



Producing Quality Goods and Services

8

Learning Objectives

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What you will be able to do once you complete this chapter:

- 1** Explain the nature of production.
- 2** Outline how the conversion process transforms raw materials, labor, and other resources into finished products or services.
- 3** Describe how research and development lead to new products and services.
- 4** Discuss the components involved in planning the production process.
- 5** Explain how purchasing, inventory control, scheduling, and quality control affect production.
- 6** Summarize how productivity and technology are related.

Did You Know?

With factories or offices in nearly every country on Earth, Nestlé rings up more than \$100 billion in global revenue and employs 280,000 people worldwide.

Nestlé Plans Ahead for Quality Production

From chocolate bars to coffee to cat food, quality food manufacturing is always on the menu at Switzerland's Nestlé. Among the company's best-known brands are Nescafé, Nesquik, Kit Kat, Häagen-Dazs, Lean Cuisine, Juicy Juice, Purina, and Fancy Feast. Nestlé's U.S. sales top \$10 billion, and its global sales exceed \$100 billion. The company employs 280,000 people worldwide and manufactures foods and beverages on every continent.

Whereas some big companies outsource most of their production to other firms, Nestlé generally handles its own. As a result, management can tightly control every aspect of the operation, from the careful selection of ingredients and the maintenance of equipment to the timing and quality of production and packaging. Sometimes Nestlé partners with a local manufacturer for competitive reasons, such as speeding a new product to market. Still, "we invariably find that we are much more cost-effective in-house than out-of-house," a Nestlé executive explains.

To be more responsive to customers' needs and tap the resources of local suppliers, Nestlé prefers to locate production in or near the markets it serves. It operates 26 manufacturing plants in the United States alone, including a state-of-the-art facility recently opened in Anderson, Indiana. The 900,000-square-foot plant makes liquid Nesquik and Coffee-Mate products using ultra-high-temperature processing and cutting-edge packaging technology. In the past, Nestlé had to keep these dairy products chilled after production to maintain quality and freshness. Now, thanks to the new production process, the products are "shelf stable" and can be distributed and stored without special refrigeration, adding to their convenience.

Sustainability is also on Nestlé's menu. As it builds new plants and updates existing facilities, the company has been incorporating numerous features that help the environment by conserving energy, reducing harmful emissions, and cutting waste. For example, the Anderson, Indiana, plant was designed to meet the U.S. Green Building Council's energy and environmental guidelines for sustainability. When Nestlé expanded its Solon, Ohio, plant, the company substituted landfill gas for most of the natural gas used to power production. In the process of making its products greener, Nestlé is redesigning some packaging to increase the amount of biodegradable materials used. Small wonder that Nestlé has become known for its social responsibility, not just its quality.¹

There's a good chance when you saw the name Nestlé in the opening case for this chapter you thought about chocolate milk or chocolate candy—products you see everyday. However, this company is so much more. Consider three factors about Nestlé. First, the company is profitable because it produces products that customers want or need. Like most companies, it wants to increase sales and profits, but it all starts with the customer. Second, Nestlé is concerned with quality. The manufacturing process begins with the selection of suppliers to get just the right ingredients. Then each step of the production process is examined to make sure that quality is a high priority. Finally, Nestlé is a socially responsible company. Among the company's top concerns are its employees, the environment, and giving something back to the communities in which it operates. Today, it is quite common to hear of profitable companies. It is less common to hear of profitable companies that are held in high regard by their competitors. And yet, Nestlé has managed to do both—earn both profits and respect. Nestlé is an excellent example of what this chapter's content—the production of quality goods and services—is all about.

We begin this chapter with an overview of operations management—the activities required to produce goods and services that meet the needs of customers. In this

section, we also discuss the role of manufacturing in the U.S. economy, competition in the global marketplace, and careers in operations management. Next, we describe the conversion process that makes production possible and also note the growing role of services in our economy. Then we examine more closely three important aspects of operations management: developing ideas for new products, planning for production, and effectively controlling operations after production has begun. We close the chapter with a look at the productivity trends and the ways that productivity can be improved through the use of technology.

What Is Production?

Have you ever wondered where a new pair of Levi jeans comes from? Or a new Mitsubishi flat-screen television, Izod pullover sweater, or Uniroyal tire for your car? Even factory service on a Hewlett-Packard computer or a Maytag clothes dryer would be impossible if it weren't for the activities described in this chapter. In fact, these products and services and millions of others like them would not exist if it weren't for production activities.

Let's begin this chapter by reviewing what an operating manager does. In Chapter 6, we described an *operations manager* as a person who manages the systems that convert resources into goods and services. This area of management is usually referred to as **operations management**, which consists of all the activities managers engage in to produce goods and services.

To produce a product or service successfully, a business must perform a number of specific activities. For example, suppose that Chevrolet has an idea for a new version of the sporty Camaro that will cost approximately \$30,000. Marketing research must determine not only if customers are willing to pay the price for this product but also what special features they want. Then Chevrolet's operations managers must turn the idea into reality.

Chevrolet's managers cannot just push the "start button" and immediately begin producing the new automobile. Production must be planned. As you will see, planning takes place both *before* anything is produced and *during* the production process.

Managers also must concern themselves with the control of operations to ensure that the organization's goals are achieved. For a product such as Chevrolet's Camaro, control of operations involves a number of important issues, including product quality, performance standards, the amount of inventory of both raw materials and finished products, and production costs.

We discuss each of the major activities of operations management later in this chapter. First, however, let's take a closer look at American manufacturers and how they compete in the global marketplace.

How American Manufacturers Compete in the Global Marketplace

After World War II, the United States became the most productive country in the world. For almost 30 years, until the late 1970s, its leadership was never threatened. By then, however, manufacturers in Japan, Germany, Great Britain, Taiwan, Korea, Sweden, and other industrialized nations were offering U.S. firms increasing competition. Now the Chinese are manufacturing everything from sophisticated electronic equipment and automobiles to less expensive everyday items—often at a lower cost than the same goods can be manufactured in other countries.

When assessing manufacturing in the United States, there is both good and bad news. First, the bad news: The number of Americans employed in the manufacturing sector has decreased. Currently,

1

Explain the nature of production.

operations management all activities managers engage in to produce goods and services



Where did these blue toy rabbits come from?

Answer: China. In today's competitive global marketplace, many products like these stuffed animals are manufactured in China and then shipped to nations around the globe. Today, people in all nations want to sell the products and services they produce to customers in their own nation and to customers in the global marketplace. In fact, experts say the world has become a smaller place because of increased global trade.

approximately 12 million U.S. workers are employed in manufacturing jobs—down from just over 19 million back in 1979.² Many of the manufacturing jobs that were lost were outsourced to low-wage workers in nations where there are few labor and environmental regulations. Finally, the number of unemployed factory workers increased during the recent economic crisis because of decreased consumer demand for manufactured goods. As a result of the previously noted factors, manufacturing accounts for only about 11 percent of the current work force.³ Since 1979, 7 million jobs have been lost, and many of those jobs aren't coming back.

Now, the good news. The United States remains the largest manufacturing country in the world—producing approximately 20 percent of total global manufacturing output.⁴ As a result, the manufacturing sector is still a very important part of the U.S. economy. Although the number of manufacturing jobs has declined, productivity has increased. At least two very important factors account for increases in productivity: First, innovation—finding a better way to produce products—is the key factor that has enabled American manufacturers to compete in the global marketplace. Often, innovation is the result of manufacturers investing money to purchase new, state-of-the-art equipment that helps employees improve productivity. Second, today's workers in the manufacturing sector are highly skilled in order to operate sophisticated equipment. Simply put, Americans are making more goods, but with fewer employees.

Even more good news. Many American manufacturers that outsourced work to factories in foreign nations are once again beginning to manufacture goods in the United States. For example, General Electric (GE) built a new plant in Louisville, Kentucky, to manufacture hybrid electric water heaters. Before the Kentucky plant was built, the water heaters were manufactured in China.⁵ Increasing labor costs in foreign nations, faster product development when goods are produced in the United States, the ability to quickly customize existing products to meet customer needs, and federal and state subsidies all help account for this trend in U.S. manufacturing.

Although the global marketplace has never been more competitive, the most successful U.S. firms have focused on the following:

1. Motivating employees to cooperate with management and improve productivity.
2. Reducing costs by selecting suppliers that offer higher quality raw materials and components at reasonable prices.
3. Using computer-aided and flexible manufacturing systems that allow a higher degree of customization.
4. Improving control procedures to help ensure lower manufacturing costs.
5. Using green manufacturing to conserve natural resources and sustain the planet.

Although competing in the global economy is a major challenge, it is a worthwhile pursuit. For most firms, competing in the global marketplace is not only profitable but also an essential activity that requires the cooperation of everyone within the organization.

Careers in Operations Management

Although it is hard to provide information about specific career opportunities in operations management, some generalizations do apply to this management area. First, you must appreciate the manufacturing process and the steps required to produce a product or service. A basic understanding of mass production and the difference between an analytical process and a synthetic process is essential.

Mass production is a manufacturing process that lowers the cost required to produce a large number of identical or similar products over a long period of time. An **analytical process** breaks raw materials into different component parts. For example, a barrel of crude oil refined by Marathon Oil Corporation—a Texas-based oil and chemical refiner—can be broken down into gasoline, oil, and lubricants and many other petroleum by-products. A **synthetic process** is just the opposite of the analytical one; it combines raw materials or components to create a finished product. Black & Decker uses a synthetic process when it combines plastic, steel, rechargeable batteries, and other components to produce a cordless drill.

mass production a manufacturing process that lowers the cost required to produce a large number of identical or similar products over a long period of time

analytical process a process in operations management in which raw materials are broken into different component parts

synthetic process a process in operations management in which raw materials or components are combined to create a finished product

Once you understand that operations managers are responsible for producing tangible products or services that customers want, you must determine how you fit into the production process. Today's successful operations managers must:

1. Be able to motivate and lead people.
2. Understand how technology can make a manufacturer more productive and efficient.
3. Appreciate the control processes that help lower production costs and improve product quality.
4. Understand the relationship between the customer, the marketing of a product, and the production of a product.

If operations management seems like an area you might be interested in, why not do more career exploration? You could take an operations management course if your college or university offers one, or you could obtain a part-time job during the school year or a summer job in a manufacturing company.

The Conversion Process

The purpose of manufacturing is to provide utility to customers. **Utility** is the ability of a good or service to satisfy a human need. Although there are four types of utilities—form, place, time, and possession—operations management focuses primarily on form utility. **Form utility** is created by people converting raw materials, finances, and information into finished products. The other types of utility—place, time, and possession—are discussed in Chapter 12.

But how does the conversion take place? How does Kellogg's convert grain, sugar, salt, and other ingredients; money from previous sales and stockholders' investments; production workers and managers; and economic and marketing forecasts into Frosted Flakes cereal products? How does New York Life Insurance convert office buildings, insurance premiums, actuaries, and mortality tables into life insurance policies? They do so through the use of a conversion process like the one illustrated in Figure 8.1. As indicated by our New York Life Insurance example, the conversion process is not limited to manufacturing products. The conversion process also can be used to produce services.

Manufacturing Using a Conversion Process

The conversion of resources into products and services can be described in several ways. We limit our discussion here to three: the focus or major resource used in the conversion process, its magnitude of change, and the number of production processes employed.

Focus By the *focus* of a conversion process, we mean the resource or resources that make up the major or most important *input*. The resources are financial, material, information, and people—the same resources discussed in Chapters 1 and 6. For a bank such as Citibank, financial resources are the major resource. A chemical and energy company such as Chevron concentrates on material resources. Your college or university is concerned primarily with information. And temporary employment services, such as Manpower, Inc., focus on the use of human resources.

Magnitude of Change The *magnitude* of a conversion process is the degree to which the resources are physically changed. At one extreme lie such processes as the one by which the Glad Products Company produces Glad

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Outline how the conversion process transforms raw materials, labor, and other resources into finished products or services.

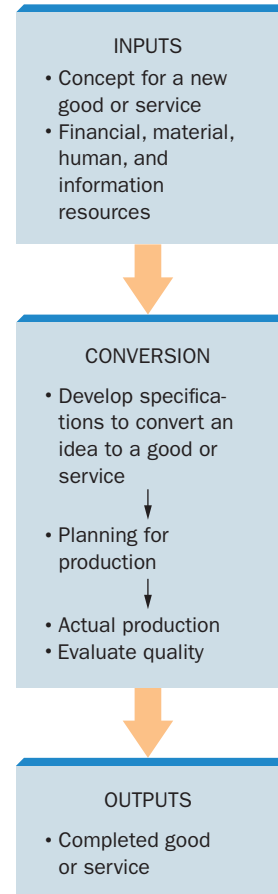
utility the ability of a good or service to satisfy a human need
form utility utility created by people converting raw materials, finances, and information into finished products



Many parts equal one automobile. The conversion process required to manufacture a complicated product like an automobile requires a number of steps *and*, in most cases, 4,000 to 5,000 different parts. In this photo, Derek Hurlburt uses high-tech machinery to bolt the wheels on a new Chevrolet Camaro at the General Motors of Canada plant in Oshawa, Ontario, Canada.

Figure 8.1 The Conversion Process

The conversion process converts ideas and resources into useful goods and services. The ability to create ideas and to produce products and services is a crucial step in the economic development of any nation.



Cling Wrap. Various chemicals in liquid or powder form are combined to produce long, thin sheets of plastic Glad Cling Wrap. Here, the original resources are totally unrecognizable in the finished product. At the other extreme, Southwest Airlines produces *no* physical change in its original resources. The airline simply provides a service and transports people from one place to another.

Number of Production Processes A single firm may employ one production process or many. In general, larger firms that make a variety of products use multiple production processes. For example, GE manufactures some of its own products, buys other merchandise from suppliers, and operates multiple divisions including a finance division, a lighting division, an entertainment division, a medical equipment division, and other divisions responsible for the products and services that customers associate with the GE name. Smaller firms, by contrast, may use one production process. For example, Texas-based Advanced Cast Stone, Inc., manufactures one basic product: building materials made from concrete.

The Increasing Importance of Services

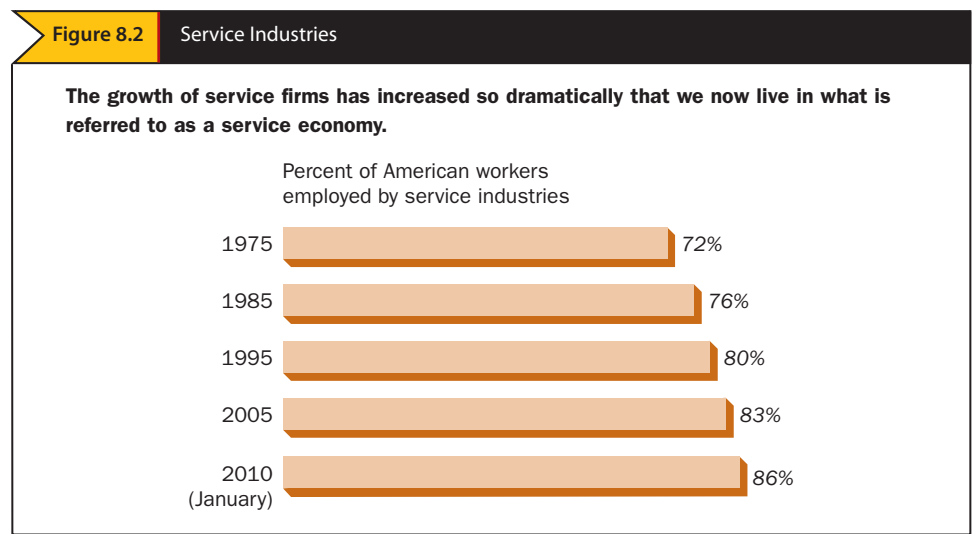
The application of the basic principles of operations management to the production of services has coincided with a dramatic growth in the number and diversity of service businesses. In 1900, only 28 percent of American workers were employed

in service firms. By 1950, this figure had grown to 40 percent, and by 2010, it had risen to 86 percent.⁶ In fact, the American economy is now characterized as a **service economy** (see Figure 8.2). A service economy is one in which more effort is devoted to the production of services than to the production of goods.

Today, the managers of restaurants, laundries, real estate agencies, banks, movie theaters, airlines, travel bureaus, and other service firms have realized that they can benefit from the experience of manufacturers. Yet the production of services is very different from the production of manufactured goods in the following four ways:

1. Services are consumed immediately and, unlike manufactured goods, cannot be stored. For example, a hair stylist cannot store completed haircuts.
2. Services are provided when and where the customer desires the service. In many cases, customers will not travel as far to obtain a service.
3. Services are usually labor-intensive because the human resource is often the most important resource used in the production of services.
4. Services are intangible, and it is therefore more difficult to evaluate customer satisfaction.⁷

Although it is often more difficult to measure customer satisfaction, today's successful service firms work hard at providing the services customers want. Compared with manufacturers, service firms often listen more carefully to customers and respond more quickly to the market's changing needs. For example, Maggiano's Little Italy restaurant is a chain of eating establishments owned by Brinker International. This restaurant prides itself on customer service and wants customers to have an enjoyable dining experience. In order to continuously improve customer service, the restaurant encourages diners to complete online surveys that prompt diners to evaluate the



Source: U.S. Bureau of Labor Statistics Web site, <http://www.bls.gov> (accessed May 1, 2010).

service economy an economy in which more effort is devoted to the production of services than to the production of goods

Ethical Challenges & SUCCESSFUL SOLUTIONS



Ecotourism Services

From boat trips to the remote Galapagos Islands to hikes through the rugged Canadian backcountry, ecotourism to regions of natural beauty is a fast-growing segment of the service economy. Specialized service businesses—large and small—have sprung up to cater to the needs of adventurous travelers who want to visit pristine places all over the planet.

Yet the ecotourism boom has intensified the controversy over bringing travelers to ecologically sensitive destinations. Some people worry that increased tourism will overwhelm fragile ecosystems, increase pollution, and lead to overcommercialization. Proponents say ecotourism attracts much-needed economic development, with more job opportunities and more money to preserve the unique character of scenic areas.

Many local governments strive for balance by limiting the number of tourists at sensitive sites and setting environmental-protection standards for travel firms. Some ecotourism services showcase their ethical side by going beyond the basics. Lindblad Expeditions, for example, donates to conservation groups in the Galapagos and other areas where it operates. Karisia, a safari firm in Kenya, gets visitors out of gas-guzzling all-terrain vehicles with tours on mountain bikes and on foot. “The idea is to get people to appreciate nature through traveling here and supporting the local communities, so they in turn become inspired to protect the animals and everything around them,” says one of the owners.

Sources: Lucy Siegle, “Is It Possible to Be an Eco-Friendly Tourist?” *The Observer (UK)*, November 22, 2009, <http://www.guardian.co.uk>; Simon Horsford, “Hump Day,” *Time International*, August 24, 2009, 49; Lindblad Expeditions, <http://www.expeditions.com>.

research and development

(R&D) a set of activities intended to identify new ideas that have the potential to result in new goods and services

food, atmosphere, service, and other variables. The information from the surveys is then used to fine-tune the way Maggiano’s meets its customers’ needs.

Now that we understand something about the production process that is used to transform resources into goods and services, we can consider three major activities involved in operations management: product development, planning for production, and operations control.

3

Describe how research and development lead to new products and services.

Where Do New Products and Services Come From?

No firm can produce a product or service until it has an idea. In other words, someone first must come up with a new way to satisfy a need—a new product or an improvement in an existing product. Both Apple’s iPad and Amazon’s Kindle began as an idea. Although no one can predict with 100 percent accuracy what types of products will be available in the next five years, it is safe to say that companies will continue to introduce new products that will change our everyday lives.

Research and Development

How did we get the iPad and the Kindle? We got them as a result of people working with new ideas that developed into useful products. In the same way, scientists and researchers working in businesses, colleges, and universities have produced many of the newer products we already take for granted.

These activities generally are referred to as *research and development*. For our purposes, **research and development (R&D)** involves a set of activities intended to identify new ideas that have the potential to result in new goods and services.

Today, business firms use three general types of R&D activities. *Basic research* consists of activities aimed at uncovering new knowledge. The goal of basic

The screenshot shows the 'myaffinia' website interface. At the top, it says 'myaffinia' and 'Customize your stay at myaffinia.com'. Below that is a section titled 'Your Name Here' with a grid of 24 different amenities, each with a small image and a label: hypo-allergenic pillow, buckwheat pillow, island pillow, magnetic therapy pillow, Swedish memory pillow, leather & down pillow, city walking tour, universal charger, contact lens solution, SPAffinia treatment, gel eye mask, rubber duckie, porter, stress kit, special occasion dessert, hair diffuser, Disney guitar, and SPAffinia massage.

Home away from home. To make their guests feel at home, Affinia Hotels has developed a revolutionary new customer service program that allows guests to customize every aspect of their stay. Using the new online service, guests can pre-select “just the right features” that help make their stay perfect and at the same time build repeat business for this upscale hotel chain.

© AP Images/PRNewsFoto/Affinia Hotels

research is scientific advancement, without regard for its potential use in the development of goods and services. *Applied research*, in contrast, consists of activities geared toward discovering new knowledge with some potential use. *Development and implementation* involves research activities undertaken specifically to put new or existing knowledge to use in producing goods and services. The 3M Company has always been known for its development and implementation research activities. Currently, the company employs 6,700 researchers worldwide and has invested more than \$6.9 billion over the last five years to develop new products designed to make people's lives easier and safer.⁸

Product Extension and Refinement

When a brand-new product is first marketed, its sales are zero and slowly increase from that point. If the product is successful, annual sales increase more and more rapidly until they reach some peak. Then, as time passes, annual sales begin to decline, and they continue to decline until it is no longer profitable to manufacture the product. (This rise-and-decline pattern, called the *product life-cycle*, is discussed in more detail in Chapter 13.)

If a firm sells only one product, when that product reaches the end of its life-cycle, the firm will die, too. To stay in business, the firm must, at the very least, find ways to refine or extend the want-satisfying capability of its product. Consider television sets. Since they were introduced in the late 1930s, television sets have been constantly *refined* so that they now provide clearer, sharper pictures with less dial adjusting. During the same time, television sets also were extended. There are television-only sets and others that include DVD players. There are even television sets that allow their owners to access the Internet. And the latest development—high-definition television—has already become the standard.

For most firms, extension and refinement are expected results of their research, development, and implementation activities. Often, product extensions and refinements result from the application of new knowledge to existing products. Each refinement or extension results in an essentially “new” product whose sales make up for the declining sales of a product that was introduced earlier. When consumers discovered that the original five varieties of Campbell's Soup were of the highest quality, as well as inexpensive, the soups were an instant success. Although one of the most successful companies at the beginning of the 1900s, Campbell's had to continue to innovate, refine, and extend its product line. For example, many consumers in the United States live in what is called an on-the-go society. To meet this need, Campbell's Soup has developed ready-to-serve products that can be popped into a microwave at work or school.



Zero calories but great taste. The goal for The Coca-Cola Company was to develop a soft drink that had real Coke taste, but zero calories. As a result of hard work by the company's product research and development team, Coca-Cola Zero is one of the most successful new products in the company's history. Today, the company sells more than 600 million cases of Coca-Cola Zero each year in more than 130 countries.



A new product or a product extension? Actually, the answer is both. For Apple, the iPad is a new product based on improved technology. For Netflix, the ability to download a movie to an iPad is a product extension and a new way to distribute rental movies. As a result, both companies have been able to increase sales and profits.

How Do Managers Plan Production?

Only a few of the many ideas for new products, refinements, and extensions ever reach the production stage. For those ideas that do, however, the next step is planning for production. Once a new product idea has been identified, planning for

4

Discuss the components involved in planning the production process.

Figure 8.3 Planning for Production

Once research and development identifies an idea that meets customer needs, manufacturers then use three additional phases to convert the idea to an actual product or service.

1

Research and development identifies an idea for a new product or service.

2

Design planning develops a plan to convert the idea into a new product or service.

3

Facilities planning identifies a site where the good or service can be produced.

4

Operational planning decides on the amount of products or services that will be produced within a specific time period.

design planning the development of a plan for converting an idea into an actual product or service

product line a group of similar products that differ only in relatively minor characteristics



Automated assembly lines: The key to increasing both quality and productivity. The hot, dirty job of welding, which is key to many manufacturing and construction tasks, is changing. Today, welders are becoming operators of robots that can weld quicker and with more precision. To help companies plan for the future, Lincoln Electric, the company that produces this robotic rapid arc welder, opened a 100,000 square foot automation center where customers can see the latest in manufacturing technology.

production involves three different phases: design planning, facilities planning, and operational planning (see Figure 8.3).

Design Planning

When the R&D staff at Hewlett-Packard recommended to top management that the firm produce and market an affordable netbook computer, the company could not simply swing into production the next day. Instead, a great deal of time and energy had to be invested in determining what the new computer would look like, where and how it would be produced, and what options would be included. These decisions are a part of design planning. **Design planning** is the development of a plan for converting an idea into an actual product or service. The major decisions involved in design planning deal with product line, required capacity, and use of technology.

Product Line A **product line** is a group of similar products that differ only in relatively minor characteristics. During the design-planning stage, a computer manufacturer such as Hewlett-Packard must determine how many different models to produce and what major options to offer. Likewise, a restaurant chain such as Pizza Hut must decide how many menu items to offer.

An important issue in deciding on the product line is to balance customer preferences and production requirements. For this reason, marketing managers play an important role in making product-line decisions. Typically, marketing personnel want a “long” product line that offers customers many options. Because a long product line with more options gives customers greater choice, it is easier to sell products that meet the needs of individual customers. On the other hand, production personnel generally want a “short” product line with fewer options because products are easier to produce. In many cases, the actual choice between a long and short product line involves balancing

© AP Images/Tony Dejak

customer preferences with the cost and problems associated with a more complex production process.

Once the product line has been determined, each distinct product within the product line must be designed. **Product design** is the process of creating a set of specifications from which a product can be produced. When designing a new product, specifications are extremely important. For example, product engineers for Whirlpool Corporation must make sure that a new frost-free refrigerator keeps food frozen in the freezer compartment. At the same time, they must make sure that lettuce and tomatoes do not freeze in the crisper section of the refrigerator. The need for a complete product design is fairly obvious; products that work cannot be manufactured without it. But services should be designed carefully as well—and *for the same reason*.

Required Production Capacity **Capacity** is the amount of products or services that an organization can produce in a given period of time. (For example, the capacity of a Panasonic assembly plant might be 1.3 million high-definition televisions per year.) Operations managers—again working with the firm’s marketing managers—must determine the required capacity. This, in turn, determines the size of the production facility. If the facility is built with too much capacity, valuable resources (plant, equipment, and money) will lie idle. If the facility offers insufficient capacity, additional capacity may have to be added later when it is much more expensive than in the initial building stage.

Capacity means about the same thing to service businesses. For example, the capacity of a restaurant such as the Hard Rock Cafe in Nashville, Tennessee, is the number of customers it can serve at one time. As with the manufacturing facility described earlier, if the restaurant is built with too much capacity—too many tables and chairs—valuable resources will be wasted. If the restaurant is too small, customers may have to wait for service; if the wait is too long, they may leave and choose another restaurant.

Use of Technology During the design-planning stage, management must determine the degree to which *automation* and *technology* will be used to produce a product or service. Here, there is a trade-off between high initial costs and low operating costs (for automation) and low initial costs and high operating costs (for human labor). Ultimately, management must choose between a labor-intensive technology and a capital-intensive technology. A **labor-intensive technology** is a process in which people must do most of the work. Housecleaning services and the New York Yankees baseball team, for example, are labor-intensive. A **capital-intensive technology** is a process in which machines and equipment do most of the work. A Sony automated assembly plant is capital-intensive.

Facilities Planning

Once initial decisions have been made about a new product line, required capacity, and the use of technology, it is time to determine where the products or services are going to be produced. Generally, a business will choose to produce a new product in an existing factory as long as (1) the existing factory has enough capacity to handle customer demand for both the new product and established products and (2) the cost of refurbishing an existing factory is less than the cost of building a new one.

After exploring the capacity of existing factories, management may decide to build a new production facility. Once again, a number of decisions must be made. Should all the organization’s production capacity be placed in one or two large facilities? Or should it be divided among several smaller facilities? In general, firms that market a wide variety of products find it more economical to have a number of smaller facilities. Firms that produce only a small number of products tend to have fewer but larger facilities.

product design the process of creating a set of specifications from which a product can be produced

capacity the amount of products or services that an organization can produce in a given time

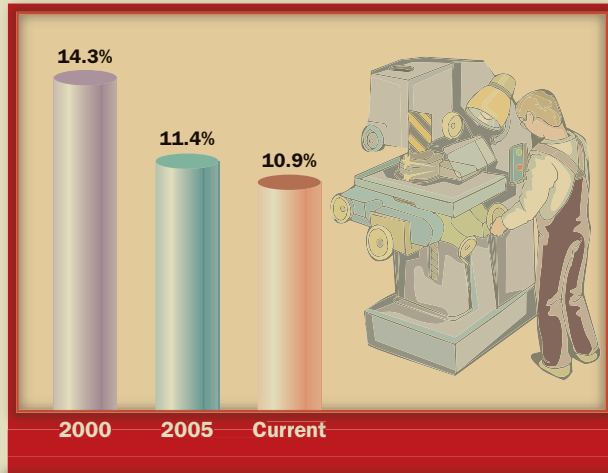
labor-intensive technology a process in which people must do most of the work

capital-intensive technology a process in which machines and equipment do most of the work



Manufacturing Employment

The bar chart below represents the percentage of U.S. manufacturing employees when compared to the nation's entire workforce.



Source: 2010 Statistical Abstract of the United States, Table 607.

plant layout the arrangement of machinery, equipment, and personnel within a production facility

at this stage, human resources and operations managers work closely together. For example, suppose that a U.S. firm such as Reebok wants to lower labor costs by constructing a sophisticated production plant in China. The human resources manager will have to recruit managers and employees with the appropriate skills who are willing to relocate to a foreign country, develop training programs for local Chinese workers, or both.

In determining where to locate production facilities, management must consider a number of variables, including the following:

- Locations of major customers and suppliers.
- Availability and cost of skilled and unskilled labor.
- Quality of life for employees and management in the proposed location.
- The cost of land and construction to build a new facility.
- Local and state taxes, environmental regulations, and zoning laws.
- The amount of financial support and subsidies, if any, offered by local and state governments.
- Special requirements, such as great amounts of energy or water used in the production process.

The choice of a location often involves balancing the most important variables for each production facility. Before making a final decision about where a proposed plant will be located and how it will be organized, two other factors—human resources and plant layout—should be examined.

Human Resources Several issues involved in facilities planning and site selection fall within the province of the human resources manager. Thus,



A big product! The Boeing facility in Everett, Washington, is an example of a fixed-position production layout and is used to build some of the world's largest airliners. When the fixed-position layout is used, the product is not moved until it is finished because it is easier to move people, machinery, and parts to where they are needed when building a jet airliner or other large products.

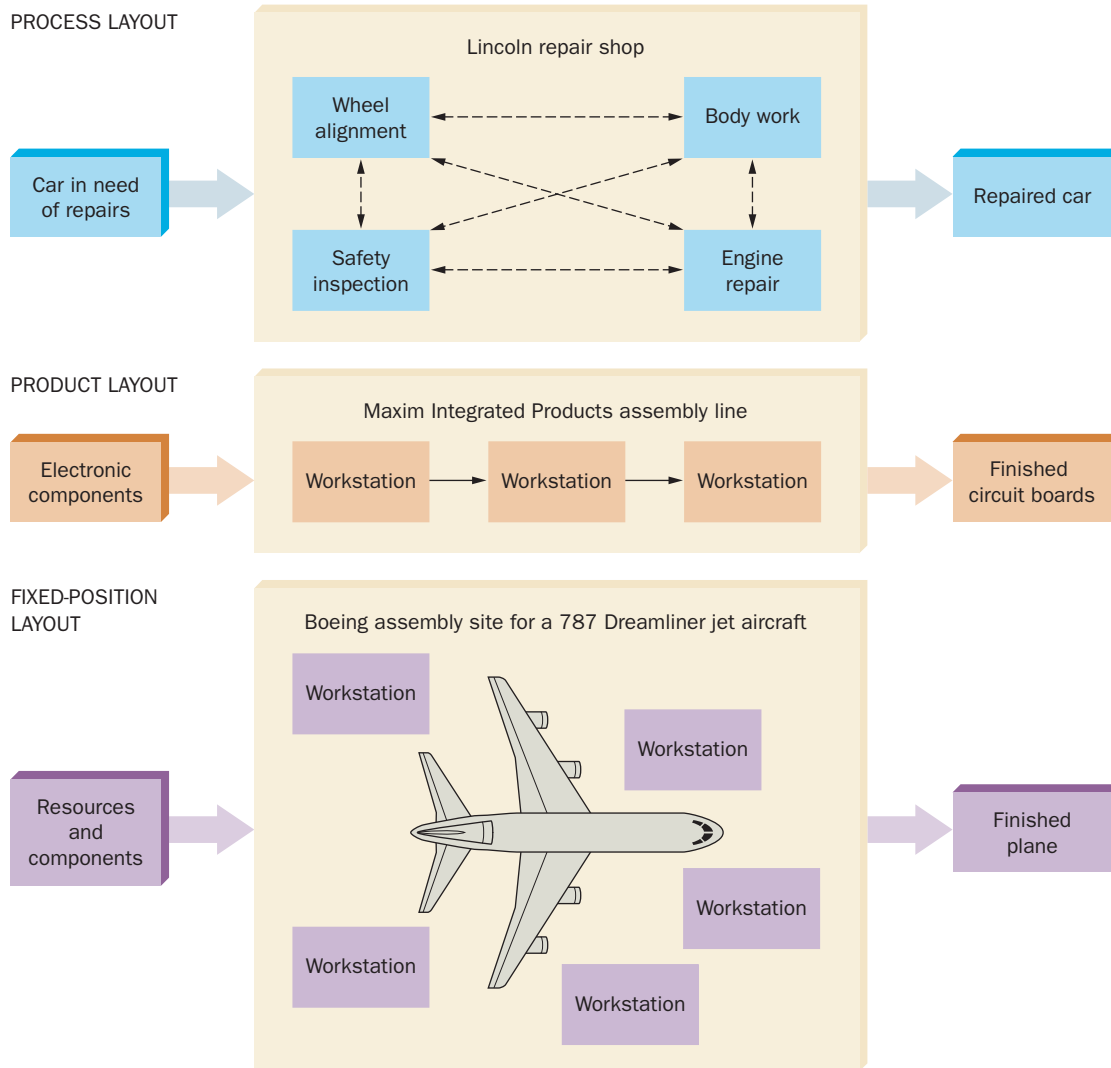
Plant Layout **Plant layout** is the arrangement of machinery, equipment, and personnel within a production facility. Three general types of plant layout are used (see Figure 8.4).

The *process layout* is used when different operations are required for creating small batches of different products or working on different parts of a product. The plant is arranged so that each operation is performed in its own particular area. An auto repair facility at a local automobile dealership provides an example of a process layout. The various operations may be engine repair, bodywork, wheel alignment, and safety inspection. If you take your Lincoln Navigator for a wheel alignment, your car “visits” only the area where alignments are performed.

A *product layout* (sometimes referred to as an *assembly line*) is used when all products undergo the same operations in the same sequence. Workstations are arranged to match the sequence of operations, and work flows from station to station. An assembly line is the best example of a product layout. For example, California-based Maxim

© Stephen Brashear/Getty Images

The process layout is used when small batches of different products are created or when working on different parts of a product. The product layout (assembly line) is used when all products undergo the same operations in the same sequence. The fixed-position layout is used in producing a product too large to move.



Integrated Products, Inc., uses a product layout to manufacture components for consumer and business electronic products.

A *fixed-position layout* is used when a very large product is produced. Aircraft manufacturers and shipbuilders apply this method because of the difficulty of moving a large product such as an airliner or a ship. The product remains stationary, and people and machines are moved as needed to assemble the product. Boeing, for example, uses the fixed-position layout to build 787 Dreamliner jet aircraft at its Everett, Washington, manufacturing facility.

Operational Planning

The objective of operational planning is to decide on the amount of products or services each facility will produce during a specific period of time. Four steps are required.

Step 1: Selecting a Planning Horizon A **planning horizon** is simply the time period during which an operational plan will be in effect. A common planning

planning horizon the period during which an operational plan will be in effect

horizon for production plans is one year. Then, before each year is up, management must plan for the next.

A planning horizon of one year generally is long enough to average out seasonal increases and decreases in sales. At the same time, it is short enough for planners to adjust production to accommodate long-range sales trends. Firms that operate in a rapidly changing business environment with many competitors may find it best to select a shorter planning horizon to keep their production planning current.

Step 2: Estimating Market Demand The *market demand* for a product is the quantity that customers will purchase at the going price. This quantity must be estimated for the time period covered by the planning horizon. Sales projections developed by marketing managers are the basis for market-demand estimates.

Step 3: Comparing Market Demand with Capacity The third step in operational planning is to compare the estimated market demand with the facility's capacity to satisfy that demand. (Remember that capacity is the amount of products or services that an organization can produce in a given time period.) One of three outcomes may result: Demand may exceed capacity, capacity may exceed demand, or capacity and demand may be equal. If they are equal, the facility should be operated at full capacity. However, if market demand and capacity are not equal, adjustments may be necessary.

Step 4: Adjusting Products or Services to Meet Demand The biggest reason for changes to a firm's production schedule is changes in the amount of products or services that a company sells to its customers. For example, Indiana-based Berry Plastics uses an injection-molded manufacturing process to produce all kinds of plastic products. One particularly successful product line for Berry Plastics is drink cups that can be screen-printed to promote a company or the company's products or services.⁹ If Berry Plastics obtains a large contract to provide promotional cups to a large fast-food chain such as Whataburger or McDonald's, the company may need to work three shifts a day, seven days a week, until the contract is fulfilled. Unfortunately, the reverse is also true. If the company's sales force does not generate new sales, there may be only enough work for the employees on one shift.

When market demand exceeds capacity, several options are available to a firm. Production of products or services may be increased by operating the facility overtime with existing personnel or by starting a second or third work shift. For manufacturers, another response is to subcontract or outsource a portion of the work to other manufacturers. If the excess demand is likely to be permanent, the firm may expand the current facility or build another facility.

What happens when capacity exceeds market demand? Again, there are several options. To reduce output temporarily, workers may be laid off and part of the facility shut down, or the facility may be operated on a shorter-than-normal workweek for as long as the excess capacity persists. To adjust to a permanently decreased demand, management may shift the excess capacity of a manufacturing facility to the production of other goods or services. The most radical adjustment is to eliminate the excess capacity by selling unused manufacturing facilities.

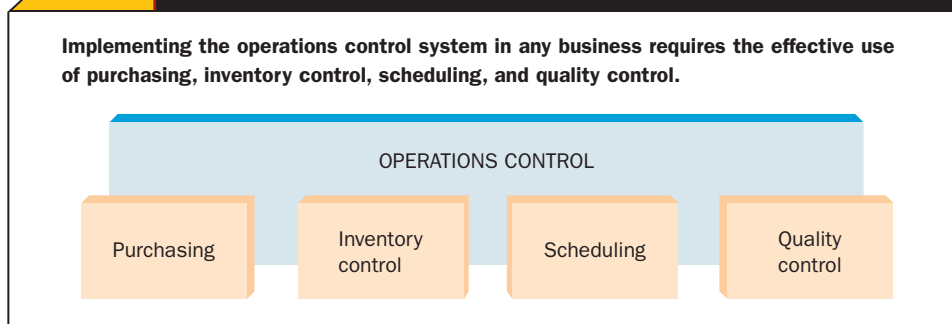
5

Explain how purchasing, inventory control, scheduling, and quality control affect production.

Operations Control

We have discussed the development of an idea for a product or service and the planning that translates that idea into the reality. Now we are ready to push the "start button" to begin the production process. In this section, we examine four important areas of operations control: purchasing, inventory control, scheduling, and quality control (see Figure 8.5).

Figure 8.5 Four Aspects of Operations Control



Purchasing

Purchasing consists of all the activities involved in obtaining required materials, supplies, components (or subassemblies), and parts from other firms. Levi Strauss, for example, must purchase denim cloth, thread, and zippers before it can produce a single pair of jeans. For all firms, the purchasing function is far from routine, and its importance should not be underestimated. For some products, purchased materials make up more than 50 percent of their wholesale costs.

The objective of purchasing is to ensure that required materials are available when they are needed, in the proper amounts, and at minimum cost. Generally, the company with purchasing needs and suppliers must develop a working relationship built on trust. In addition to a working relationship built on trust, many companies believe that purchasing is one area where they can promote diversity. For example, AT&T developed a Supplier Diversity Program that includes minorities, women, and disabled veteran business enterprises in 1968. Today, more than 40 years later, goals for the AT&T program include purchasing a total of 21.5 percent of all products and services from these three groups. As a result of its Supplier Diversity Program, the company is now recognized as one of the nation's leading companies in supplier diversity.¹⁰

Purchasing personnel should constantly be on the lookout for new or backup suppliers, even when their needs are being met by their present suppliers, because problems such as strikes and equipment breakdowns can cut off the flow of purchased materials from a primary supplier at any time.

The choice of suppliers should result from careful analysis of a number of factors. The following are especially critical:

- **Price.** Comparing prices offered by different suppliers is always an essential part of selecting a supplier. Even tiny differences in price add up to enormous sums when large quantities are purchased.
- **Quality.** Purchasing specialists always try to buy materials at a level of quality in keeping with the type of product being manufactured. The minimum acceptable quality is usually specified by product designers.
- **Reliability.** An agreement to purchase high-quality materials at a low price is the purchaser's dream. However, the dream becomes a nightmare if the supplier does not deliver.
- **Credit terms.** Purchasing specialists should determine if the supplier demands immediate payment or will extend credit. Also, does the supplier offer a cash discount or reduction in price for prompt payment?
- **Shipping costs.** Low prices and favorable credit terms offered by a supplier can be wiped out when the buyer must pay the shipping costs. Above all, the question of who pays the shipping costs should be answered before any supplier is chosen.

Inventory Control

Can you imagine what would happen if a Coca-Cola manufacturing plant ran out of the company's familiar red-and-white aluminum cans? It would be impossible to complete the manufacturing process and ship the cases of Coke to retailers.

purchasing all the activities involved in obtaining required materials, supplies, components, and parts from other firms



When inventory is very important! While most people regard a cell phone as a convenient way to stay in touch with friends, relatives, and business associates, this inventory—10,000 ready-to-use cell phones—is being shipped to people who have experienced the trauma caused by earthquakes. An effective inventory control system helps speed the phones to the people who need them to communicate with family and friends.

Management would be forced to shut the assembly line down until the next shipment of cans arrived from a supplier. In reality, operations managers for Coca-Cola realize the disasters that a shortage of needed materials can cause and will avoid this type of problem if at all possible. The simple fact is that shutdowns are expensive because costs such as rent, wages, insurance, and other expenses still must be paid.

Operations managers are concerned with three types of inventories. A *raw-materials inventory* consists of materials that will become part of the product during the production process. The *work-in-process inventory* consists of partially completed products. The *finished-goods inventory* consists of completed goods. Each type of inventory also has a *holding cost*, or storage cost, and a *stock-out cost*, the cost of running out of inventory. **Inventory control** is the process of managing inventories in such a way as to minimize inventory costs, including both holding costs and potential stock-out costs.

Today, computer systems are being used to keep track of inventories and alert managers to impending stock-outs. One of the most sophisticated methods of inventory control used today is materials requirements

planning. **Materials requirements planning (MRP)** is a computerized system that integrates production planning and inventory control. One of the great advantages of an MRP system is its ability to juggle delivery schedules and lead times effectively. For a complex product such as an automobile, it is virtually impossible for individual managers to oversee the hundreds of parts that go into the finished product. However, a manager using an MRP system can arrange both order and delivery schedules so that materials, parts, and supplies arrive when they are needed.

Two extensions of MRP are used by manufacturing firms today. The first is known as *manufacturing resource planning*, or simply *MRP II*. The primary difference between the two systems is that MRP involves just production and inventory personnel, whereas MRP II involves the entire organization. Thus, MRP II provides a single common set of facts that can be used by all the organization's managers to make effective decisions. The second extension of MRP is known as *enterprise resource planning (ERP)*. The primary difference between ERP and the preceding methods is that ERP software is more sophisticated and can monitor not only inventory and production processes but also quality, sales, and even such variables as inventory at a supplier's location.

Because large firms can incur huge inventory costs, much attention has been devoted to inventory control. The just-in-time system being used by some businesses is one result of all this attention. A **just-in-time inventory system** is designed to ensure that materials or supplies arrive at a facility just when they are needed so that storage and holding costs are minimized. The customer must specify what will be needed, when, and in what amounts. The supplier must be sure that the right supplies arrive at the agreed-upon time and location. For example, managers using a just-in-time inventory system at a Ford assembly plant determine the number of automobiles that will be assembled in a specified time period. Then Ford purchasing personnel order just the parts needed to produce those automobiles. In turn, suppliers deliver the parts in time or when they are needed on the assembly line.

Without proper inventory control, it is impossible for operations managers to schedule the work required to produce goods that can be sold to customers.

Scheduling

Scheduling is the process of ensuring that materials and other resources are at the right place at the right time. The materials and resources may be moved from a warehouse to the workstations, they may move from station to station along an

inventory control the process of managing inventories in such a way as to minimize inventory costs, including both holding costs and potential stock-out costs

materials requirements planning (MRP) a computerized system that integrates production planning and inventory control

just-in-time inventory system a system designed to ensure that materials or supplies arrive at a facility just when they are needed so that storage and holding costs are minimized

scheduling the process of ensuring that materials and other resources are at the right place at the right time

assembly line, or they may arrive at workstations “just in time” to be made part of the work-in-process there.

As our definition implies, both place and time are important to scheduling. The *routing* of materials is the sequence of workstations that the materials will follow. Assume that Drexel-Heritage—one of America’s largest and oldest furniture manufacturers—is scheduling production of an oval coffee table made from cherry wood. Operations managers route the needed materials (wood, screws, packaging materials, etc.) through a series of individual workstations along an assembly line. At each workstation, a specific task is performed, and then the partially finished coffee table moves to the next workstation. When routing materials, operations managers are especially concerned with the sequence of each step of the production process. For the coffee table, the top and legs must be cut to specifications before the wood is finished. (If the wood were finished before being cut, the finish would be ruined, and the coffee table would have to be stained again.)

When scheduling production, managers also are concerned with timing. The *timing* function specifies when the materials will arrive at each station and how long they will remain there. For the cherry coffee table, it may take workers 30 minutes to cut the table top and legs and another 30 minutes to drill the holes and assemble the table. Before packaging the coffee table for shipment, it must be finished with cherry stain and allowed to dry. This last step may take as long as three days depending on weather conditions and humidity. Only after the product is completely dry can the coffee table be packaged and shipped to wholesalers and retailers.

Regardless of whether the finished product requires a simple or complex production process, operations managers are responsible for monitoring schedules—called *follow-up*—to ensure that the work flows according to a timetable. For complex products, many operations managers prefer to use Gantt charts or the PERT technique.

Scheduling Through Gantt Charts Developed by Henry L. Gantt, a **Gantt chart** is a graphic scheduling device that displays the tasks to be performed on the vertical axis and the time required for each task on the horizontal axis. Gantt charts do the following:

- Allow you to determine how long a project should take.
- Lay out the order in which tasks need to be completed.
- Determine the resources needed.
- Monitor progress of different activities required to complete the project.

A Gantt chart that describes the activities required to build three dozen golf carts is illustrated in Figure 8.6. Gantt charts usually are not suitable for scheduling extremely complex situations. Nevertheless, using them forces a manager to plan the steps required to get a job done and to specify time requirements for each part of the job.

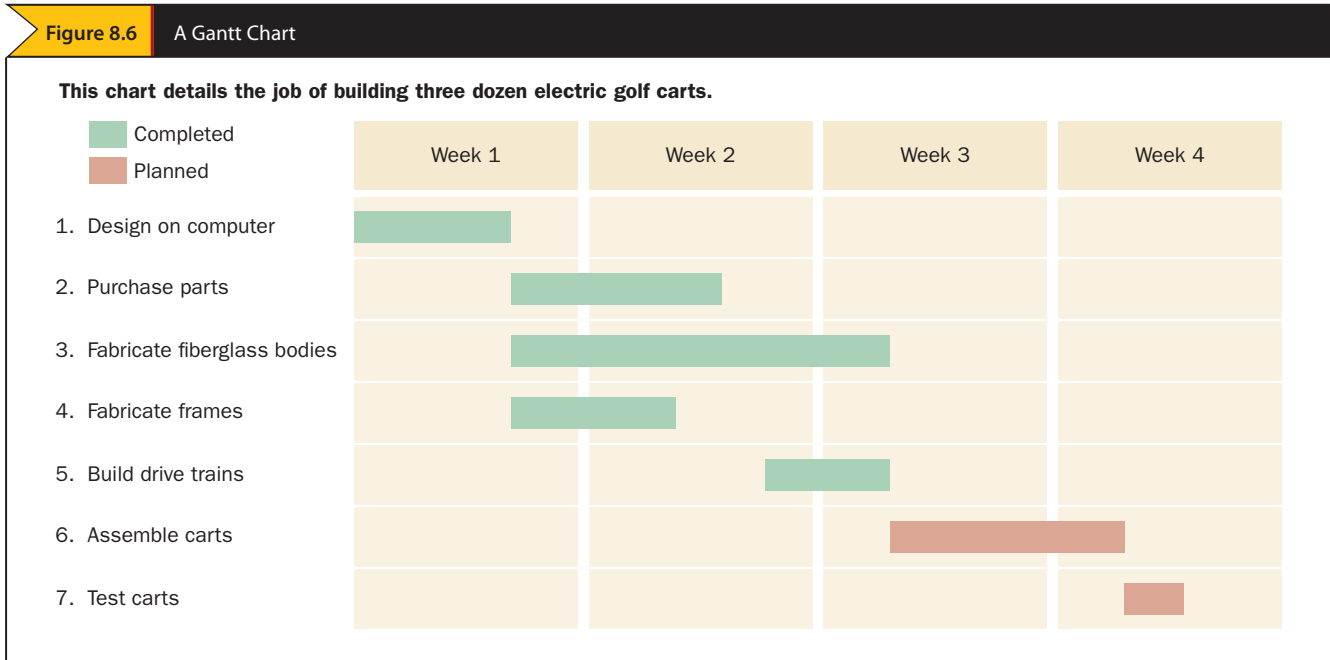
Scheduling via PERT Another technique for scheduling a complex project and maintaining control of the schedule is **PERT (Program Evaluation and Review Technique)**. To use PERT, we begin by identifying all the major *activities* involved in the project. For example, the activities involved in producing your textbook are illustrated in Figure 8.7.

All events are arranged in a sequence. In doing so, we must be sure that an event that must occur before another event in the actual process also occurs before that event on the PERT chart. For example, the manuscript must be edited before the type is set. Next, we use arrows to connect events that must occur in sequence. We then estimate the time required for each activity and mark it near the corresponding arrow. The sequence of production activities that take the longest time from start to finish is called the *critical path*. The activities on this path determine the minimum time in which the process can be completed. These activities are the ones that must

Gantt chart a graphic scheduling device that displays the tasks to be performed on the vertical axis and the time required for each task on the horizontal axis

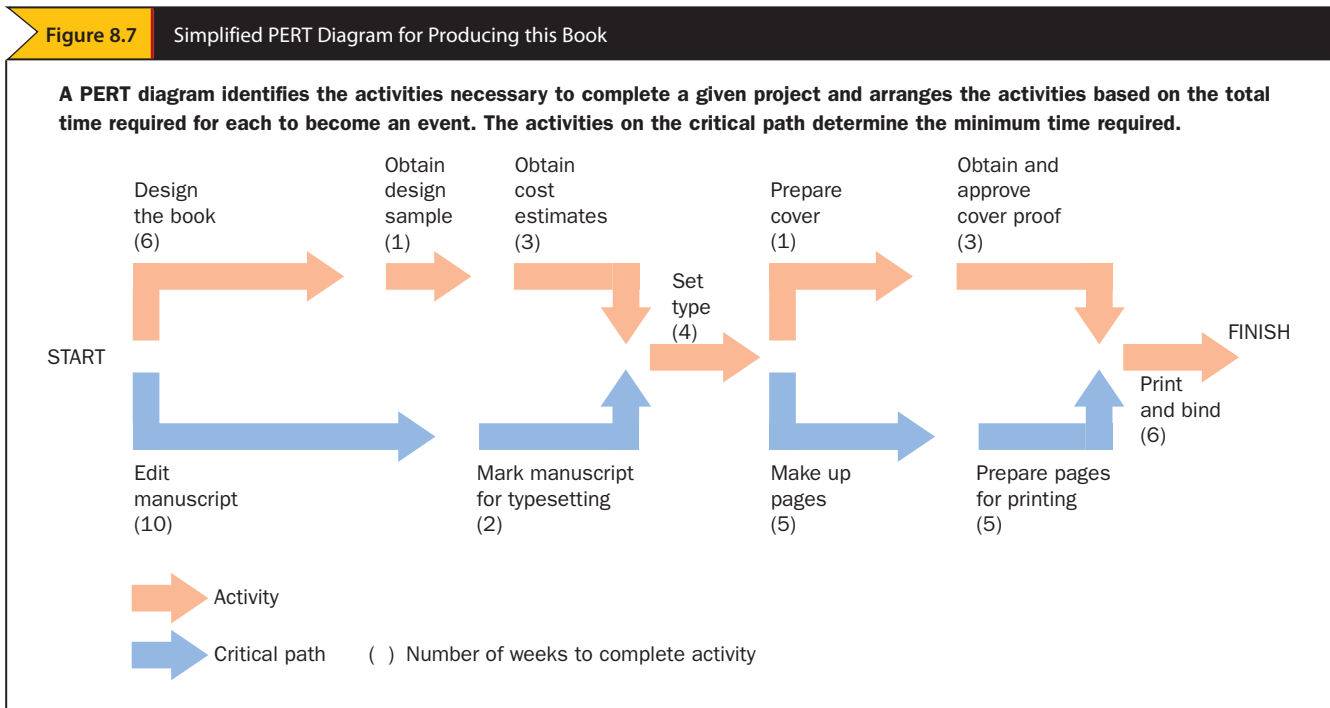
PERT (Program Evaluation and Review Technique) a scheduling technique that identifies the major activities necessary to complete a project and sequences them based on the time required to perform each one

Figure 8.6 A Gantt Chart



Source: Robert Kreitner, *Management*, 11th ed. Copyright © 2009 by Houghton Mifflin Company. Reprinted with permission.

Figure 8.7 Simplified PERT Diagram for Producing this Book



be scheduled and controlled carefully. A delay in any one of them will cause a delay in completion of the project as a whole.

Quality Control

As mentioned earlier in this chapter, American business firms that compete in the very competitive global marketplace have taken another look at the importance of improving quality. Today, there is even a national quality award. The **Malcolm Baldrige National Quality Award** is given by the U.S. president to organizations that apply and are judged to be outstanding in specific managerial tasks that lead

Malcolm Baldrige National Quality Award an award given by the U.S. president to organizations that apply and are judged to be outstanding in specific managerial tasks that lead to improved quality for both products and services

to improved quality for both products and services. Past winners include Ritz-Carlton Hotels, Boeing, Motorola, Honeywell Federal Manufacturing & Technologies, Cargill Corn Milling North America, Richland Community College (part of the Dallas Community College District), and many others. For many organizations, using the Baldrige criteria results in

- better employee relations,
- higher productivity,
- greater customer satisfaction,
- increased market share, and
- improved profitability.¹¹

Although winning the “Baldrige” can mean prestige and lots of free media coverage, the winners all have one factor in common: They use quality control to improve their firm’s products or services.

Quality control is the process of ensuring that goods and services are produced in accordance with design specifications. The major objective of quality control is to see that the organization lives up to the standards it has set for itself on quality. Some firms, such as Mercedes-Benz, have built their reputations on quality. Customers pay more for their products in return for assurances of high quality. Other firms adopt a strategy of emphasizing lower prices along with reasonable (but not particularly high) quality.

Many U.S. firms use two systems to gather statistical information about the quality of their products and study the way they operate. **Statistical process control (SPC)** is a system that uses sampling to obtain data that are plotted on control charts and graphs to see if the production process is operating as it should and to pinpoint problem areas. **Statistical quality control (SQC)**, a similar technique, is a set of specific statistical techniques used to monitor all aspects of the production process to ensure that both work-in-process and finished products meet the firm’s quality standards. A firm can use the information provided by both these techniques to correct problems in the production process and to improve the quality of its products.

Inspection Increased effort is also being devoted to **inspection**, which is the examination of the quality of work-in-process. Inspections are performed at various times during production. Purchased materials may be inspected when they arrive at the production facility. Subassemblies and manufactured parts may be inspected before they become part of a finished product. In addition, finished goods may be inspected before they are shipped to customers. Items that are within design specifications continue on their way. Those that are not within design specifications are removed from production.

Improving Quality Through Employee Participation Over the years, more and more managers have realized that quality is an essential “ingredient” of the good or service being provided. This view of quality provides several benefits. The number of defects decreases, which causes profits to increase. Furthermore, making products right the first time reduces many of the rejects and much of the rework. In addition, making employees responsible for quality often eliminates the need for inspection. An employee is encouraged to accept full responsibility for the quality of his or her work.

The use of a **quality circle**, a team of employees who meet on company time to solve problems of product quality, is another way manufacturers are achieving better quality at the operations level. Quality circles have been used



Quality matters! SC Johnson was started in 1886 as a parquet flooring company. Today, more than 125 years later, the company is one of the world’s most trusted manufacturers of household products like Windex. The company’s success is tied to its quest for quality in all of the products it produces. In this photo, an employee examines the finished product to make sure small details like labels and packaging meet the company’s stringent quality standards.

quality control the process of ensuring that goods and services are produced in accordance with design specifications

statistical process control (SPC)

a system that uses sampling to obtain data that are plotted on control charts and graphs to see if the production process is operating as it should and to pinpoint problem areas

statistical quality control (SQC)

a set of specific statistical techniques used to monitor all aspects of the production process to ensure that both work-in-process and finished products meet the firm’s quality standards

inspection the examination of the quality of work-in-process

quality circle a team of employees who meet on company time to solve problems of product quality

successfully in companies such as IBM, Northrop Grumman Corporation, Lockheed Martin, and GE.

Total quality management (TQM) can also be used to improve quality of a firm's products or services. As noted in Chapter 6, a TQM program coordinates the efforts directed at improving customer satisfaction, increasing employee participation, strengthening supplier partnerships, and facilitating an organizational atmosphere of continuous quality improvement. Firms such as American Express, AT&T, Motorola, and Hewlett-Packard all have used TQM to improve product quality and, ultimately, customer satisfaction.

Another technique that businesses may use to improve not only quality but also overall performance is Six Sigma. **Six Sigma** is a disciplined approach that relies on statistical data and improved methods to eliminate defects for a firm's products and services. Although many experts agree that Six Sigma is similar to TQM and other methods used to improve quality, Six Sigma often has more top-level support, much more teamwork, and a new corporate attitude or culture. The companies that developed, refined, and have the most experience with Six Sigma are Motorola, GE, and Honeywell. Although each of these companies is a corporate giant, the underlying principles of Six Sigma can be used by all firms regardless of size.¹²

World Quality Standards: ISO 9000 and ISO 14000 Different companies have different perceptions of quality. Without a common standard of quality, however, customers may be at the mercy of manufacturers and vendors. As the number of companies competing in the world marketplace has increased, so has the seriousness of this problem. To deal with the problem of standardization, the International Organization for Standardization, a nongovernmental organization with headquarters in Geneva, Switzerland, was created. The **International Organization for Standardization (ISO)** is a network of national standards institutes and similar organizations from 161 different countries that is charged with developing standards for quality products and services that are traded throughout the globe. According to the organization,

ISO's work makes a positive difference to the world we live in. ISO standards add value to all types of business operations. They contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. ISO standards also serve to safeguard consumers and users of products and services in general, as well as making their lives simpler.¹³

Standardization is achieved through consensus agreements between national delegations representing all the economic stakeholders—suppliers, customers, and often governments. The member organization for the United States is the American National Standards Institute located in Washington, D.C.

In 1987, the panel published ISO 9000 (*iso* is Greek for “equal”), which sets the guidelines for quality procedures that businesses must use to receive certification. Certification by independent auditors and laboratory testing services serves as evidence that a company meets the standards for quality control procedures in design, production processes, and product testing.

Although certification is not a legal requirement to do business globally, the organization's 161 member countries have approved the ISO standards. In fact, ISO standards are so prevalent around the globe that many customers refuse to do business with noncertified companies. As an added bonus, companies completing the certification process often discover new, cost-efficient ways to improve their existing quality-control programs.

As a continuation of this standardization process, the International Organization for Standardization has developed ISO 14000. ISO 14000 is a family of international standards for incorporating environmental concerns into operations and product standards. As with ISO 9000 certification, ISO 14000

Six Sigma a disciplined approach that relies on statistical data and improved methods to eliminate defects for a firm's products and services

International Organization for Standardization (ISO) a network of national standards institutes and similar organizations from 161 different countries that is charged with developing standards for quality products and services that are traded throughout the globe



Small Manufacturers Achieve Big Productivity Gains

Even the smallest manufacturer can boost productivity with careful planning for product design, facilities, and site selection. For example, family-owned Ingrained Style Furniture, based in Calgary, Canada, recently purchased new equipment for computer-assisted product design. The company, which makes high-quality home furnishings, has only five employees. Yet its owner chose to borrow \$300,000 to buy the new high-tech machinery, even though orders were slowing due to an economic downturn. Why? “We are looking at a fourfold increase in productivity from that machinery,” the owner says—a whopping improvement in productivity that is helping the company continue its long-term record of growth and profitability while maintaining top quality.

Mole Hollow Candles is a small Massachusetts business that produces

hand-dipped candles for sale across the United States. For many years, the company ran a factory and separate warehouse in central Massachusetts. Then new owners bought Mole Hollow Candles. The new owners analyzed every aspect of the operation and, over time, determined that they could improve productivity by moving to a larger facility with manufacturing and distribution activities under one roof. Just as important, the new site accommodates larger trucks and is much closer to major highways than the previous facilities, smoothing the way for speedier receipt of raw materials and distribution of finished products.



Sources: Craig S. Semon, “An American Light,” *Telegram* (Worcester, MA), February 9, 2010, <http://www.telegram.com/article/20100209/NEWS/2090342/1002/BUSINESS>; Denise Deveau, “Small Businesses Getting the Skinny on Lean Manufacturing,” *CBC News*, October 15, 2009, <http://www.cbc.ca/money/story/2009/10/05/f-small-business-lean-manufacturing.html#ixzz0eyOZYPIq>; Joel Schlesinger, “Credit Crunch Puts Pressure on Small Business; Furniture Firm Plans for Growth Even in Downturn,” *Calgary Herald*, January 19, 2009, <http://www.canada.com/calgaryherald/news/calgarybusiness/story.html?id=ba68926c-2893-4edc-8873-626be5462d49>.

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requires that a company’s procedures be documented by independent auditors. It also requires that a company develop an environmental management system that will help it to achieve environmental goals, objectives, and targets. Both the ISO 9000 and ISO 14000 family of standards are updated periodically. For example, ISO 9001:2008 reflects new standards for quality when compared with the original ISO standards.

Improving Productivity with Technology

No coverage of production and operations management would be complete without a discussion on productivity. Productivity concerns all managers, but it is especially important to operations managers, the people who must oversee the creation of a firm’s goods or services. We define **productivity** as the average level of output per worker per hour. Hence, if each worker at plant A produces 75 units per day and each worker at plant B produces only 70 units per day, the workers at plant A are more productive. If one bank teller serves 25 customers per hour and another serves 28 per hour, the second teller is more productive.

Productivity Trends

Overall productivity growth for the U.S. business sector averaged 3.9 percent for the period 1979–2008.¹⁴ More specifically, productivity in 2008 increased 1.2 percent.¹⁵ (Note: At the time of publication, 2008 was the last year that complete statistics were available.) Although a 1.2 percent increase in U.S. productivity in 2008 does not compare with the nation’s average productivity gains for the period between 1979 and 2008, it does compare favorably with 16 other nations that the U.S. Bureau of Labor Statistics tracks each year. By comparison, productivity in 2008 decreased in 12 of the 17 economies. Only 5 of the 17 countries had productivity increases. Among these five, both the United States and the Republic of Korea led other nations with a productivity increase of 1.2 percent.¹⁶

6

Summarize how productivity and technology are related.

productivity the average level of output per worker per hour

Several factors have been cited as possible causes for the small increase in America's productivity growth rate. First, the economic crisis that accompanied the downturn in the home construction and automobile industries and the crisis in banking and finance have caused many businesses to reduce the rate of investment in new equipment and technology. As workers have had to use increasingly outdated equipment, their ability to increase productivity has declined.

Another important factor that has hurt the U.S. productivity growth rate is the tremendous growth of the service sector in the United States. Although this sector grew in the number of employees and economic importance, its productivity levels did not grow as fast. Today, many economic experts agree that improving service-sector productivity can lead to higher overall productivity growth for the nation.

Finally, increased government regulation is frequently cited as a factor affecting productivity. Federal agencies such as the Occupational Safety and Health Administration, the Environmental Protection Agency, and the Food and Drug Administration are increasingly regulating business practices. Often, the time employees spend complying with government reporting requirements can reduce productivity growth rates. Even though executives, managers, and business owners often cite increased regulation from all levels of government as a reason for low productivity, the general public believes there is need for effective government regulations that improve working conditions, product safety, and the environment. For example, the recent British Petroleum oil spill in the Gulf of Mexico and its effect on nearby beaches and wetlands may have been prevented or at least reduced if there had been more government regulation of off-shore drilling. Although there are two sides to the regulatory argument, it may be beneficial to take a new look at existing and proposed regulations to ensure all the regulations are needed and compliance is no more time-consuming and expensive than absolutely necessary.

Improving Productivity Growth Rates

Several techniques and strategies have been suggested to improve current productivity growth rates. For example:

- Government policies that may be hindering productivity growth could be eliminated or at least modified.
- Increased employee motivation and participation can enhance productivity.
- Increased cooperation between labor and management could be fostered to improve productivity.
- Investing more money in facilities, equipment, technology and automation, and employee training could improve productivity.

The Impact of Computers and Robotics on Productivity

Automation is the total or near-total use of machines to do work. The rapid increase in automated procedures has been made possible by the microprocessor, a silicon chip that led to the production of desktop computers for businesses, homes, and schools. In factories, microprocessors are used in robotics and in computer manufacturing systems.

Robotics **Robotics** is the use of programmable machines to perform a variety of tasks by manipulating materials and tools. Robots work quickly, accurately, and steadily. For example, Illumina, Inc., a San Diego company, uses robots to perform medical laboratory tests. The information then is sold to some of the world's largest pharmaceutical companies, where it is used to alter existing prescription drugs, develop new drug therapies, and customize diagnoses and treatments for all kinds of serious diseases. As an added bonus, Illumina's

automation the total or near-total use of machines to do work

robotics the use of programmable machines to perform a variety of tasks by manipulating materials and tools

robots can work 24 hours a day at much lower costs than if human lab workers performed the same tests.¹⁷

Robots are especially effective in tedious, repetitive assembly-line jobs, as well as in handling hazardous materials. They are also useful as artificial “eyes” that can check the quality of products as they are being processed on the assembly lines. To date, the automotive industry has made the most extensive use of robotics, but robots also have been used to mine coal, inspect the inner surfaces of pipes, assemble computer components, provide certain kinds of patient care in hospitals, and clean and guard buildings at night.

Computer Manufacturing Systems People are quick to point out how computers have changed their everyday lives, but most people do not realize the impact computers have had on manufacturing. In simple terms, the factory of the future has already arrived. For most manufacturers, the changeover began with the use of computer-aided design and computer-aided manufacturing. **Computer-aided design (CAD)** is the use of computers to aid in the development of products. Ford speeds up car design, Canon designs new photocopiers, and American Greetings creates new birthday cards by using CAD. **Computer-aided manufacturing (CAM)** is the use of computers to plan and control manufacturing processes. A well-designed CAM system allows manufacturers to become much more productive. Not only are a greater number of products produced, but speed and quality also increase. Toyota, Hasbro, Oneida, and Apple Computer all have used CAM to increase productivity.

If you are thinking that the next logical step is to combine the CAD and CAM computer systems, you are right. Today, the most successful manufacturers use CAD and CAM together to form a computer-integrated manufacturing system. Specifically, **computer-integrated manufacturing (CIM)** is a computer system that not only helps to design products but also controls the machinery needed to produce the finished product. For example, Liz Claiborne, Inc., uses CIM to design clothing, to establish patterns for new fashions, and then to cut the cloth needed to produce the finished product. Other advantages of using CIM include improved flexibility, more efficient scheduling, and higher product quality—all factors that make a production facility more competitive in today’s global economy.

Flexible Manufacturing Systems Manufacturers have known for a number of years that the old-style, mass-production, and traditional assembly lines used to manufacture products present a number of problems. For example, although traditional assembly lines turn out extremely large numbers of identical products economically, the system requires expensive, time-consuming retooling of equipment whenever a new product is to be manufactured. This type of manufacturing is often referred to as a continuous process. **Continuous process** is a manufacturing process in which a firm produces the same product(s) over a long period of time. Now it is possible to use flexible manufacturing systems to solve such problems. A **flexible manufacturing system (FMS)** combines electronic machines and computer-integrated manufacturing in a single production system. Instead of having to spend vast amounts of time and effort to retool the traditional mechanical equipment on an assembly line for each new product, an FMS is rearranged simply by reprogramming electronic machines. Because FMSs require less time and expense to reprogram than traditional systems, manufacturers can produce smaller batches of a variety of products without raising the production cost. Flexible manufacturing is sometimes referred to as an intermittent process. An **intermittent process** is a manufacturing process in which a firm’s manufacturing machines and equipment are changed to produce different products. When compared with the continuous process (longer production runs), an intermittent process has a shorter production run.

computer-aided design (CAD) the use of computers to aid in the development of products

computer-aided manufacturing (CAM) the use of computers to plan and control manufacturing processes

computer-integrated manufacturing (CIM) a computer system that not only helps to design products but also controls the machinery needed to produce the finished product

continuous process a manufacturing process in which a firm produces the same product(s) over a long period of time

flexible manufacturing system (FMS) a single production system that combines electronic machines and computer-integrated manufacturing

intermittent process a manufacturing process in which a firm’s manufacturing machines and equipment are changed to produce different products

For most manufacturers, the driving force behind FMSs is the customer. In fact, the term *customer-driven production* is often used by operations managers to describe a manufacturing system that is driven by customer needs and what customers want to buy. For example, advanced software and a flexible manufacturing system have enabled Dell Computer to change to a more customer-driven manufacturing process. The process starts when a customer phones a sales representative on a toll-free line or accesses Dell's Web site. Then the representative or the customer enters the specifications for the new product directly into a computer. The order then is sent to a nearby plant. Once the order is received, a team of employees, with the help of a reprogrammable assembly line, can build the product just the way the customer wants it. Products include desktop computers, notebook computers, and other Dell equipment.¹⁸ Although the costs of designing and installing an FMS such as this are high, the electronic equipment is used more frequently and efficiently than the machinery on a traditional assembly line.

Technological Displacement Automation is increasing productivity by cutting manufacturing time, reducing error, and simplifying retooling procedures. However, many of the robots being developed for use in manufacturing will not replace human employees. Rather, these robots will work with employees in making their jobs easier and help to prevent accidents. In the future, most experts agree that, because U.S. manufacturers will continue to innovate, workers who have manufacturing jobs will be highly skilled and can work with the automated and computer-assisted manufacturing systems. Those that don't possess high-tech skills will be dispensable and unemployed. Many workers will be faced with the choice of retraining for new jobs or seeking jobs in other sectors of the economy. Government, business, and education will have to cooperate to prepare workers for new roles in an automated workplace.

The next chapter discusses many of the issues caused by technological displacement. In addition, a number of major components of human resources management are described, and we see how managers use various reward systems to boost motivation, productivity, and morale.

return to inside business

Nestlé

All around the world, supermarket shelves are packed with foods made by Nestlé for consumers and their furry friends. The company originally made baby formula and, applying its expertise in production, soon expanded into dairy products, coffee, chocolate bars, and pet food. Now, more than a century after Henri Nestlé founded the company in Switzerland, its U.S. food manufacturing plants are earning ISO certifications in environmental management systems, food safety management, and occupational health and safety. The plants also follow the Nestlé Continuous Excellence program to ensure higher quality through such initiatives as Six Sigma.

Nestlé takes a long-term view when planning for production. It recently began distributing the

first of 12 million cocoa trees to farmers in Ivory Coast, where the company gets much of its cocoa. Over the next decade, these new trees will produce more and higher-quality beans for the farmers, increasing their income and improving the supply of cocoa for Nestlé.

Questions

1. How does the purchasing function affect the quality of a product like Nestlé's Kit Kat chocolate bars?
2. What benefits would a global corporation such as Nestlé be likely to gain by having all its U.S. plants qualify for ISO certification?

SUMMARY

Summary

1 Explain the nature of production.

Operations management consists of all the activities that managers engage in to create goods and services. Operations are as relevant to service organizations as to manufacturing firms. Generally, three major activities are involved in producing goods or services: product development, planning for production, and operations control. Today, U.S. manufacturers are forced to compete in an ever-smaller world to meet the needs of more-demanding customers. As a result, U.S. manufacturers have used innovation to improve productivity. Because of innovation, fewer workers are needed, but those workers who are needed possess the skills to use automation and technology. In an attempt to regain a competitive edge, manufacturers have taken another look at the importance of improving quality and meeting the needs of their customers. They also have used new techniques to motivate employees, reduced costs, used computer-aided and flexible manufacturing systems, improved control procedures, and used green manufacturing. Competing in the global economy is not only profitable but also an essential activity that requires the cooperation of everyone within an organization.

2 Outline how the conversion process transforms raw materials, labor, and other resources into finished products or services.

A business transforms resources into goods and services in order to provide utility to customers. Utility is the ability of a good or service to satisfy a human need. Form utility is created by people converting raw materials, finances, and information into finished products. Conversion processes vary in terms of the major resources used to produce goods and services (focus), the degree to which resources are changed (magnitude of change), and the number of production processes that a business uses. The application of the basic principles of operations management to the production of services has coincided with the growth and importance of service businesses in the United States.

3 Describe how research and development lead to new products and services.

Operations management often begins with product R&D. The results of R&D may be entirely new products or extensions and refinements of existing products. R&D activities are classified as basic research (aimed at uncovering new knowledge), applied research (discovering new knowledge with some potential use), and development and implementation (using new or existing knowledge to produce goods and services). If a firm sells only one product, when that product reaches the end of its life-cycle, the firm will die, too. To stay in business,

the firm must, at the very least, find ways to refine or extend the want-satisfying capability of its product.

4 Discuss the components involved in planning the production process.

Planning for production involves three major phases: design planning, facilities planning, and operational planning. First, design planning is undertaken to address questions related to the product line, required production capacity, and the use of technology. Then production facilities, human resources, and plant layout must be considered. Operational planning focuses on the use of production facilities and resources. The steps for operational planning include (1) selecting a planning horizon, (2) estimating market demand, (3) comparing market demand with capacity, and (4) adjusting production of products or services to meet demand.

5 Explain how purchasing, inventory control, scheduling, and quality control affect production.

The major areas of operations control are purchasing, inventory control, scheduling, and quality control. Purchasing involves selecting suppliers. The choice of suppliers should result from careful analysis of a number of factors, including price, quality, reliability, credit terms, and shipping costs. Inventory control is the management of stocks of raw materials, work-in-process, and finished goods to minimize the total inventory cost. Today, most firms use a computerized system to maintain inventory records. In addition, many firms use a just-in-time inventory system, in which materials or supplies arrive at a facility just when they are needed so that storage and holding costs are minimized. Scheduling ensures that materials and other resources are at the right place at the right time. Both Gantt charts and PERT can be used to improve a firm's ability to schedule the production of products. Quality control guarantees that products meet the design specifications for those products. The major objective of quality control is to see that the organization lives up to the standards it has set for itself on quality. A number of different activities can be used to improve quality.

6 Summarize how productivity and technology are related.

Productivity is the average level of output per worker per hour. From 1979 to 2008, U.S. productivity growth averaged a 3.9 percent increase. More specifically, productivity in 2008 increased 1.2 percent. Although a 1.2 percent increase in U.S. productivity in 2008 does not compare with the nation's average productivity gains for the period between 1979 and 2008, it does compare favorably with the 16 other nations that the U.S. Bureau

of Labor Statistics tracks each year. Several factors have been cited as possible causes for lower productivity growth, and managers have begun to explore solutions for overcoming them. Possible solutions include less government regulation, increased cooperation between management and labor, increased employee motivation and participation, and additional investment by business to fund new or renovated facilities, equipment, employee training, and the use of automation and technology.

Automation, the total or near-total use of machines to do work, has for some years been changing the way work is done in factories. A growing number of industries are

using programmable machines called robots to perform tasks that are tedious or hazardous to human beings. Computer-aided design, computer-aided manufacturing, and computer-integrated manufacturing use computers to help design and manufacture products. FMS combines electronic machines and computer-integrated manufacturing to produce smaller batches of products more efficiently than on the traditional assembly line. Instead of having to spend vast amounts of time and effort to retool the traditional mechanical equipment on an assembly line for each new product, an FMS is rearranged simply by reprogramming electronic machines.

Key Terms

You should now be able to define and give an example relevant to each of the following terms:

operations management (217)	capital-intensive technology (225)	Malcolm Baldrige National Quality Award (232)	automation (236)
mass production (218)	plant layout (226)	quality control (233)	robotics (236)
analytical process (218)	planning horizon (227)	statistical process control (SPC) (233)	computer-aided design (CAD) (237)
synthetic process (218)	purchasing (229)	statistical quality control (SQC) (233)	computer-aided manufacturing (CAM) (237)
utility (219)	inventory control (230)	inspection (233)	computer-integrated manufacturing (CIM) (237)
form utility (219)	materials requirements planning (MRP) (230)	quality circle (233)	continuous process (237)
service economy (221)	just-in-time inventory system (230)	Six Sigma (234)	flexible manufacturing system (FMS) (237)
research and development (R&D) (222)	scheduling (230)	International Organization for Standardization (ISO) (234)	intermittent process (237)
design planning (224)	Gantt chart (231)	productivity (235)	
product line (224)	PERT (Program Evaluation and Review Technique) (231)		
product design (225)			
capacity (225)			
labor-intensive technology (225)			

Review Questions

- List all the activities involved in operations management.
- What is the difference between an analytical and a synthetic manufacturing process? Give an example of each type of process.
- In terms of focus, magnitude, and number, characterize the production processes used by a local pizza parlor, a dry-cleaning establishment, and an auto repair shop.
- Describe how research and development leads to new products.
- Explain why product extension and refinement are important.
- What are the major elements of design planning?
- What factors should be considered when selecting a site for a new manufacturing facility?
- What is the objective of operational planning? What four steps are used to accomplish this objective?
- If you were an operations manager, what would you do if market demand exceeded the production capacity of your manufacturing facility? What action would you take if the production capacity of your manufacturing facility exceeded market demand?
- Why is selecting a supplier so important?
- What costs must be balanced and minimized through inventory control?
- How can materials requirements planning (MRP), manufacturing resource planning (MRP II), and enterprise resource planning (ERP) help to control inventory and a company's production processes?
- How does the just-in-time-inventory system help to reduce inventory costs?

14. Explain in what sense scheduling is a *control* function of operations managers.
15. How can management and employees use statistical process control, statistical quality control, inspection, and quality circles to improve a firm's products?
16. How might productivity be measured in a restaurant? In a department store? In a public school system?
17. How can CIM and FMS help a manufacturer to produce products?

Discussion Questions

1. Why would Rubbermaid—a successful U.S. company—need to expand and sell its products to customers in foreign countries?
2. Do certain kinds of firms need to stress particular areas of operations management? Explain.
3. Is it really necessary for service firms to engage in research and development? In planning for production and operations control?
4. How are the four areas of operations control interrelated?
5. In what ways can employees help to improve the quality of a firm's products?
6. Is operations management relevant to nonbusiness organizations such as colleges and hospitals? Why or why not?

Video Case 8.1

Burton Snowboards' High-Quality Standards



"The people at Burton are a powerful, inspiring, and fun group, and I will miss that," said the recently departing CEO of Vermont's fabled Burton Snowboards. In fact, the company's nearly 900 employees are some of the many reasons the firm has grown to be the world's leading snowboard and accessories company. Many are snowboard enthusiasts, not least among them Jake Burton Carpenter, founder and currently interim CEO. Despite his management responsibilities, Jake still rides a snowboard about 100 days of the year, sometimes to test new products, but sometimes just for fun. "There are a lot of vibrant folks," at the company "and it rubs off on you," he says.

The company began as an entrepreneurial venture housed in a barn in 1977. Jake, who says he was a failure in shop class while in school, handmade his own boards for a sport that had few followers and was yet to be recognized. Snowboarding has since come a long way, having made its Olympic debut during the 1998 Winter Games at Nagano, Japan. Burton Snowboards has grown, too. With world headquarters in Burlington, the company operates a factory in Austria and stores in Chicago, Los Angeles, New York, Wrentham (MA), Orlando, and of course Burlington, as well as in Tokyo and Innsbruck (Austria). It also works with thousands of retail dealers in more than 30 countries around the world and offers products for sale online as well.

A major factor in the company's success is the high-quality standards to which it has adhered from its very beginning. These have made Burton Snowboards a premium supplier whose name is synonymous with quality. Its snowboards are made to exacting specifications from wood, fiberglass, and steel, not cheaper foam materials, and with unrelenting attention to every step, including the finishing details. "We don't cut corners," says a company spokesper-

son, though that sometimes means its products will cost a bit more than competitors'. The prevailing philosophy at the firm is that "you get what you pay for," and by listening to its core customers, who fall between 12 and 35 years of age, Burton remains confident that its high standards meet the expectations of those for whom snowboarding is not just a sport but also a lifestyle. "We've always based our decisions around snowboarders and what's best for them," says Jake.

Quality is further assured by the company's policy of redesigning every product every year in order to retain its position as "an innovator, not an imitator" and to keep up with changing customers' needs and desires as well as with competitors' efforts to grow their own market share. One such threat comes from ski companies that have decided to move into the snowboarding industry. Burton's managers credit much of the company's success to its ability to respond well to change. According to Jake, "As a company we've always thrived on opportunity."

One new opportunity the firm faces is the need to control its production costs without sacrificing quality. Burton recently announced that it is closing its Burlington factory and will manufacture exclusively at the Austrian plant it has operated for the past 25 years. "It costs us significantly more to produce a board in Vermont than we are capable of selling it for," a company statement said, "and sadly, this is not sustainable in the current economy." Nearly 400 employees will remain at the Burlington facility, however, which has "excelled at prototyping and developing product" in the past and will still carry that responsibility. "Here in Vermont," said the then-CEO, "we will continue to focus on advanced product development, which will allow us to bring the latest snowboard technology to riders faster than ever before."¹⁹

Questions

1. About 40 people will lose their jobs when Burton closes its Burlington factory, and the company is working with the state of Vermont to provide them with help in finding new employment. How do you think the factory closing might affect the productivity of the remaining headquarters staff? What impact could it have on product quality?
2. Do you think there will be an impact on quality when the design and development staff are separated from the factory floor by so many miles? Why or why not?
3. Can you reconcile the company's focus on product quality with its decision to concentrate manufacturing in a place where it's less expensive to operate? If so, how, and if not, why not?

Case 8.2

Toyota's Quality Crisis

Toyota Motor Corp., once the role model for world-class manufacturing, is facing a quality crisis. With over \$200 billion in annual sales and 320,000 employees worldwide, the Japan-based automaker has been driving hard for higher market share. However, after a string of recalls involving millions of vehicles, Toyota is now playing catch-up in the very area in which it has long prided itself—product quality. It also faces serious questions about its slow response to reports of defects.

Production efficiency has long been central to Toyota's culture and its financial strength. Its just-in-time inventory system, which minimizes holding costs, has been copied by manufacturers all over the world. Still, during the past decade alone, the company has boosted its bottom line by building new factories and wringing billions of dollars in savings from its production process. It has reduced the number of parts in its cars, redesigned components to be cheaper and lighter, and increased the speed at which designs are finalized and moved into production. Asked about the effect on quality, a Toyota vice president in North America commented: "It's not true that by reducing cost you automatically reduce quality. Every automaker has to stay competitive relative to price."

Yet in 2005 and again in 2006, Toyota recalled millions of vehicles. After that series of recalls, the company announced a quality-improvement plan based on its famous Toyota Way. One tenet of the Toyota Way is mutual ownership of problems, with quality circles designated to deal with difficulties as they arise. A second is the need to solve problems at their source, which allows factory workers to stop the production line if necessary to address a problem. The third is an urgent and constant drive to improve work processes, fueled by employee suggestions.

In 2008, Toyota's president acknowledged that the company needed to improve internal communications. "When Toyota was a small company," he said, "we could expressly communicate" about quality problems and solutions. "But now that Toyota is so big, we've realized that we have not adequately communicated."

Quality problems surfaced again in 2009, when Toyota learned that a number of vehicles sold in Europe had faulty gas pedals that could lead to sudden acceleration, a serious safety problem. Although Toyota sent its European distributors a bulletin about the problem, it didn't notify U.S. dealers

or regulators. That September, the U.S. National Highway Traffic Safety Administration put pressure on Toyota to recall cars because of "unintended acceleration" problems, some reportedly linked to fatal accidents. However, the company didn't announce its gas-pedal fix until November and didn't actually issue the recall until January 2010.

With U.S. regulators and the car-buying public expressing outrage at the slow speed of Toyota's response, Congress held hearings on the matter in March 2010. Toyota's president testified and offered a public apology. Toyota's top U.S. official, asked about the gas-pedal problem, told legislators: "We did not hide it. But it was not properly shared."

The crisis deepened in April when U.S. regulators, after reviewing documents turned over by Toyota, said they would slap the automaker with a multimillion-dollar fine for delaying the recall. For its part, Toyota blamed poor communication. Only weeks after the Congressional hearings, Toyota's president told securities analysts: "Once we thoroughly explored and tried to identify the root cause, we came to realize the problem was . . . with communications [rather] than with quality itself." A company statement, issued the same day, reinforced this explanation: "We have publicly acknowledged on several occasions that the company did a poor job of communicating during the period preceding our recent recalls."

Right after the recalls, *Consumer Reports* suspended its "buy" recommendations on the eight Toyota models involved. The magazine, which many consumers consult before buying cars and trucks, later issued a rare "don't buy" warning on one of Toyota's Lexus GX SUVs, expressing concern about the possibility of a rollover during emergency driving maneuvers. What can Toyota do to steer out of its quality crisis?²⁰

Questions

1. Although the Toyota Way relates to quality control, can it be applied to the company's communications about quality? Explain your answer.
2. Evaluate this Toyota executive's quote: "Every automaker has to stay competitive relative to price." What are the implications for the company's management of productivity?
3. What do you think Toyota needs to do to restore its reputation for quality?

Building Skills for Career Success



1 JOURNALING FOR SUCCESS

Today, people purchase all kinds of products ranging from inexpensive, everyday items to expensive, sophisticated products including electronics, automobiles, and even housing. In each case, customers like to think they are “getting their money’s worth” when they purchase a product or service.

Assignment

1. Describe a recent purchase that you made. Be sure to include the cost and why you made the purchase.
2. Given the cost of the product or service, were you satisfied? Why?
3. Do you think that the quality of this product or service was acceptable or unacceptable?
4. How could the manufacturer or provider of the service improve the quality of the product or service?

2 EXPLORING THE INTERNET

Improvements in the quality of products and services is an ever-popular theme in business management. Besides the obvious increase to profitability to be gained by such improvements, a company’s demonstration of its continuous search for ways to improve operations can be a powerful statement to customers, suppliers, and investors. Two of the larger schools of thought in this field are Six Sigma and Total Quality Management.

Assignment

1. Use Internet search engines to find more information about each of these topics.
2. From the information on the Internet, can you tell whether there is any real difference between these two approaches?
3. Describe one success story of a firm that realized improvement by adopting either approach.

3 DEVELOPING CRITICAL-THINKING SKILLS

Plant layout—the arrangement of machinery, equipment, and personnel within a production facility—is a critical ingredient in a company’s success. If the layout is inefficient, productivity and, ultimately, profits will suffer. The purpose of the business dictates the type of layout that will be most efficient. There are three general types: process layout, product layout, and fixed-position layout.

Assignment

1. For each of the following businesses, identify the best type of layout:

One-hour dry cleaner
Health club
Auto repair shop
Fast-food restaurant

Shipyard that builds supertankers
Automobile assembly plant

2. Prepare a two-page report explaining why you chose these layouts and why proper plant layout is important.

4 BUILDING TEAM SKILLS

Suppose that you are planning to build a house in the country. It will be a brick, one-story structure of approximately 2,000 square feet, centrally heated and cooled. It will have three bedrooms, two bathrooms, a family room, a dining room, a kitchen with a breakfast nook, a study, a utility room, an entry foyer, a two-car garage, a covered patio, and a fireplace. Appliances will operate on electricity and propane fuel. You have received approval and can be connected to the cooperative water system at any time. Public sewerage services are not available; therefore, you must rely on a septic system. You want to know how long it will take to build the house.

Assignment

1. Identify the major activities involved in the project and sequence them in the proper order.
2. Estimate the time required for each activity.
3. Working in a group, prepare a PERT diagram to show the steps involved in building your house.
4. Present your PERT diagram to the class and ask for comments and suggestions.

5 RESEARCHING DIFFERENT CAREERS

Because service businesses are now such a dominant part of our economy, job seekers sometimes overlook the employment opportunities available in production. Two positions often found in these plants are quality-control inspector and purchasing agent.

Assignment

1. Using the *Occupational Outlook Handbook* at your local library or on the Internet (<http://stats.bls.gov/oco/home.htm>), find the following information for the jobs of quality-control inspector and purchasing agent:

Nature of work, including main activities and responsibilities
Job outlook
Earnings
Training, qualifications, and advancement.

2. Look for other production jobs that may interest you and compile the same sort of information about them.
3. Summarize in a two-page report the key things you learned about jobs in production.



Graeter's Leadership and Management Efforts Enhance Performance

Graeter's, the premier ice-cream maker based in Cincinnati, is a special organization. A small company (\$20 million in annual sales) currently unfolding ambitious plans for national expansion, it is also a fourth-generation family firm with an entrepreneurial spirit. Even though it is currently undergoing changes as monumental as building a new factory and preparing to quadruple production, Graeter's still clings fiercely to its original small-batch production method for making rich, creamy ice cream by hand from a simple recipe of natural ingredients. "What is unique to Graeter's, I believe, is that they are just the best out there," says one food industry analyst.

A FAMILY AFFAIR

Graeter's top-management team consists of CEO Richard Graeter II and his two cousins, (brothers) Bob and Chip Graeter. All are great grandsons of the original founders. As vice president of manufacturing, Bob is responsible for sourcing the fresh fruits, cream, eggs, sugar, and top-quality chocolates that go into Graeter's products, whereas Chip oversees the 45 company-owned retail stores in Cincinnati and neighboring cities. A controller and vice president of sales and marketing are also on the team. All three Graeters grew up by working their way through various jobs within the company, sometimes making packing boxes and stamping the names of flavors on ice-cream containers. "I think I always knew that I'd be here," says Richard. "Looking back, I can't imagine not being here. It is just such a part of who I am." On the other hand, he observes, "It can be challenging to work with your family. My father and I didn't always see things the same way. But on the other hand, there is a lot of strength in the family relationship. . . we certainly had struggles, and family businesses do struggle, especially with transition . . . but we found people to help us, including lawyers, accountants, and a family-business psychologist."

Richard describes the current management structure as "an equal partnership" of himself and his two cousins. He says of their collaborative decision-making process, "Every major decision, we make on a consensus basis. That doesn't mean we don't have a different point of view from time to time, but. . . we learn to see each other's view and discuss, debate, and get down to a decision that all of us support. The other thing that we have learned to do, something that is a little different than our parents' generation [did], is bring in outside people into the . . . executive level of the management team. . . . We now work with a couple of consultants to help us plan our strategy to look for a new vision, to develop training programs. . . all those systems that big companies have."

Says another of the company's managers about problem solving and decision making at Graeter's, "If I can get the right resources in the room, there is no problem that cannot

be solved. . . . Sometimes that means the operators on the floor. . . because they are in touch with what is really going on. So I ask a lot of questions. I understand what the barriers are, and I find resources to come to a solution." A team of technicians meets with their manager twice a day. "We get in a room for half an hour and I go around the room and I say, 'What did you see today? What did you learn today? What kind of problems do you see? What could we do about that?'"

EMBRACING OPPORTUNITIES FOR GROWTH

Change has come quickly to Graeter's, not all of it anticipated. After three generations of local mom-and-pop style operations, the company is poised for what it hopes will be rapid nationwide expansion of its supermarket distribution operation, which currently puts Graeter's ice cream in the freezers of about 1,700 Kroger's supermarkets in the Midwest, Texas, and Colorado. A new factory to help increase production was already being built when an unexpected opportunity arose: to buy out the last franchise company operating Graeter's retail stores and take over the franchisor's factory as well. The management team jumped at the chance. "A few months ago our strategy was just operate one plant," says Richard. "Now our strategy is, adapt to the opportunity that came along. . . we are operating three plants. The goal is to keep all of your assets deployed productively, so if we have these three plants, what is the most we can do out of those plants to be generating product and profit? One example would be supplying restaurants in other cities, which we really weren't considering originally because our new plant was really geared for pints, but if we have this excess capacity, the smart thing to do is figure out what we can do with that."

As the company looks forward to the possibility of opening Graeter's stores as far away as Dallas, Los Angeles, and New York, the management team is carefully considering the risk. "Our family has always been contented to make a little less profit in order to ensure our long-term survival," says Richard. "It is a trait that we intend to drum into the fifth generation the same way that our fathers drummed it into us."²¹

Questions

1. What do you think is Graeter's current basis of departmentalization? Do you think this basis might change as Graeter's begins to expand across the country?
2. How would you describe the decision-making process at Graeter's?
3. How many types of planning can you observe in the case? How well do you think Graeter's team handles the planning function of management?



Now you should be ready to provide evidence that you have a management team with the necessary skills and experience to execute your business plan successfully. Only a competent management team can transform your vision into a successful business. You also should be able to describe your manufacturing and operations plans. The three chapters in Part 3 of your textbook, “Understanding the Management Process,” “Creating a Flexible Organization,” and “Producing Quality Goods and Services,” should help you in answering some of the questions in this part of the business plan.

THE MANAGEMENT TEAM COMPONENT

The management team component should include the answers to at least the following questions:

- 3.1. How is your team balanced in technical, conceptual, interpersonal, and other special skills needed in your business?
- 3.2. What will be your style of leadership?
- 3.3. How will your company be structured? Include a statement of the philosophy of management and company culture.
- 3.4. What are the key management positions, compensation, and key policies?
- 3.5. Include a job description for each management position and specify who will fill that position. *Note:* Prepare an organization chart and provide the résumé of each key manager for the appendix.
- 3.6. What other professionals, such as a lawyer, an insurance agent, a banker, and a certified public accountant, will you need for assistance?

THE MANUFACTURING AND OPERATIONS PLAN COMPONENT

If you are in a manufacturing business, now is a good time to describe your manufacturing and operations plans, space requirements, equipment, labor force, inventory control, and purchasing requirements. Even if you are in a service-oriented business, many of these questions still may apply.

The manufacturing and operations plan component should include the answers to at least the following questions:

- 3.7. What are the advantages and disadvantages of your planned location in terms of
 - Wage rates
 - Unionization
 - Labor pool
 - Proximity to customers and suppliers
 - Types of transportation available
 - Tax rates
 - Utility costs
 - Zoning requirements
- 3.8. What facilities does your business require? Prepare a floor plan for the appendix. Will you rent, lease, or purchase the facilities?
- 3.9. Will you make or purchase component parts to be assembled into the finished product? Make sure to justify your “make-or-buy decision.”
- 3.10. Who are your potential subcontractors and suppliers?
- 3.11. How will you control quality, inventory, and production? How will you measure your progress?
- 3.12. Is there a sufficient quantity of adequately skilled people in the local labor force to meet your needs?

REVIEW OF BUSINESS PLAN ACTIVITIES

Be sure to go over the information you have gathered. Check for any weaknesses and resolve them before beginning Part 4. Also, review all the answers to the questions in Parts 1, 2, and 3 to be certain that they are consistent throughout the entire business plan. Finally, write a brief statement that summarizes all the information for this part of the business plan.

The information contained in “Building a Business Plan” will also assist you in completing the online *Interactive Business Plan*.