in a fixed sequence of production steps. All units go through the same set of steps.

Example patient flow for one customer

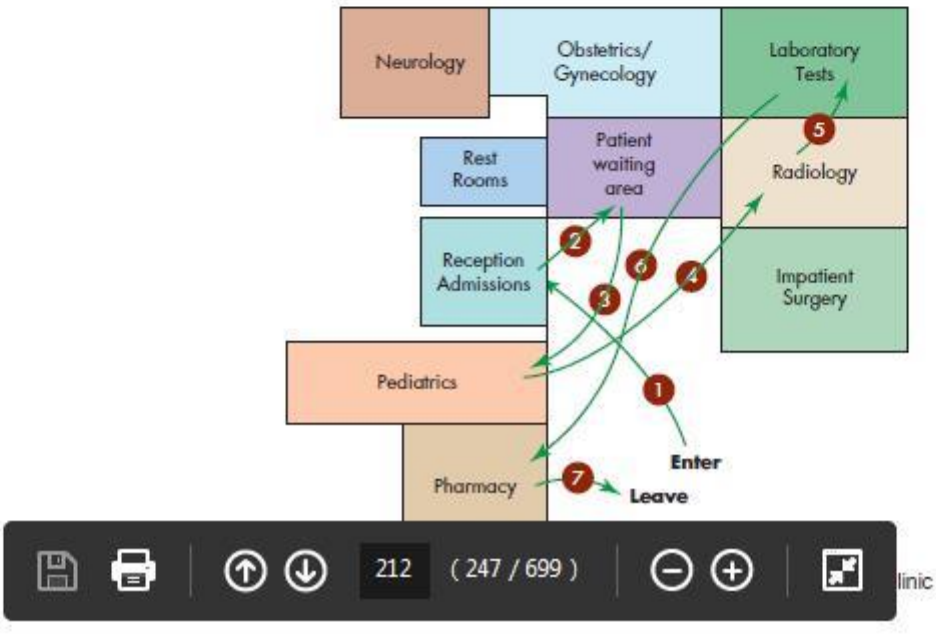

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FIGURE 7.6 Product Layout for a Service—Automated Car Wash

It is efficient for large-volume make-to-stock operations that mass-produce many units of a product quickly: A partially finished product moves step by step through the plant on conveyor belts or other equipment, often in a straight line, as it passes through each stage until the product is completed. Automobile, food-processing, and television-assembly plants use same-steps layouts, as do mail-processing facilities, such as UPS or FedEx.

Figure 7.6 shows a product layout at a service provider—an automatic car wash. Figure 7.7 is a goods-producer assembling parts needed to make storm windows. Same-steps layouts are efficient because the work skill is built into the equipment, allowing unskilled labor to perform simple tasks. But they are often inflexible, especially where they use specialized equipment that's hard to rearrange for new applications.

Fixed Position Layouts A **fixed-position layout** is often used when size, shape, or other factors make it difficult to move the service to another production facility. In fixed-position layouts the product or client remains at one location; equipment, materials, and human skills are moved to that location, as needed, to perform the service or to build the product. While recovering at home from a knee replacement, for example, physical rehabilitation specialists come to the patient's home for rehab services. When home plumbing goes bad or the roof leaks, repair services are brought to that home—at its fixed position—where the services are performed. Such layouts are used for building huge ships that can't be moved, for constructing buildings, and for agricultural operations—plowing, fertilizing, and harvesting—at farm sites.

Fixed-Position Layout *labor, equipment, materials, and other resources are brought to the geographic location where all production work is done*

Quality Planning

Every operations plan includes activities for ensuring that products meet the firm's and customers' quality standards. The American Society for Quality defines

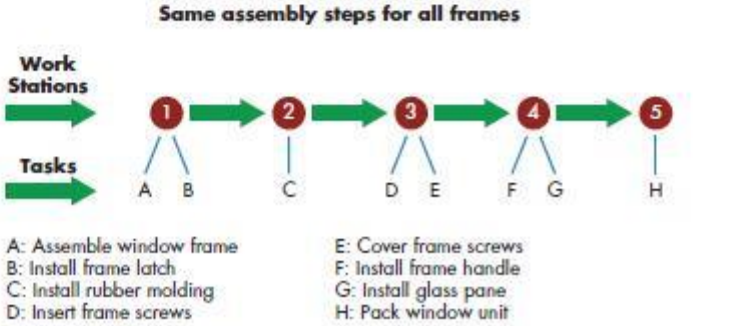

FIGURE 7.7 Product Layout for Goods Production—Storm Window Assembly

Quality *combination of "characteristics of a product or service that bear on its ability to satisfy stated or implied needs"*

quality as a subjective term, the combination of "characteristics of a product or service that bear on its ability to satisfy stated or implied needs."[11] Such characteristics may include a reasonable price and dependability in delivering the benefits it promises.

Planning for quality begins when products are being designed. As we will see later, product design is a marketing responsibility, but it involves operations managers, too. Early in the process, goals are established for both performance and consistency. **Performance** refers to how well the product does what it is supposed to do. For loyal buyers of Godiva premium chocolates, performance includes such sensory delights as aroma, flavor, color, and texture. "Truly fine chocolates," observes master chocolatier Thierry Muret, "are always fresh, contain high-quality ingredients like cocoa beans and butter…and feature unusual textures and natural flavors." The recipe was designed to provide these features. Superior performance helps Godiva remain one of the world's top brands.[12]

Performance *dimension of quality that refers to how well a product does what it is supposed to do*

Consistency *dimension of quality that refers to sameness of product quality from unit to unit*

In addition to performance, quality also includes **consistency**, the sameness of product quality from unit to unit. Business travelers using Courtyard by Marriott, for example, enjoy high consistency with each overnight stay, which is one reason Courtyard by Marriott is among the best-selling brands in the lodging industry. Courtyard by Marriot achieved this status by maintaining the same features at all of Marriott's more than 967 Courtyard hotels in 38 countries. Designed for business travelers, most guest rooms include a Courtyard Suite with high-speed Internet access, meeting space, and access to an exercise room, restaurant and lounge, swimming pool, and 24-hour access to food. The layout of the suites is identical at many locations, the rooms are always clean, and check-in/checkout procedures are identical so that lodgers know what to expect with each overnight stay. This consistency is achieved by monitoring for uniformity of materials and supplies, encouraging conscientious work, training employees, and maintaining equipment.

In addition to product design, quality planning includes employees deciding what constitutes a high-quality product—for both goods and services—and determining how to measure these quality characteristics.

Methods Planning

In designing operations systems, managers must identify each production step and the specific methods for performing it. They can then reduce waste and inefficiency by examining procedures on a step-by-step basis by using an approach called *methods improvement*.

Improving Process Flows Improvements for operations begin by documenting current production practices. A detailed description, often using a diagram called a *process flowchart*, is helpful in organizing and recording information. The flowchart identifies the sequence of production activities, movements of materials, and work performed at each stage of the process. It can then be analyzed to isolate wasteful activities, sources of delay, and other inefficiencies in both goods and services operations. The final step is implementing improvements.

Improving Customer Service Consider, for example, the traditional checkout method at hotels. The process flowchart in Figure 7.8 shows five stages of customer activities. Hotel checkout can be time consuming for customers standing in line to pay. They become impatient and annoyed, especially during popular checkout times when lines are long. Other hotel tasks are disrupted, too, as managers are forced to reassign employees to the front desk to assist with surging checkout lines. Hotel managers developed an improved checkout method that avoids wasting time in line for customers and reduces interruptions of other staff duties as well. It saves time by eliminating steps 1, 2, 3A, and 5. On the morning of departure customers find a copy of charges delivered under their room door. Or, they can scan their bills on television in the privacy of their rooms any time before departure. If the bill is correct, no further checkout is required, and the hotel submits the charges against the credit card that the customer submitted during check-in.

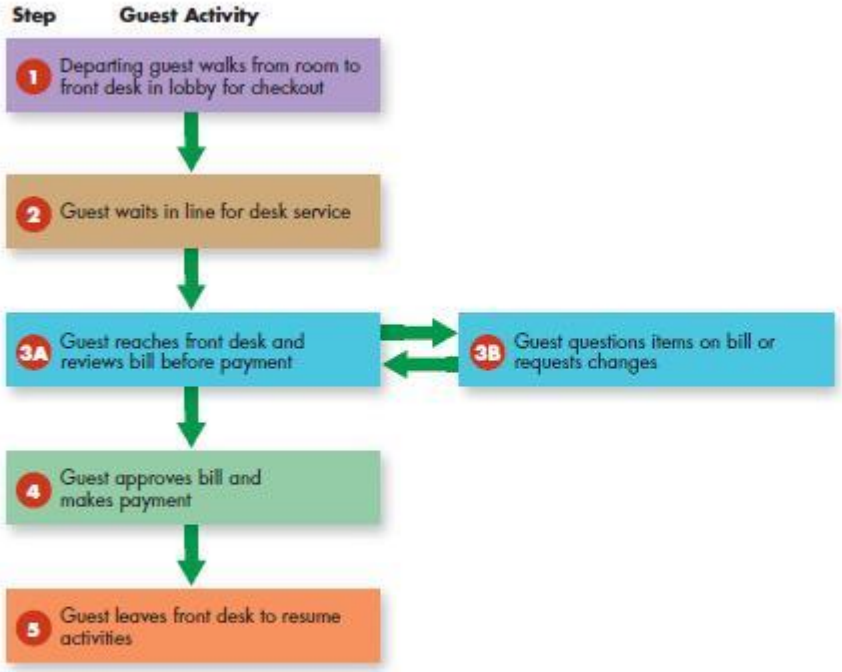

FIGURE 7.8 Flowchart of Traditional Guest Checkout

Operations Scheduling

OBJECTIVE 7-5
Discuss the information contained in four kinds of operations schedules—the master operations schedule, detailed schedule, staff schedule, and project schedule.

Continuing with the flow of activities in Figure 7.4, once managers and their teams have determined the operations plans, they then develop timetables for implementing the plans. This aspect of operations, called *operations scheduling*, identifies times when specific activities will occur. In this section we consider four general kinds of schedules. (1) The *master schedule* is "the game plan" for deciding the volume of upcoming activities for months ahead. (2) *Detailed schedules* show day-to-day activities that will occur in production. (3) *Staff schedules* identify who and how many employees will be working, and when. (4) Finally, *project schedules* provide coordination for completing large-scale projects.

The Master Operations Schedule

Master Operations Schedule
schedule showing which products will be produced, and when, in upcoming time periods

Scheduling of operation occurs at different levels. First, a top-level **master operations schedule** shows which services or products will be produced and when, in upcoming time periods. Logan Aluminum, for example, makes coils of aluminum that it supplies to customer companies that use it to make beverage cans. Logan's master schedule, with a format like the partial schedule shown in Figure 7.9, covers production for 60 weeks in which more than 300,000 tons will be produced. For various types of coils (products), the master schedule specifies how many tons will

Coil # (Product)	8/4/14	8/11/14	8/18/14	...	11/3/14	11/10/14
TC016	1,500	2,500			2,100	600
TC032	900		2,700		3,000	
TR020	300		2,600			1,600

FIGURE 7.9 Example of Partial Master Operations Schedule

KEY RESOURCES	Quarter/Year 1/2014	2/2014	3/2014	4/2014	1/2015	2/2015	3/2015	4/2015
Number of Stores	17	17	18	19	20	20	21	22
Staffing Level (no. of Employees)	1,360	1,360	1,530	1,615	1,700	1,700	1,653	1,827
Fresh Vegetables (tons)	204	204	192	228	240	240	230	260
Canned Goods (case loads)	73,950	77,350	80,100	80,100	83,000	84,500	88,600	90,200
Fresh Meats Etc.	–	–	–	–	–	–	–	–
–								
–								
–								

FIGURE 7.10 Food Retailer's Partial Operations Schedule

be produced each week, helping managers determine the kinds of materials, equipment, and other resources that will be needed for each upcoming week.

The master schedule for a service provider, such as a regional food retailer, may begin with the planned number of retail stores to be operating in each quarter of the coming two years. Then, key resources needed in each quarter to provide customer services for all stores are identified (estimated). Figure 7.10 shows an example of such a partial master schedule. It provides information for planning on how many people the company will have to hire and train, planning for purchases of food products and the financing needed for those purchases, and planning for construction requirements of new stores.

Detailed Schedules

Detailed Schedule *schedule showing daily work assignments with start and stop times for assigned jobs*

Although the master production schedule is the backbone for overall scheduling, additional information comes from **detailed schedules**, schedules showing daily work assignments with start and stop times for assigned jobs at each work station. Logan's production employees need to know the locations of all coils in the plant and their various stages of completion. Managers must assign start and stop times, and employees need scheduled work assignments daily, not just weekly. Detailed short-term schedules allow managers to use customer orders and information about equipment status to update sizes and the variety of coils to be made each day.

Staff Schedules and Computer-Based Scheduling

Staff Schedule *assigned working times in upcoming days for each employee on each work shift*

Scheduling is useful for employee staffing in service companies, too, including restaurants, hotels, and transportation and landscaping companies. **Staff schedules**, in general, specify assigned working times in upcoming days—perhaps for as many as 30 days or more—for each employee on each work shift. Staff schedules consider employees' needs and the company's efficiency and costs, including the ebbs and flows of demand for production.

Computer-based scheduling, using tools such as the *ABS Visual Staff Scheduler® PRO* (VSS Pro) software, can easily handle multishift activities for many employees—both part-time and full-time. It accommodates vacation times, holiday adjustments, and daily adjustments in staffing for unplanned absences and changes in production schedules.

Project Scheduling

Special projects, such as new business construction or redesigning a product, require close coordination and precise timing among many activities. In these cases, project management is facilitated by project scheduling tools, including Gantt charts and PERT.

The Gantt Graphical Method Named after its developer, Henry Gantt, a **Gantt chart** breaks down large projects into steps to be performed and specifies the time required to perform each one. The project manager lists all activities needed to complete the work, estimates the time required for each step, records the progress on the chart, and checks the progress against the time scale on the chart to keep the project moving on schedule. If work is ahead of schedule, some employees may be shifted to another project. If it's behind schedule, workers may be added or completion delayed.

Gantt Chart *production schedule that breaks down large projects into steps to be performed and specifies the time required to perform each step*

Figure 7.11 shows a Gantt chart for the renovation of a college classroom. It shows progress to date and schedules for remaining work and that some steps can be performed at the same time (e.g., step D can be performed during the same time as steps C and E), but others cannot (e.g., step A must be completed before any of the others can begin). Step E is behind schedule; it should have been completed before the current date.

Project Scheduling with PERT Charts The *Program Evaluation and Review Technique* (*PERT*) provides even more information for controlling the progress of large projects. Along with times required to perform the activities, the layout of the **PERT chart** uses arrows to show the necessary *sequence* among activities, from start to finish, for completing the project. It also identifies the *critical path*, the most time-consuming set of activities, for completing the project.

PERT Chart *production schedule specifying the sequence of activities, time requirements, and critical path for performing the steps in a project*

Figure 7.12 shows a PERT chart for renovating the college classroom. The project's nine activities and the times required to complete them are identified. Each activity

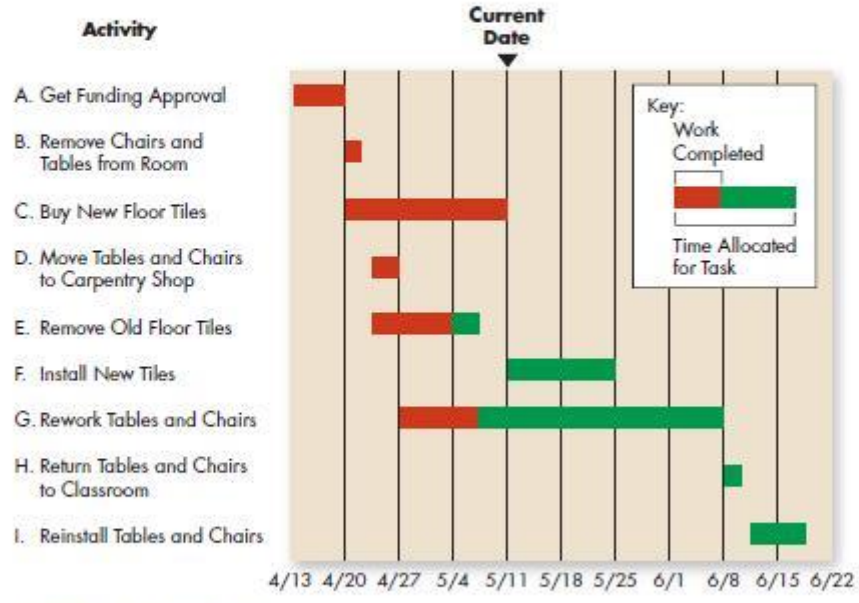

FIGURE 7.11 Gantt Chart

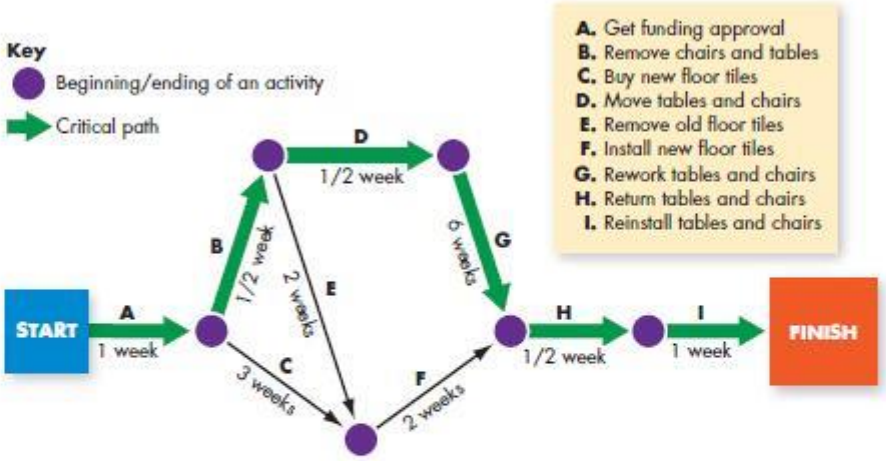

FIGURE 7.12 PERT Chart

is represented by an arrow. The arrows are positioned to show the required sequence for performing the activities. For example, chairs and tables can't be returned to the classroom (H) until after they've been reworked (G) and after new floor tiles are installed (F). Accordingly, the diagram shows arrows for G and F coming before activity H. Similarly, funding approval (A) has to occur before anything else can get started.

The critical path is informative because it reveals the most time-consuming path for project completion, and for most projects, speed of completion is vital. The critical path for classroom renovation consists of activities A, B, D, G, H, and I, requiring 9.5 weeks. It's critical because a delay in completing any of those activities will cause corresponding lateness beyond the planned completion time (9.5 weeks after startup). Project managers will watch those activities and, if potential delays arise, take special action—by reassigning workers and equipment—to speed up late activities and stay on schedule.

OBJECTIVE 7-6
Discuss
the two key activities required for operations control.

Operations Control

Once long-range plans have been put into action and schedules have been drawn up, **operations control** requires managers to monitor performance by comparing results with detailed plans and schedules. If employees do not meet schedules or quality standards, managers can take corrective action. **Follow-up**, checking to ensure that production decisions are being implemented, is a key and ongoing facet of operations.

Operations Control *process of monitoring production performance by comparing results with plans and taking corrective action when needed*

Follow-Up *operations control activity for ensuring that production decisions are being implemented*

Operations control includes *materials management* and *quality control*. Both activities ensure that schedules are met and products delivered, both in quantity and in quality.

Materials Management

Some of us have difficulty keeping track of personal items now and then—clothes, books, smart phones, and so on. Imagine keeping track of thousands, or even millions, of things at any one time. That's the challenge in **materials management**, the process by which managers plan, organize, and control the flow of materials from sources of supply through distribution of finished goods. For manufacturing firms, typical materials costs make up 50 to 75 percent of total product costs.

Materials Management *process of planning, organizing, and controlling the flow of materials from sources of supply through distribution of finished goods*

Materials Management Activities for Physical Goods

Once a product has been designed, successful materials flows depend on five activities.

From selecting suppliers on through the distribution of finished goods, materials managers engage in the following areas that compose materials management:

- **Supplier selection** is the process of finding and choosing suppliers of services and materials. This step includes evaluating potential suppliers, negotiating terms of service, and maintaining positive buyer–seller relationships.
- **Purchasing** (sometimes called *procurement*) is the acquisition of all the raw materials and services that a company needs to produce its products. Most large firms have purchasing departments to buy proper services and materials in the amounts needed.
- **Transportation** is the means of transporting resources to the producer and finished goods to customers.
- **Warehousing** is the storage of both incoming materials for production and finished goods for distribution to customers.
- **Inventory control** includes the receiving, storing, handling, and counting of all raw materials, partly finished goods, and finished goods. It ensures that enough materials inventories are available to meet production schedules, while at the same time avoiding expensive excess inventories.

Supplier Selection *process of finding and choosing suppliers from whom to buy*

Purchasing *acquisition of the materials and services that a firm needs to produce its products*

Transportation *activities in transporting resources to the producer and finished goods to customers*

Warehousing *storage of incoming materials for production and finished goods for distribution to customers*

Inventory Control *process of receiving, storing, handling, and counting of all raw materials, partly finished goods, and finished goods*

Lean Production System *production system designed for smooth production flows that avoid inefficiencies, eliminate unnecessary inventories, and continuously improve production processes*

Just-in-Time (JIT) Production *type of lean production system that brings together all materials at the precise time they are required at each production stage*

Lean Production Systems

Managers must take timing into consideration when managing materials, as well. Pioneered by Toyota, **lean production systems** are designed for smooth production flows that avoid inefficiencies, eliminate unnecessary inventories, and continuously improve production processes. **Just-in-time (JIT) production**, a type of lean system, brings together all needed materials at the precise moment they are required for each production stage, not before, thus creating fast and efficient responses to customer orders. All resources flow continuously—from arrival as raw materials to final assembly and shipment of finished products.

JIT production reduces the number of goods in process (goods not yet finished) to practically nothing. It minimizes inventory costs, reduces storage space requirements for inventories, and saves money by replacing stop-and-go production with smooth movement. Once smooth flow is the norm, disruptions are more visible and employees can resolve them more quickly. Finding and eliminating disruptions by the continuous improvement of production is a major objective of JIT production.

Inventory Management Is Crucial for Producing Services

For many service firms, too, the materials stakes are high. UPS delivers 20 million packages every day and promises that all of them will arrive on schedule. It keeps this promise by tracking the locations, schedules, and on-time performance of 625 aircraft and 93,361 vehicles. However, the most important "inventory" used for many high-contact services is not physical goods but exists in the form of information about service product offerings, clients, their interests, needs, activities, and even their plans for interactions with other clients.

Consider, as an example, the *inventories of information* at Collette Vacations where the *management of information* is a vital activity. Collette offers three product lines, Classic Touring, Explorations (for smaller groups), and Family Vacations, that collectively offer more than 150 escorted tours on seven continents including more than 50 countries. Each tour (the product), designed by a professional tour planner, includes a complete itinerary, duration, advanced arrangements for accommodations, and pricing. Vacationers select from among land tours, river cruises, and rail journeys that include sightseeing, meals, entertainment, and accommodations to experience new places, people history, and culture.

As a tour begins, one of the company's more than 100 Professional Tour Managers interacts face-to-face with clients as friend and guide for the entire duration, often 8-to-14 days, while handling all day-to-day details—confirming meals availabilities, ensuring hotel room accommodations, arranging local transportation, helping with sight-seeing selections, providing knowledge of local culture, assisting each tourist with any questions or problems, and handling emergencies.

Quality control means taking action to ensure that operations produce products that meet specific quality standards. These quality control inspectors are checking finished goods before shipment to make sure they meet or surpass the standards set by their customers.

As you can see, these many activities create vast amounts of information—the *inventory of information*—that must be accurate and accessible for success with current tours and clients, and for all the thousands of clients booked on hundreds of future tours. It is also vital for contacting many thousands of potential customers with advance information about tours that will be offered a year or two in the future.[13]

Quality Control

Quality Control *action of ensuring that operations produce products that meet specific quality standards*

Quality control is taking action to ensure that operations produce goods or services that meet specific quality standards. Consider, for example, service operations in which customer satisfaction depends largely on the employees who provide the service. By monitoring services, managers and other employees can detect mistakes and make corrections. First, however, managers or other personnel must establish specific standards and measurements. At a bank, for example, quality control for teller services might require supervisors to observe employees periodically and evaluate their work according to a checklist. Managers would either review the results with employees and either confirm proper performance or indicate changes for bringing performance up to standards.

The high quality of customer-employee interactions is no accident in firms that monitor customer encounters and provide training for employee skills development. Many managers realize that without employees trained in customer-relationship skills, quality suffers, and businesses, such as airlines—as we saw in our opening story—and hotels, can lose customers to better-prepared competitors.

Quality Improvement and Total Quality Management

OBJECTIVE 7-7
Identify
the activities and underlying objectives involved in total quality management.

It is not enough to *control* quality by inspecting products and monitoring service operations as they occur, as when a supervisor listens in on a catalog sales service representative's customer calls. Businesses must also consider *building* quality into goods and services in the first place. Hospitals, such as St. Luke's Hospital of Kansas City, for example, use employee teams to design quality-assured treatment programs and patient-care procedures. Learning from past problems of staff and patients, teams

managing in turbulent times

Leaner Operations Are Restoring the U.S. Auto Industry

Recent signs of recovery for the U.S. auto industry stem from more than financial bailouts. General Motors and Chrysler, suffering grave financial losses in 2008, needed to demonstrate that they can survive and repay the bridge loans received from the U.S. Department of the Treasury. Under the guise of restructuring or reorganization, the steps automakers have taken can be summarized in just two words: *leaner operations*. GM, Chrysler, and Ford are adopting business strategies that Japanese producers have been using (and have mastered) for three decades to simplify production and capture a greater market share.[14]

A reduction in product offerings is the foundation for leaner operations: A smaller number of makes, models, and options such as colors, engine sizes, trims, etc. simplifies product design, production, and distribution. Fewer options and models also lead to lower costs, higher quality, and better customer service. Because it's easier to design fewer products, design and engineering requirements are vastly lowered. Designers strive for commonality of component parts so that all models use the same parts (e.g., all use the same door handles) rather than having separate designs for each model. Parts reductions simplify the supply chain, as well. Fewer suppliers are needed, communications are easier and faster, and closer relationships with suppliers provide faster supplier responses on short notice.

Design simplification is a blessing for assembly operations, too, because fewer production steps are required, and when quality problems arise, they are easier to find and are quickly corrected. Because fewer components require less inventory space and equipment, smaller factories, which are less costly and easier to maintain, become possible. Production scheduling is simpler, as are materials movements during production, so there is less work stoppage and fewer mistakes,

Keith Dannemiller/Alamy

product quality improves, and on-time deliveries to customers increase.

The company's distribution network is simplified, too, when some of its auto brands are eliminated. GM has downsized to just four core brands—Buick, Cadillac, Chevrolet, and GMC—after ending the Oldsmobile, Pontiac, Saturn, Hummer, and Saab brands under the GM label.[15] Chrysler's roster includes just three major brands: Chrysler, Jeep, and Dodge. Ford has discontinued its Mercury brand. Fewer brands means some auto dealerships are no longer needed, which lowered distribution costs. With speedier product designs and production operations, newer products get into the marketplace more quickly than those of competitors, and customer service improves. When the benefits of lower costs, higher quality, and lower prices are added together, it becomes apparent that lean production systems offer significant competitive advantages. Implementing these benefits, and doing so quickly, at GM, Chrysler, and Ford continues to be a massive challenge for survival in turbulent times.[16]

continuously redesign treatments, work methods, and procedures to eliminate the sources of quality problems, rather than allowing existing conditions to continue. That is, they insist that every job be done correctly without error ("do it right the first time"), rather than relying on inspection to catch mistakes and make corrections after they occur. To compete on a global scale, U.S. companies continue to emphasize a quality orientation. All employees, not just managers, participate in quality efforts, and firms have embraced new methods to measure progress and to identify areas for improvement. In many organizations, quality improvement has become a way of life.

The Quality-Productivity Connection

It's no secret that *quality* and *productivity* are watchwords in today's competitive environment. Companies are not only measuring productivity and insisting on improvements; they also are requiring that quality bring greater satisfaction to customers, improve sales, and boost profits.

Productivity *the amount of output produced compared with the amount of resources used to produce that output*

Productivity is a measure of economic performance: It compares how much we produce with the resources we use to produce it. The formula is fairly simple. The more services and goods we can produce while using fewer resources, the more productivity grows and the more everyone—the economy, businesses, and workers—benefits. At the national level, the most common measure is called *labor productivity*, because it uses the amount of labor worked as the resource to compare against the benefits, the country's GDP, resulting from using that resource:

$$\text{Labor productivity of a country} = \frac{\text{GDP for the year}}{\text{Total number of labor hours worked for the year}}$$

This equation illustrates the general idea of productivity. We prefer the focus on labor, rather than on other resources (such as capital or energy), because most countries keep accurate records on employment and hours worked. Thus, national labor productivity can be used for measuring year-to-year changes and to compare productivities with other countries. For 2014, for example, U.S. labor productivity was $64.12 of output per hour worked by the nation's labor force. By comparison, Norway was $86.61, Ireland was $71.31, and Belgium was $60.17. In contrast, the Republic of Korea was $26.83, lowest among the 20 measured countries.[17]

However, focusing on just the amount of output is a mistake because productivity refers to both the *quantity and quality* of what we produce. When resources are used more efficiently, the quantity of output is certainly greater. But experience has shown businesses that unless the resulting products are of satisfactory quality, consumers will reject them. And when consumers don't buy what is produced, GDP suffers and productivity falls. Producing quality, then, means creating fitness for use—offering features that customers want.

Managing for Quality

Total Quality Management (TQM) *all activities involved in getting high-quality goods and services into the marketplace*

Total quality management (TQM) includes all the activities necessary for getting high-quality goods and services into the marketplace. TQM begins with leadership and a desire for continuously improving both processes and products. It must consider all aspects of a business, including customers, suppliers, and employees. To marshal the interests of all these stakeholders, TQM first evaluates the costs of poor quality. TQM then identifies the sources causing unsatisfactory quality, assigns responsibility for corrections, and ensures that those who are responsible take steps for improving quality.

The Cost of Poor Quality

As seen prominently in the popular press, Toyota recalled more than 24 million cars in 2009–2013, costing the world's then-number-one automaker billions of dollars and a severe blemish to its high-quality image. Problems ranging from sticking gas pedals to stalling engines and malfunctioning fuel pumps were dangerous and costly not only to Toyota, but also to many consumers.

As with goods producers, service providers and customers suffer financial distress from poor-quality service products. The banking industry is a current example. As a backbone of the U.S. financial system, banks and their customers are still suffering because of bad financial products, most notably home mortgage loans. Lenders during "good times" began relaxing (or even ignoring altogether) traditional lending standards for determining whether borrowers were creditworthy. Lenders in some cases intentionally overstated property values so customers could borrow more money than the property justified. Borrowers were sometimes encouraged to overstate (falsify) their incomes and were not required to present evidence of income or even employment. Some borrowers, unaware of the terms of their loan agreements, were surprised after an initial time lapse when a much higher interest rate (and monthly payment) suddenly kicked in. Unable to meet their payments, borrowers had to abandon their homes. Meanwhile, banks were left holding foreclosed properties, unpaid (defaulted) loans, and no cash. With shortages of bank funds threatening to shut down the entire financial system, the entire nation felt the widespread costs of

poor quality—loss of equity by homeowners from foreclosures, a weakened economy, high unemployment, and loss of retirement funds in peoples' savings accounts.

Quality Ownership: Taking Responsibility for Quality To ensure high-quality goods and services, many firms assign responsibility for some aspects of TQM to specific departments or positions. These specialists and experts may be called in to assist with quality-related problems in any department, and they keep everyone informed about the latest developments in quality-related equipment and methods. They also monitor quality-control activities to identify areas for improvement.

The backbone of TQM, however, and its biggest challenge, is motivating all employees and the company's suppliers to achieve quality goals. Leaders of the quality movement use various methods and resources to foster a quality focus, such as training, verbal encouragement, teamwork, and tying compensation to work quality. When those efforts succeed, employees and suppliers will ultimately accept **quality ownership**, the idea that quality belongs to each person who creates it while performing a job.

Quality Ownership *principle of total quality management that holds that quality belongs to each person who creates it while performing a job*

With TQM, everyone—purchasers, engineers, janitors, marketers, machinists, suppliers, and others—must focus on quality. At Saint Luke's Hospital of Kansas City, for example, every employee receives the hospital's "balanced scorecard" showing whether the hospital is meeting its goals: fast patient recovery for specific illnesses, 94 percent or better patient-satisfaction rating, every room cleaned when a patient is gone to X-ray, and the hospital's return on investment being good enough to get a good bond rating in the financial markets. Quarterly scores show the achievement level reached for each goal. Every employee can recite where the hospital is excelling and where it needs improvement. In recognition of its employees' dedication to quality performance, Saint Luke's received the Malcolm Baldrige National Quality Award, the prestigious U.S. award for excellence in quality, and is a three-time winner of the Missouri Quality Award.[18]

Tools for Total Quality Management

Hundreds of tools have proven useful for quality improvement, ranging from statistical analysis of product data, to satisfaction surveys of customers, to **competitive product analysis**, a process by which a company analyzes a competitor's products to identify desirable improvements. Using competitive analysis, for example, Toshiba might take apart a Xerox copier and test each component. The results would help managers decide which Toshiba product features are satisfactory, which features should be upgraded, and which operations processes need improvement. In this section, we survey five of the most commonly used tools for TQM: (1) *value-added analysis*, (2) *quality improvement teams*, (3) *getting closer to the customer*, (4) *the ISO series*, and (5) *business process reengineering*.

Competitive Product Analysis *process by which a company analyzes a competitor's products to identify desirable improvements*

Value-Added Analysis **Value-added analysis** refers to the evaluation of all work activities, materials flows, and paperwork to determine the value that they add for customers. It often reveals wasteful or unnecessary activities that can be eliminated without jeopardizing customer service. The basic tenet is so important that Tootsie Roll Industries, the venerable candy company, employs it as a corporate principle: "We run a trim operation and continually strive to eliminate waste, minimize cost, and implement performance improvements."[19]

Value-added Analysis *process of evaluating all work activities, materials flows, and paperwork to determine the value that they add for customers*

Quality Improvement Teams Companies throughout the world have adopted **quality improvement teams**, which are patterned after the successful Japanese concept of *quality circles*, collaborative groups of employees from various work areas who meet regularly to define, analyze, and solve common production problems. The teams' goal is to improve both their own work methods and the products they make. Quality improvement teams organize their own work, select leaders, and address problems in the workplace. For years, Motorola has sponsored

Quality Improvement Team *total quality management tool in which collaborative groups of employees from various work areas work together to improve quality by solving common shared production problems*

companywide team competitions to emphasize the value of the team approach, to recognize outstanding team performance, and to reaffirm the team's role in the company's continuous-improvement culture.

Getting Closer to the Customer Successful businesses take steps to know what their customers want in the products they consume. On the other hand, struggling companies have often lost sight of customers as the driving force behind all business activity. Such companies waste resources by designing products that customers do not want. Sometimes, they ignore customer reactions to existing products, an example of which is the outpouring of complaints about airline services that go unanswered (see this chapter's opening case). Or companies fail to keep up with changing customer preferences. BlackBerry mobile devices, for example, fell behind competing products because they did not offer customers the features that Samsung, Motorola, and Apple provided.

Successful firms take steps to know what their customers want in the products they consume. Caterpillar's (CAT) financial services department, for example, received the Malcolm Baldrige National Quality Award for high ratings by its customers (that is, dealers and buyers of Caterpillar equipment). Buying and financing equipment from Cat Financial became easier as CAT moved its services increasingly online. Customers now have 24/7 access to information on how much they owe on equipment costing anywhere from $30,000 to $2 million, and they can make payments around the clock, too. In the past, the 60,000 customers had to phone a Cat representative, who was often unavailable, resulting in delays and wasted time. The improved online system is testimony to Cat Financial's dedication in knowing what customers want, and then providing it.[20]

Identifying Customers—Internal and External Improvement projects are undertaken for both external and internal customers. Internal suppliers and internal customers exist wherever one employee or activity relies on others. For example, marketing managers rely on internal accounting information—costs for materials, supplies, and wages—to plan marketing activities for coming months. The marketing manager is a customer of the firm's accountants, the information user relies on the information supplier. Accountants in a TQM environment recognize this supplier–customer connection and take steps to improve information for marketing.

The ISO Series Perhaps you've driven past companies proudly displaying large banners announcing, "This Facility Is ISO Certified." The ISO (pronounced ICE-oh) label is a mark of quality achievement that is respected throughout the world and, in some countries, it's a requirement for doing business.

ISO 9000 *program certifying that a factory, laboratory, or office has met the quality management standards set by the International Organization for Standardization*

ISO 9000 **ISO 9000** is a certification program attesting that a factory, a laboratory, or an office has met the rigorous quality management requirements set by the International Organization for Standardization (ISO). Today, more than 170 countries have adopted ISO 9000 as a national standard. Over 1 million certificates have been issued to organizations worldwide meeting the ISO standards.

The standards of *ISO 9000* allow firms to show that they follow documented procedures for testing products, training workers, keeping records, and fixing defects. It allows international companies to determine (or be assured of) quality of product (or the business) when shipping for, from, and to suppliers across borders. To become certified, companies must document the procedures followed by workers during every stage of production. The purpose is to ensure that a company's processes can create products exactly the same today as it did yesterday and as it will tomorrow.

ISO 14000 *certification program attesting to the fact that a factory, laboratory, or office has improved its environmental performance*

ISO 14000 The **ISO 14000** program certifies improvements in environmental performance by requiring a firm to develop an *environmental management system*: a plan documenting how the company has acted to improve its performance in using resources (such as raw materials) and in managing pollution. A company must not only identify hazardous wastes that it expects to create, but it must also stipulate plans for treatment and disposal.

Business Process Reengineering Every business consists of processes, activities that it performs regularly and routinely in conducting business, such as receiving and storing materials from suppliers, billing patients for medical treatment, filing insurance claims for auto accidents, and filling customer orders from Internet sales. Any business process can increase customer satisfaction by performing it well. By the same token, any business process can disappoint customers when it's poorly managed.

Business process reengineering focuses on improving a business process—rethinking each of its steps by starting from scratch. *Reengineering* is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements as measured by cost, quality, service, and speed. The discussion of CAT's changeover to an online system for customers is an example. CAT reengineered the whole payments and financing process by improving equipment, retraining employees, and connecting customers to CAT's databases. As the example illustrates, redesign is guided by a desire to improve operations and thereby provide higher-value services for customers.

Business Process Reengineering *rethinking and radical redesign of business processes to improve performance, quality, and productivity*

Adding Value Through Supply Chains

OBJECTIVE 7-8
Explain
how a supply chain strategy differs from traditional strategies for coordinating operations among firms.

The term *supply chain* refers to the group of companies and stream of activities that work together to create a product. A **supply chain** (or **value chain**) for any product is the flow of information, materials, and services that starts with raw-materials suppliers and continues adding value through other stages in the network of firms until the product reaches the end customer.

Supply Chain (Value Chain) *flow of information, materials, and services that starts with raw-materials suppliers and continues adding value through other stages in the network of firms until the product reaches the end customer*

Figure 7.13 shows the chain of activities for supplying baked goods to consumers. Each stage adds value for the final customer. This bakery example begins with raw materials (grain harvested from the farm). It also includes storage and transportation activities, factory operations for baking and wrapping, and distribution to retailers. Each stage depends on the others for success in getting freshly baked goods to consumers. However, a failure by any link can spell disaster for the entire chain.

The Supply Chain Strategy

Traditional strategies assume that companies are managed as individual firms rather than as members of a coordinated supply system. Supply chain strategy is based on the idea that members of the chain will gain competitive advantage by working as a coordinated unit. Although each company looks out for its own interests, it works

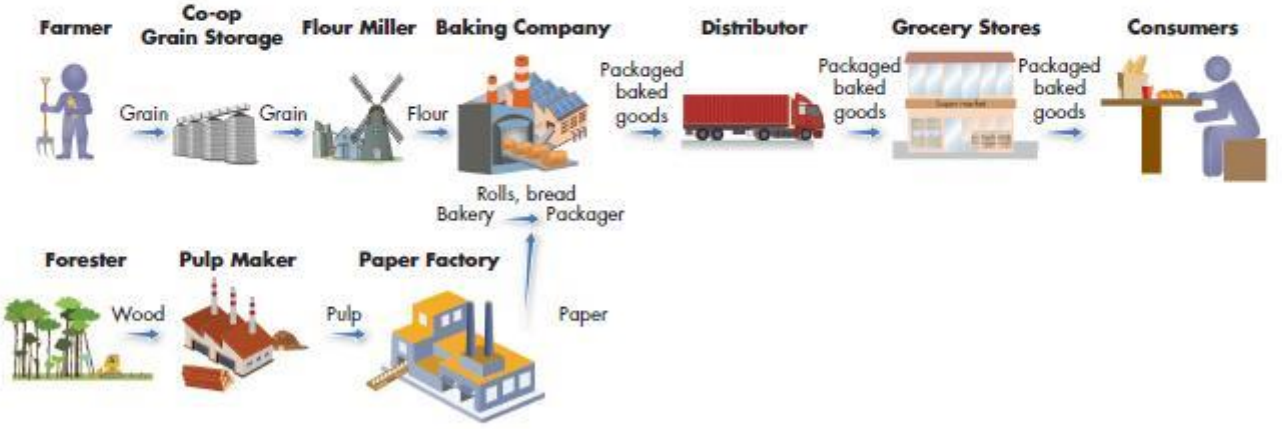

FIGURE 7.13 Supply Chain for Baked Goods

closely with suppliers and customers throughout the chain. Everyone focuses on the entire chain of relationships rather than on just the next stage in the chain.

A traditionally managed bakery, for example, would focus simply on getting production inputs from flour millers and paper suppliers, and then on supplying baked goods to distributors. Unfortunately, this approach limits the chain's performance and doesn't allow for possible improvements when activities are more carefully coordinated. Proper management and better coordination among supply chain activities can provide fresher baked goods at lower prices.

Supply Chain Management (SCM) *principle of looking at the supply chain as a whole to improve the overall flow through the system*

Supply Chain Management

Supply chain management (SCM) looks at the chain as a whole to improve the overall flow through a system composed of companies working together. Because customers ultimately get better value, supply chain management gains competitive advantage for each of the chain's members.

An innovative supply chain strategy was the heart of Michael Dell's vision when he established Dell Inc. Dell's concept improves performance by sharing information among chain members. Dell's long-term production plans and up-to-the-minute sales data are available to suppliers via the Internet. The process starts when customer orders are automatically translated into updated production schedules in the factory. These schedules are used not only by operations managers at Dell but also by such parts suppliers as Sony, which adjust their own production and shipping activities to better meet Dell's production needs. In turn, parts suppliers' updated schedules are transmitted to their materials suppliers, and so on up the chain. As Dell's requirements change, suppliers up and down the chain synchronize their schedules to produce only the right materials and parts. As a result, Dell's prices are low and turnaround time for shipping PCs to customers is reduced to a matter of hours instead of days.

Reengineering Supply Chains for Better Results

Process improvements and reengineering often are applied in supply chains to lower costs, speed up service, and coordinate flows of information and material. Because the smoother flow of accurate information along the chain reduces unwanted inventories and transportation, avoids delays, and cuts supply times, materials move faster to business customers and individual consumers. SCM offers faster deliveries and lower costs than customers could get if each member acted only according to its own operations requirements.

Outsourcing and Global Supply Chains

Outsourcing *replacing internal processes by paying suppliers and distributors to perform business processes or to provide needed materials or services*

Outsourcing is the strategy of paying suppliers and distributors to perform certain business processes or to provide needed materials or services. The decision to outsource expands supply chains. The movement of manufacturing and service operations from the United States to countries such as China, Mexico, and India has reduced U.S. employment in traditional jobs. It has also created new operations jobs for SCM. Maytag, for example, had to develop its own internal global operations expertise before it could decide to open a new refrigerator factory in Mexico, import refrigerators from South Korea's Daewoo, and get laundry appliances from South Korea's Samsung Electronics. In departing from a long-standing practice of domestic production, Maytag adopted new supply chain skills for evaluating prospective outsourcing partners.

Skills for coordinating Maytag's domestic activities with those of its cross-border partners didn't end with the initial decision to get appliances from Mexico and Korea. Maytag personnel in their Newton, Iowa, headquarters have near-constant interaction with their partners on a host of continuing new operations issues. Product redesigns are transferred from the United States and used at remote manufacturing sites. Arrangements for cross-border materials flows require compliance with each country's commerce regulations. Production and global transportation scheduling

finding a better way

Too Good to Waste

In 2013, the Food and Agriculture Organization of the United Nations released a report on the impact of food waste. Among its more disturbing findings were that approximately one-third of all food produced is wasted or lost. According to FAO Director-General Jose Graziano da Silva, "We simply cannot allow one-third of all the food we produce to go to waste or be lost because of inappropriate practices, when 870 million people go hungry every day." According to this study, food waste occurs along the supply chain, with fifty-four percent occurring during production, post-harvest handling, and storage. However, there are some differences among low-income countries and their middle- and high-income counterparts. "Downstream" waste, at the retail or consumer level, is much higher in developed economies, creating additional opportunities for consumer education in these areas.

Nathaniel Noir/Alamy

In addition to the human impacts of food wastage, there are dire environmental consequences. For example, meat wastage has the most severe environmental consequences as the land use and carbon footprint associated with meat production is much higher. Unused grain and cereal products, such as rice, impact both land use and methane emissions (which are particularly high in rice production). On the other hand, the impact of fruit waste tends to be primarily associated with excess water consumption. Given the increasing scarcity of water supplies, this concern is not easily dismissed.

The key to minimizing food waste falls in supply chain management. Beginning with the producer, it is essential that predictive analytics are employed to balance production with downstream demand for the product. Even with better modeling, food surpluses will continue to occur, but they could be better managed. Rather than disposing of excess food in the supply chain, intermediaries need to be more diligent about finding alternative uses, whether it is donating it to food programs or diverting it for livestock feed. Consumers must also be educated about the importance of planning their food spending to avoid over-purchasing as well as the actual meaning of "best-before-dates," which often lead retailers and consumers to discard healthy and nutritious foods because they fail to meet certain aesthetic standards. Each member of the supply chain, from producer to consumer, has a role in reducing food waste, becoming better stewards of our planet and resources.[21]

are coordinated with U.S. market demand so that outsourced products arrive in the right amounts and on time without tarnishing Maytag's reputation for high quality. Although manufacturing operations are located remotely, they are closely integrated with the firm's home-base activities. That tightness of integration demands on-site operations expertise on both sides of the outsourcing equation. Global communication technologies are essential. The result for outsourcers is a greater need of operations skills for integration among dispersed facilities.

OBJECTIVE 7-3

Explain how companies with different business strategies are best served by having different operations capabilities. (pp. 208–209)

Production is a flexible activity that can be molded into many shapes to give different operations capabilities (production capabilities) for different purposes. Its design is best driven from above by the firm's larger business strategy. When firms adopt different strategies for winning customers in specific target markets, they should also adjust their *operations capabilities*—what production must do especially well—to match the chosen strategy. That is, different target markets have different desires or expectations for the products—services and goods—that they seek. Accordingly, operations managers must clarify and understand their target market's most-preferred product characteristic from among the following: Do they want low-cost products? Highest quality products? Dependability of product performance? A wide variety of offerings rather than just a few? To meet any chosen strategy, then, they adopt an operations capability that is geared toward meeting the target customers' needs. The operations capability that is appropriate for a low-cost strategy, for example, is different than the kind of competence that is best for a dependability strategy. Accordingly, the operations characteristics, such as number and size of production facilities, employee skills, kinds of equipment, and its operations activities, will be different, resulting in different operations capabilities to better support their different purposes.

OBJECTIVE 7-4

Identify the major factors that are considered in operations planning. (pp. 210–215)

Operations planning includes five major considerations: (1) *Capacity planning* considers current and future capacity requirements for meeting anticipated customer demand. The amount of a product that a company can produce under normal conditions is its *capacity*, and it depends on how many people it employs and the number and sizes of its facilities. (2) *Location planning* is crucial because a firm's location affects costs of production, ease of transportation, access to skilled workers, and convenient accessibility for customers. (3) *Layout planning* determines the physical location of service teams, machinery, equipment, and facilities and affects how efficiently a company can respond to customer demand. A *process (custom-products) layout* is effective for make-to-order production specializing in custom designed services or goods. A *product (same-steps) layout*, such as an assembly line, is often used for large-volume, make-to-stock production of services or goods. A *fixed-position layout* is necessary when, because of size, shape, or any other reason, the service to be provided cannot be moved to another facility. Instead, the product or client remains at one location; equipment, materials, and human skills are moved to that location, as needed, to perform the service or to build the product. (4) *Quality planning* begins when products are being designed and extends into production operations for ensuring that the desired performance and consistency are built into products. Quality is defined as the combination of "characteristics of a product or service that bear on its ability to satisfy stated or implied needs." Quality planning involves setting goals for both *performance* and *consistency*. (5) *Methods planning* considers each production step and the specific methods for performing it for producing services and goods. The purpose is to reduce waste and inefficiency by methods improvement procedures.

OBJECTIVE 7-5

Discuss the information contained in four kinds of operations schedules—the master operations schedule, detailed schedule, staff schedule, and project schedule. (pp. 215–218)

Operations scheduling identifies times when specific operations activities will occur. The *master schedule*, the top-level schedule for upcoming production, shows how many of which products (services or goods) will be produced in each time period, in weeks or months ahead, to meet

upcoming customer demand. Thereafter, the schedule shows how many units of each major resource—materials, employees, equipment—will be required. By identifying these future resource requirements, managers can develop plans for acquiring the resources on time for upcoming time periods.

Detailed schedules take a shorter-range perspective by specifying daily work assignments with start and stop times for assigned jobs at each workstation. Detailed schedules allow managers and other employees to make last-minute adjustments so that resources are available and matched to meet immediate customer service requirements.

Staff schedules identify who and how many employees will be working and their assigned working times on each work shift for the upcoming month or months. Staff scheduling considers the needs of employees as well as the company's goals of maximizing efficiency and controlling costs.

Finally, *project schedules* provide information for completing large-scale projects using project scheduling tools, such as Gantt and *PERT charts*. *A Gantt chart* breaks down special large projects into the sequence of steps to be performed and specifies the time required to perform each. Gantt charts help managers to assess if work is ahead or behind schedule so that adjustments can be made. PERT charts show the necessary sequence among activities, and identify the critical path—the most time-consuming set of activities for completing the project.

OBJECTIVE 7-6

Discuss the two key activities required for operations control. (pp. 218–220)

Materials management and quality control are two key activities of operations control. Once plans and schedules have been drawn up, operations control requires managers to monitor performance by comparing results against those plans and schedules. If schedules or quality standards are not met, managers take corrective action. Follow-up—checking to ensure that decisions are being implemented—is an essential facet of operations control. Materials management—including supplier selection, purchasing, transportation, warehousing, and inventory control—facilitates the flow of materials. Materials management is the process by which managers plan, organize, and control the flow of materials and services from sources of supply through distribution of finished products to customers. For producing and delivering physical goods, it may use lean production systems, such as just-in-time operations, for smooth production flows that avoid inefficiencies, comply with schedules, eliminate unnecessary inventories, and continuously improve production processes. For high-contact services, such as tourism and vacation services, inventory exists in the form of information about service offerings, facilities arrangements, clients, client interests, activities schedules, and plans for interactions among and with clients. Quality control means taking action to ensure that operations produce goods and services that meet specific quality standards. By monitoring products and services, managers and other employees can detect mistakes, identify potential quality failures, and make corrections to avoid poor quality. Both materials management and quality control are essential to ensure that schedules are met and products delivered, both in quality and quantity.

OBJECTIVE 7-7

Identify the activities and underlying objectives involved in total quality management. (pp. 220–225)

Successful companies focus on productivity, which measures both the quantity and quality of the products produced or delivered. Productivity compares the level of production with the amount of resources used to produce it. *Total quality management* (*TQM*) is a customer-driven culture for offering products with characteristics that customers want. It includes all the activities necessary for getting customer-satisfying goods and services into the marketplace and, internally, getting every job to give better service to internal customers (other departments) within the organization. TQM begins with leadership and a desire for continuously improving both processes and products. It considers all aspects of a business, including customers, suppliers, and employees. The TQM culture fosters an attitude of *quality ownership* among employees and suppliers, the idea that quality belongs to each person who creates it while performing a job, so that quality improvement becomes a continuous way of life. It identifies the *costs of poor quality*, including all forms of financial distress resulting from

poor-quality products, and uses cost-of-poor-quality information as a guide for process improvement to prevent such costs in the future.

Numerous quality-improvement tools can then be used to gain those improvements and reduce those costs. Some process improvement tools of TQM include competitive product analysis, value-added analysis, the use of quality improvement teams, business process reengineering, and "getting closer to the customer" to gain valid information of what customers really want, so that improved products more closely meet customer desires.

ISO 9000 is a certification program attesting that a factory, laboratory, or office has met the rigorous quality management requirements set by the International Organization for Standardization. Similarly, *ISO 14000* certifies improvements in environmental performance. Finally, business process reengineering focuses on the radical redesign of business processes to achieve improvements in cost, quality, service, and speed.

OBJECTIVE 7-8

Explain how a supply chain strategy differs from traditional strategies for coordinating operations among firms. (pp. 225–227)

The supply chain strategy is based on the idea that members of the *supply chain*, the stream of all activities and companies that add value in creating a product, will gain competitive advantage by working together as a coordinated unit. The supply chain for any product, be it a service or a physical good, is the flow of information, materials, and services that starts with raw-materials suppliers and continues adding value through other stages in the network of firms until the product reaches the end customer. In contrast, traditional strategies assume that companies are managed as individual firms, each acting in its own interest. By managing the chain as a whole—using *supply chain management*—companies can more closely coordinate activities throughout the chain. Because accurate information is shared between companies along the chain, they can reduce unwanted materials and transportation, avoid delays in deliveries to cut supply times, quickly add service centers to meet upsurges in demand, and move materials faster through the chain. By sharing information across all stages in the chain, overall costs and inventories can be reduced, quality can be improved, and overall flow through the system improves, thus providing customers higher value from faster deliveries and lower costs.

Outsourcing, the strategy of paying suppliers and distributors to perform certain business processes or to provide needed materials or services, expands supply chains. The prevalence of outsourcing has created new operations jobs in supply chain management.

key terms

assembly line layout (p. 212)
business process reengineering (p. 225)
capacity (p. 210)
competitive product analysis (p. 223)
consistency (p. 214)
detailed schedule (p. 216)
fixed-position layout (p. 213)
follow-up (p. 218)
Gantt chart (p. 217)
goods operations (goods production) (p. 202)
high-contact system (p. 207)
inventory control (p. 219)
ISO 9000 (p. 224)
ISO 14000 (p. 224)
just-in-time (JIT) production (p. 219)
lean production system (p. 219)
low-contact system (p. 207)
make-to-order operations (p. 207)
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