**CHAPTER 10: PRODUCTION AND OPERATIONS MANAGEMENT**

**Chapter Overview**

This chapter describes the process of producing goods and services. It looks at the importance of production and operations management and discusses the new technologies that are transforming the production function. It then discusses the tasks of the production and operations manager, the importance of quality, and the methods businesses use to ensure high quality.

**Glossary of Key Terms**

**Benchmarking:** process of determining how well other companies perform business functions or tasks

**Computer-aided design (CAD):** process that allows engineers to design components as well as entire products on computer screens faster and with fewer mistakes than they could achieve working with traditional drafting systems

**Computer-aided manufacturing (CAM):** computer tools to analyze CAD output and enable a manufacturer to analyze the steps that a machine must take to produce a needed product or part

**Computer-integrated manufacturing (CIM):** production system in which computers help workers design products, control machines, handle materials, and control the production function in an integrated fashion

**Flexible manufacturing system (FMS):** production facility that workers can quickly modify to manufacture different products

**International Organization for Standardization (ISO):** organization whose mission is to develop and promote international standards for business, government, and society to facilitate global trade and cooperation

**Inventory control:** function requiring production and operations managers to balance the need to keep stock on hand to meet demand against the costs of carrying inventory

**Just-in-time (JIT) system:** broad management philosophy that reaches beyond the narrow activity of inventory control to influence the entire system of production and operations management

**LEED (Leadership in Energy and Environmental Design):** voluntary certification program administered by the U.S. Green Building Council, aimed at promoting the most sustainable construction processes available

**Make, buy, or lease decision:** choosing whether to manufacture a product or component in house, purchase it from an outside supplier, or lease it

**Mass production:** a system for manufacturing products in large quantities through effective combinations of employees, with specialized skills, mechanization, and standardization

**Materials requirement planning (MRP):** computer-based production planning system that lets a firm ensure that it has all the parts and materials it needs to produce its output at the right time and place and in the right amounts

**Production:** use of resources, such as workers and machinery, to convert materials into finished goods and services

**Production and operations management:** oversee the production process by managing people and machinery in converting materials and resources into finished goods and services

**Production control:** creates a well-defined set of procedures for coordinating people, materials, and machinery to provide maximum production efficiency

**Quality:** good or service that is free of deficiencies

**Quality control:** measuring output against established quality standards

**Learning Objective 1: Explain the strategic importance of production.**

*Production and operations management is a vital business function. Without a quality good or service, a company cannot create profits, and it soon fails. The production process is also crucial in a not-for-profit organization, because the good or service it produces justifies the organization’s existence. Production and operations management plays an important strategic role by lowering the costs of production, boosting output quality, and allowing the firm to respond flexibly and dependably to customers’ demands.*

**Annotated Lecture Outline**

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| **Opening Vignette:**  **Intel’s “Fab” New Manufacturing Facility**  Intel, the company that supplies about 80% of chips in all laptops, recently made a $9 billion investment in company expansions. A large portion of this investment will go to their new chip-producing facility in Arizona known as Fab 42. The new facility will employ roughly 1,000 new workers. Thirty quality-control specialists will monitor the automatic manufacturing processes 24/7. This will enable the facility to test for over 1,500 different defects in microscopic silicon wafers. Fab 42 will help Intel continue to be a leading manufacturer well into the world of 22-nanometer technology. |  |
| 1. Producing goods and services |  |
| * 1. Businesses create *utility*, the want-satisfying power of a good or service. |  |
| * 1. Basic utilities include time, place, ownership, and form. |  |
| 1. *Production* is the use of resources, such as workers and machinery, to convert materials into finished goods and services. | *Lecture Enhancer: Discuss the conversion process that occurs, and the resources needed, in a hospital.* |

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| * 1. *Production and operations management* oversee the production process by managing people and machinery in converting materials and resources into finished goods and services. | PowerPoint Slide 3  Figure 10.1 The Production Process: Converting Inputs to Outputs |
| * 1. *Production* differs from *manufacturing*: Production spans both manufacturing and nonmanufacturing industries. | Figure 10.2 Typical Production Systems |
| * 1. Production always converts inputs into outputs. | PowerPoint Slide 4  *Class Activity: Lead a class discussion on the inputs, transformation process, and outputs of a college.* |
| **THE STRATEGIC IMPORTANCE OF PRODUCTION** | PowerPoint Slide 5 |
| * 1. Production is a vital function necessary for generating money to pay employees, lenders, and stockholders. |  |
| * 1. The production process is just as crucial in nonprofit organizations. | *Lecture Enhancer: Describe the production process for the American Red Cross during a crisis.* |
| * 1. Effective production and operations management can: |  |
| * + 1. lower a firm’s costs of production |  |
| * + 1. boost the quality of its goods and services |  |

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| * + 1. allow it to respond dependably to customer demands |  |
| * + 1. enable it to renew itself by providing new products. |  |
| 1. **Mass Production** | PowerPoint Slide 6 |
| 1. *Mass production* is a system for manufacturing products in large quantities through effective combinations of employees, with specialized skills, mechanization, and standardization. | *Lecture Enhancer: What companies do you think provide examples of mass production?* |
| 1. Mass production makes outputs available in large quantities at lower prices than individually crafted items would cost. |  |
| 1. Mass production includes three main components: specialization of labor, mechanization, and standardization. |  |
| 1. Specialization of labor divides work into its simplest components so that each worker concentrates on one task. | *Lecture Enhancer: What are the advantages and disadvantages of increasing the specialization of labor?* |
| 1. In mechanization, machines perform work previously done by people. |  |
| 1. Standardizationmeans that uniform, interchangeable goods and parts are produced. |  |

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| d. The *assembly line* is a manufacturing method that moves the product along a conveyor belt past workstations where workers perform specialized tasks: | *Class Activity:*  *Ask students if they have ever performed highly specialized job duties on a recurring basis, and discuss their reactions to that experience.* |
| * + - 1. provides a logical extension of the three main components of mass production |  |
| * + - 1. efficient method for making mass quantities of similar items |  |
| * + - 1. highly inefficient when producing small batches of different items |  |
| 1. **Flexible Production** |  |
| * 1. Flexible production generally involves using: |  |
| * + - 1. information technology to share the details of customer orders |  |
| * + - 1. programmable equipment to fulfill the orders |  |
| * + - 1. skilled people to carry out whatever tasks are needed to fill a particular order. |  |
| * 1. Flexible production is most beneficial when combined with lean production methods that reduce requirements for workers and inventory. |  |

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| * 1. Flexible production requires a lot of communication among everyone in the organization. |  |
| * 1. Flexible production is now widely used in the auto industry; changing from mass production to flexible production has enabled auto companies to produce different kinds of cars at the same plant. |  |
| 1. **Customer-Driven Production** | *Lecture Enhancer: Do you think Chipotle is an example of customer-driven production? Can you provide other examples?* |
| * 1. Customer-driven production evaluates customer demands to link products made with products bought. |  |
| * 1. One method links computers in factories with retail scanners to create short-term forecasts and design production schedules. |  |
| * 1. Another method creates a product only after a customer orders it. |  |

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**Assessment Check Answers**

**1.1 What is mass production?**

*Mass production is a system for manufacturing products in large quantities through effective combinations of employees with specialized skills, mechanization, and standardization.*

**1.2 What is the difference between flexible production and customer-driven production?**

*Flexible production generally involves using technology to receive and fulfill orders and skilled people to carry out tasks needed to fill a particular order. Customer-driven production evaluates customer demands in order to make the connection between products manufactured and products bought.***Learning Objective 2: Identify and describe the production processes.**

*The four main categories of production processes are the analytic production system, which reduces a raw material to its component parts in order to extract one or more marketable products; the synthetic production system, which combines a number of raw materials or parts to produce finished products; the continuous production process, which generates finished products over a lengthy period of time; and the intermittent production process, which generates products in short production runs.*

**Annotated Lecture Outline**

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| **PRODUCTION PROCESSES** |  |
| 1. Production processes use either an analytic or synthetic system; time requirements call for either a continuous or an intermittent process. | PowerPoint Slide 7 |
| * 1. An analytic production system reduces a raw material to its component parts in order to extract one or more marketable products (e.g., petroleum refining, corn processing). | *Lecture Enhancer: Is carbonated beverage production an analytic or synthetic production system?* |
| * 1. A synthetic production systemcombines a number of raw materials or parts or transforms raw materials to produce finished products (e.g., Canon’s camera-making assembly line). | *Lecture Enhancer: Is meat processing an analytic or synthetic production system?* |
| * 1. A continuous production process generates finished products over a lengthy period of time (e.g., steel industry). | *Class Activity:*  *Ask students how the very high costs of a shutdown in a continuous production process might lead to poor or unethical decision making by management.* |
| * 1. An intermittent production process generates products in short production  runs, shutting down machines frequently or changing their  configurations to produce different products (e.g., most services—dentists, plumbers). |  |

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Assessment Check Answers

2.1 What are the two main production systems?

*The two systems are analytic production and synthetic production.*

2.2 What are the two time-related production processes?

*The two time-related production processes are the continuous production process and the intermittent production process.*

**Learning Objective 3: Explain the role of technology in the production process.***Computer-driven automation allows companies to design, create, and modify products rapidly and produce them in ways that effectively meet customers’ changing needs. Important design and production technologies include robots, computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-integrated manufacturing (CIM). Many firms are pouring resources into the development of manufacturing processes that result in a reduction of waste, energy use, and pollution.*

**Annotated Lecture Outline**

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| **TECHNOLOGY AND THE PRODUCTION PROCESS** | PowerPoint Slide 8 |
| 1. **Green Manufacturing Processes** |  |
| * 1. More and more firms are using manufacturing processes that reduce waste, energy use, and pollution. | Going Green:  Kraft Foods’ Recipe for Zero Waste |
| * 1. Some companies seek LEED (Leadership in Energy and Environmental Design)certification for their facilities. | *Class Activity:*  *Ask students if a company’s “green” efforts have positively affected their purchasing that company’s goods or services.* |
| * 1. *LEED (Leadership in Energy and Environmental Design* is a voluntary certification program administered by the U.S. Green Building Council, aimed at promoting the most sustainable construction processes available. |  |
| 1. **Robots** |  |
| * 1. A *robot*is a reprogrammable machine capable of performing a variety of tasks that require the repeated manipulation of materials and tools. | *Lecture Enhancer:*  *Name some industries where robots are used as part of the assembly-line process.* |

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| * 1. Robots can repeat the same tasks many times without varying their movements. |  |
| * 1. Historically, robots were most common in automotive and electronics manufacturing. |  |
| * 1. More industries are adding robots to production lines as technology makes them less expensive and more useful. | *Lecture Enhancer: What are the advantages and disadvantages of robotic surgery in the medical field?* |
| * + 1. A pick-and-place robot moves in two or three directions as it picks something up from one spot and places in another. |  |
| * + 1. Field robots assist people in nonmanufacturing, often hazardous, environments such as nuclear power plants, the international space station, and even battlefields. |  |
| * 1. Using vision systems, infrared sensors, and bumpers on mobile platforms, robots can automatically move parts or finished goods from one place to another, while either following or avoiding people. |  |
| 1. **Computer-Aided Design and Manufacturing** |  |
| * 1. *Computer-aided design (CAD)* is a process that allows engineers to design components as well as entire products on computer screens faster and with fewer mistakes than they could achieve working with traditional drafting systems. |  |

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| * + 1. Using an electronic pen, an engineer can sketch three-dimensional (3-D) designs on an electronic drafting board or directly on the screen. |  |
| * + 1. The computer then provides tools to make major and minor design changes and to analyze the results for particular characteristics or problems. |  |
| * 1. *Computer-aided manufacturing (CAM)* is the use of tools to review CAD output and analyze the steps that a machine must take to produce a needed product or part. |  |
| * 1. Both CAD and CAM technologies are now used together at most modern production facilities. |  |
| 1. **Flexible Manufacturing Systems** |  |
| * 1. A *flexible manufacturing system (FMS)* is a production facility that workers can quickly modify to manufacture different products. | *Lecture Enhancer: FMS is used by Toyota Motors and Honda to manufacture automobiles. What do you see as the benefits of using FMS in this industry?* |
| * 1. Computer-controlled centers make metal parts, robots handle parts, and remote-controlled carts deliver materials. |  |
| * 1. Electronic controls link and direct activities, and software reprograms machine tools while they are running. |  |

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| 1. **Computer-Integrated Manufacturing** |  |
| * 1. *Computer-integrated manufacturing (CIM)* is a production system in which computers help workers design products, control machines, handle materials, and control the production function in an integrated fashion. |  |
| * 1. CIM combines robots, CAD/CAM, FMS, computers, and other technologies. |  |
| * 1. The key to CIM is a centralized computer system running software that integrates and controls separate processes and functions. |  |
| * 1. The advantages of CIM include increased productivity, decreased design costs, increased equipment utilization, and improved quality. |  |

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**Going Green:**

Kraft Foods’ Recipe for Zero Waste

**Summary**

Kraft has been placed on the Dow Jones’ Sustainability Index for seven years in a row now, and for good reason. At 36 plants both nationally and internationally, Kraft has achieved zero waste through several ideas pitched by employees. In California, food waste is transformed into animal feed, in Wisconsin, process waste is converted into energy for local power grids, and in Russia, coffee containers are reused while the coffee grounds are saved for fertilizer. These are just a few examples, while Kraft also aims to decrease their overall generated waste by 15% in the next few years.

**Answers to Questions for Critical Thinking**

1. **Why does Kraft ask for employee suggestions on reducing waste?**

*Kraft asks for employee suggestions regarding how they can reduce waste because their employees belong to the local communities where the plants are located and are therefore good resources for informing the corporation about community needs. Also, this boosts employee morale since they are contributing to a large-scale industry project.*

1. **Kraft switched a third of its snacks to foods with whole grains and lower sodium and calories. Should it continue shifting to healthier products? Why or why not?**

*Kraft should continue shifting to healthier products because society is continuing to lean towards a healthier lifestyle, and the availability of more nutritious Kraft Food products will show them that they can still enjoy their food while eating healthy.*

Assessment Check Answers

**3.1 List some of the reasons businesses invest in robots.**

*Businesses use robots to free people from sometimes dangerous assignments and to move heavy items from one place to another in a factory.*

**3.2 What is a flexible manufacturing system (FMS)?**

*A FMS is a production facility that workers can quickly modify to manufacture different products.*

**3.3** **What are the major benefits of computer-integrated manufacturing (CIM)?**

*The main benefits are increased productivity, decreased design costs, increased equipment utilization, and improved quality.*

**Learning Objective 4: Identify the factors involved in a location decision.**

*Criteria for choosing the best site for a production facility fall into three categories: transportation, human, and physical factors. Transportation factors include proximity to markets and raw materials, along with availability of transportation alternatives. Physical variables involve such issues as water supply, available energy, and options for disposing of hazardous wastes. Human factors include the area’s labor supply, local regulations, taxes, and living conditions.*

**Annotated Lecture Outline**

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| **THE LOCATION DECISION** | PowerPoint Slide 9 |
| 1. The decision of where to locate a production facility hinges on transportation, human, and physical factors. | Table 10.1 Factors in the Location Decision |
| * 1. Transportation factors include proximity to markets and raw materials, along with availability of alternative modes for transporting both inputs and outputs. |  |
| * + 1. Large assembly plants are often located near major rail lines. |  |
| * + 1. Shopping malls are often located next to major streets and freeways because most customers arrive by car. | *Lecture Enhancer: What locations on streets do you think are most avoided by retailers and why?* |
| * 1. Physical factors involve such issues as weather, water supplies, available energy, and options for disposing of hazardous waste. |  |
| * + 1. Theme parks are often located in warm climates so they can be open year-round. |  |

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| * + 1. A manufacturing business that wants to locate near a community must prepare an *environmental impact study* that analyzes how a proposed plant would affect the quality of life in the surrounding area. |  |
| * 1. Human factors include an area’s labor supply, local regulations, taxes, and living conditions. | *Lecture Enhancer: In your state, what labor skills might attract certain businesses?* |
| * + 1. Local labor costs |  |
| * + 1. The availability of qualified workers | *Class Activity:*  *Lead a discussion on the factors that exist in Silicon Valley that might explain why that area is attractive for so many technology companies.* |
| 1. Additional factors that must be considered include insurance costs; availability of employee needs; ample space for needs of firm; community issues; energy costs; and government incentives. | **Hit & Miss:**  **The Sun Is Shining Brighter in Senatobia** |
| 1. A recent trend in location strategy is bringing production facilities closer to final markets. |  |
| * 1. One reason is reduced shipping time and costs. |  |
| * 1. Another is enhanced cultural affinity between parent company and supplier. |  |

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**Hit & Miss:**

**The Sun Is Shining Brighter in Senatobia**

**Summary**

Twin Creeks Technologies is locating its new solar panel production facility in Senatobia. The facility will occupy 250,000 square feet and create several hundred jobs for local workers. The state of Mississippi is providing $50 million in loan assistance for the building project, and the state and the city of Senatobia are providing $4 million toward infrastructure improvement at the building site. Twin Creeks considered 25 sites in 6 other states before deciding on the Senatobia location in Mississippi. Twin Creeks is also working with local colleges to recruit engineers and begin training other potential job candidates for the plant.

**Answers to Questions for Critical Thinking**

1. **Besides government incentives, what other factors did Twin Creeks likely consider in its decision to locate its plant in Senotobia?**

*Twin Creeks likely considered factors such as the local labor supply, the proximity to suppliers and the market, and the availability of ample physical space when deciding where to locate its plant.*

1. **How does the community benefit from this decision? Could there be any drawbacks?**

*The community benefits from this decision because Twin Creeks is working with local colleges and vocational centers to provide skilled training to local workers, 13 percent of whom are unemployed. Possible drawbacks, although not addressed in the article, could include negative impacts on the local environment as a result of the production process.*

Assessment Check Answers

**4.1 How does an environmental impact study influence the location decision?**

*An environmental impact study influences the location decision because it studies how transportation, energy use, water and sewer treatment needs, and other factors will affect plants, wildlife, water, air, and other features of the natural environment.*

**4.2 What human factors are relevant to the location decision?**

*Human factors include an area’s labor supply, labor costs, local regulations, taxes, and living conditions.***Learning Objective 5: Explain the job of production managers.**

*Production and operations managers use people and machinery to convert inputs (materials and resources) into finished goods and services. Four major tasks are involved. First, the managers must plan the overall production process. Next, they must pick the best layout for their facilities. Then they implement their production plans. Finally, they control the production process and evaluate results to maintain the highest possible quality.*

*Implementation involves deciding whether to make, buy, or lease components; selecting the best suppliers for materials; and controlling inventory to keep enough, but not too much, on hand.*

**Annotated Lecture Outline**

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| **THE JOB OF PRODUCTION MANAGERS** | PowerPoint Slide 10  *Lecture Enhancer:*  *What is most important—to plan, determine, implement, or control? Why?* |
| * 1. Production and operations managers oversee the work of people and machinery to convert inputs (materials and resources) into finished goods and services. |  |
| * 1. These managers perform four major tasks: | Figure 10.3 Tasks of Production Managers |
| * + 1. plan the overall production process |  |
| * + 1. determine the best layout for the firm’s facilities |  |
| * + 1. implement the production plan |  |

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| * + 1. control the manufacturing process to maintain the highest possible quality. |  |
| 1. **Planning the Production Process** | PowerPoint Slide 11 |
| * 1. Choose what products or services to offer customers. |  |
| * + 1. Products must satisfy customers and be produced as efficiently and inexpensively as possible. |  |
| * 1. Convert original product ideas into final specifications. |  |
| * 1. Design the most efficient facilities to produce the new product or service. |  |
| * 1. Production managers must understand how a project fits into a company’s structure. | *Class Activity:*  *Ask students what personality traits and skills they think would be needed to be an effective production manager.* |
| * + 1. In a traditional manufacturing organization, each production manager is given a specific area of authority and responsibility, such as purchasing or inventory control. |  |
| * + 1. One drawback to this structure is that it may actually pit the purchasing manager against the inventory control manager. |  |
| * + 1. More organizations have moved toward team-oriented structures, with team members assigned to specific projects reporting to the production manager. |  |

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| 1. **Determining the Facility Layout** | *Lecture Enhancer:*  *Think of a local business and its layout. If the business adds new products or services, how might its layout change?* |
| * 1. An efficient facility layout can reduce material handling, decrease costs, and improve product flow through the facility. |  |
| * 1. Common layout designs: process, product, fixed-position, and customer-oriented. | Figure 10.4 Basic Facility Layouts |
| * + 1. A *process layout* groups machinery and equipment according to their functions. | PowerPoint Slide 12 |
| * + 1. A *product layout* sets up production equipment along a product-flow line, and the work in process moves along this line past workstations. | PowerPoint Slide 13 |
| * + 1. A *fixed-position layout* places the product in one spot and workers, materials, and equipment come to it. | PowerPoint Slide 14  *Lecture Enhancer: Provide local examples of businesses that use fixed-position layouts.* |
| * + 1. A *customer-oriented layout* arranges facilities to enhance the interactions between customers and a service. | PowerPoint Slide 15  *Class Activity: Ask students what type of a layout Apple stores utilize.* |

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| 1. **Implementing the Production Plan** | PowerPoint Slide 16 |
| * 1. Implementing the production plan involves: (1) deciding whether to make, buy, or lease components; (2) selecting the best suppliers; and (3) controlling inventory. |  |
| * 1. **Make, Buy, or Lease Decision** |  |
| * + 1. Involveschoosing whether to manufacture a product or component in house, purchase it from an outside supplier, or lease it. |  |
| * + 1. Factors in the decision include cost, availability of reliable outside suppliers, and the need for confidentiality. | **Hit & Miss:**  **Goodyear Tire & Genencor: A Sweet Alliance** |
| * + 1. Having an alternative supplier ensures that the firm obtains materials despite strikes, quality-assurance problems, or other   situations that affect inputs. | *Lecture Enhancer: What would be the challenges in identifying alternative suppliers for organic produce markets?* |
| * 1. **Selection of Suppliers** |  |
| * + 1. Selection is based on a comparison of quality, prices, dependability of delivery, and services offered by competing companies. | Case 10.1  **Macedonia: New Apparel Manufacturing Hub?** |
| * + 1. For a major purchase, the process of selection may take several weeks or even months and may rest with a number of people. |  |
| * + 1. The Internet has given buyers powerful tools for finding and comparing suppliers. |  |
| * + 1. Firms often buy raw materials or parts over long-term contracts, building relationships with fewer suppliers. |  |
| * + 1. Networking provides a way for production managers to learn about suppliers and get to know them personally. |  |
| * 1. **Inventory Control** | PowerPoint Slide 17 |
| * + 1. *Inventory control* requires production and operations managers to balance demand against the costs of carrying inventory. |  |
| * + 1. Many firms maintain *perpetual inventory* systems to continuously monitor the amounts and locations of their stock. | *Class Activity:*  *Lead a class discussion to identify other costs associated with carrying excessive inventory, in addition to warehousing costs, taxes, insurance, and maintenance.* |
| * + 1. Some companies go further and hand over their inventory control functions to suppliers in vendor-managed inventory. |  |
| * 1. **Just-in-Time-Systems** |  |
| * + 1. A just-in-time (JIT) system is a broad management philosophy that reaches beyond the narrow activity of inventory control to influence the entire system of production and operations management. | *Lecture Enhancer: What are the advantages of JIT?* |

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| * + 1. A JIT seeks to provide the right part, at the right place, right before it is needed in production. |  |
| * 1. **Materials Requirement Planning** |  |
| * + 1. *Materials requirement planning (MRP)* is a computer-based production planning system that lets a firm ensure that it has all the parts and materials it needs to produce its output at the right time and place and in the right amounts. |  |
| * + 1. Production managers use MRP programs to create schedules that identify the specific parts and materials required to produce an item. |  |

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**Hit & Miss:**

**Goodyear Tire & Genencor: A Sweet Alliance**

**Summary**

Genencor, an industrial biotechnology firm, has created a way to produce synthetic rubber from sugar instead of refined oil waste. Goodyear is collaborating with Genencor to provide greener, biologically based materials for producing its tires. Both firms see the collaboration as a win-win for all, including consumers.

**Answers to Questions for Critical Thinking**

1. **Describe the benefits of creating a research alliance for future raw materials or supplies.**

*By creating a research alliance rather than relying on only their own independent research, companies can increase the odds of developing successful solutions.*

1. **Investing in a future with a supplier requires planning. How might this decision affect other aspects of the production process?**

*As Goodyear designs new products, it will need to consult with its partner supplier to determine whether Genencor is capable of supplying materials for these new products.*

Assessment Check Answers

**5.1 List the four major tasks of production and operations managers.**

*The four tasks are planning overall production, laying out the firm’s facilities, implementing the production plan, and controlling manufacturing to achieve high quality.*

**5.2 What is the difference between a traditional manufacturing structure and a team-based structure?**

*In the traditional structure, each manager is given a specific area of authority. In a team-based structure, all workers are responsible for their output.*

**5.3 What factors affect the make, buy, or lease decision?**

*The costs of leasing or purchasing parts from vendors, versus producing them in house, the availability of dependable outside suppliers, and the need for confidentiality affect this decision.*

**Learning Objective 6: Discuss controlling the production process.***The production control process consists of five steps: planning, routing, scheduling, dispatching, and follow-up. Quality control is an important consideration throughout this process. Coordination of each of these phases should result in high production efficiency and low production costs.*

**Annotated Lecture Outline**

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| **CONTROLLING THE PRODUCTION PROCESS** | PowerPoint Slide 18 |
| * 1. *Production control* creates a well-defined set of procedures for coordinating people, materials, and machinery to provide maximum production efficiency. | *Lecture Enhancer: What control steps can you see that McDonald’s takes to provide uniform quality and control costs?* |
| * 1. Production control includes five steps: planning, routing, scheduling, dispatching, and follow-up. | Figure 10.5 Steps in Production Control |
| 1. **Production Planning** |  |
| * 1. The phase of production control called *production planning* determines the amount of resources an organization needs to produce a certain output. |  |
| * 1. This process develops a list of materials that lists all needed parts and materials. |  |
| * + 1. By comparing information about needed parts and materials with the firm’s perpetual inventory data, purchasing staff can identify necessary purchases. |  |
| * 1. Production planning also ensures the availability of needed machines and personnel. |  |

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| * 1. Production planning for services tends to emphasize human resources more than materials. | *Lecture Enhancer: How would an unexpected spike in product demand affect human resources?* |
| 1. **Routing** |  |
| * 1. *Routing* determines the sequence of steps throughout the facility and specifies who will perform each aspect at what location. |  |
| * 1. Routing choices depend on two factors: the nature of the good or service and the facility layout. |  |
| 1. **Scheduling** |  |
| * 1. *Scheduling* specifies the timetables that show how long each operation will take and when workers should perform it. |  |
| * 1. Production managers use a number of analytical methods for scheduling. |  |
| * + 1. A *Gantt chart* tracks projected and actual work progress over time; best for simple projects. | PowerPoint Slide 19  Figure 10.6 Sample Gantt Chart |
| * + 1. A *program evaluation and review technique (PERT)* chart schedules complex projects and minimizes delays by coordinating all aspects of the production process. | PowerPoint Slide 20  Figure 10.7 PERT Diagram for the Purchase and Installation of a New Robot |
| * + 1. The *critical path* on a PERT chart is the sequence of operations that requires the longest time to complete. | **Business Etiquette**  **Tips for Starting That New Job** |

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| 1. **Dispatching** |  |
| * 1. *Dispatching* is the phase of production control in which management instructs each department on what work to do and the time allowed for its completion. |  |
| * 1. Dispatching includes authorizing performance, providing instructions, and listing job priorities. |  |
| 1. **Follow-Up** |  |
| * 1. *Follow-up* is the phase of production control in which managers and employees or team members spot problems in the production process and come up with solutions. | *Lecture Enhancer: How could a restaurant use follow-up meetings to improve its service and profitability?* |

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Assessment Check Answers

**6.1 What five steps are involved in controlling the production process?**

*The five steps are planning, routing, scheduling, dispatching, and follow-up.*

**6.2 What is the difference between a PERT chart and a Gantt chart?**

*PERT charts, which seek to minimize delays by coordinating all aspects of the production process, are used for more complex projects; Gantt charts, which track projected and actual work progress over time, are used for scheduling relatively simple projects.***Learning Objective 7: Determine the importance of quality.***Quality control involves evaluating goods and services against established quality standards. Such checks are necessary to spot defective products and to see that they are not shipped to customers. Devices for monitoring quality levels of the firm’s output include visual inspection, electronic sensors, robots, and X-rays. Companies are increasing the quality of their goods and services by using Six Sigma techniques and by becoming ISO 9000 and 14000 certified.*

**Annotated Lecture Outline**

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| **IMPORTANCE OF QUALITY** | PowerPoint Slide 21  **Case 10.2**  **The F-35 Fighter Jet Flies Over Budget** |
| * 1. *Quality* refers to a good or service that is free of deficiencies. |  |
| * + 1. The cost of poor quality can amount to 20 percent of sales revenues. |  |
| * + 1. Expenses include downtime, repair costs, rework, and employee turnover. | *Lecture Enhancer: Can you think of any examples of companies that incurred additional costs because of product quality issues?* |
| * 1. *Benchmarking* is the process of determining how well other companies perform business functions or tasks. |  |
| * + 1. Companies then make improvements to match or exceed the quality found in their competitors’ products or services. |  |

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| * + 1. It’s important to establish what a firm wants to accomplish, what it wants to measure, and which company can provide the most useful benchmarking information. | *Class Activity:*  *Ask students how the types of companies that a hospital might benchmark could improve the patient check-in process.* |
| 1. **Quality Control** |  |
| * 1. *Quality control* involves measuring output against established quality standards. | *Lecture Enhancer: How might the standards for cake quality vary between a traditional bakery and a bakery that specializes in wedding cakes?* |
| * 1. Firms need these checks to find defective products and avoid delivering inferior shipments. |  |
| * 1. Standards should be set high enough to meet customer expectations. |  |
| * 1. Visual inspections, electronic sensors, robots, and X-rays monitor quality levels. |  |
| * 1. Customer surveys, negative feedback, or a high rejection rate for a product or component flag problem areas. | *Lecture Enhancer: Have you ever participated in a customer survey on quality?* |
| * 1. Firms that outsource operations may face a greater challenge in monitoring quality. | **Solving an Ethical Controversy**  **Multivitamins Produced in China: Are Stricter Quality Controls Necessary?** |
| * 1. The *Six Sigma* concept means that a company tries to make products error-free 99.9997 percent of the time. |  |
| 1. **ISO Standards** | PowerPoint Slide 22 |
| * 1. The *International Organization for Standardization (ISO)* is an organization whose mission is to promote the development of standardized products to facilitate trade and cooperation across national borders. |  |
| * 1. The ISO network consists of national standards bodies from 163 countries. |  |
| * 1. An ISO 9000 family series of standards sets requirements for quality processes. |  |
| * 1. The ISO 14000 series of standards sets standards for operations that minimize harm to the environment. |  |
| * 1. Many organizations have received significant benefits from ISO 9000. | *Lecture Enhancer: What types of benefits would a global manufacturer obtain from using ISO-certified suppliers?* |
| * 1. Many consumers prefer to buy from companies that are ISO 9000–certified. |  |

**Notes: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Assessment Check Answers

**7.1 What are some ways in which a company can monitor the quality level of its output?**

*Benchmarking, quality control, Six Sigma, and ISO standards are ways of monitoring quality.*

**7.2 List some of the benefits of acquiring ISO 9000 certification.**

*These standards define how a company should ensure that its products meet customers’ requirements. Studies show that customers prefer to buy from companies that are ISO 9000 certified.*

**Answers to Review Questions**

**1. What is utility? How does production create utility?**

*Utility is the want-satisfying or value-added power of a good or service. Businesses can create or enhance four basic kinds of utility: time, place, ownership, and form. Production creates form utility by converting raw materials and other inputs into finished products.*

**2. Why is production such an important business activity? In what ways does it create value for the company and its customers?**

*Production is an important business activity because the resulting goods or services represent the opportunity to grow in sales and profitability by effectively serving customers’ needs. Without production, none of the other functions would operate. Without a product to sell, a company cannot generate the funds needed to pay employees, lenders, or stockholders. The production process is just as critical for not-for-profit organizations because the services they produce justify their existence. Production puts a value on its inputs by converting them into marketable outputs with features that customers want and will purchase.*

**3. Why are firms now moving more toward flexible production and customer-driven production instead of mass production? Describe a product that you think would be better suited to flexible production or customer-driven production than mass production. Explain your choice.**

*Many firms are now moving toward flexible and customer-driven production because these methods cost-effectively produce smaller batches with the help of advanced computer technology to deliver customer requests, programmable equipment to fill orders, and skilled people to carry out tasks. In turn, satisfying more consumer tastes and needs adds to the revenues and profits of businesses.*

*An item that does not lend itself to mass production is one that requires increasing levels of specialization to meet the needs or wants of the customer. It is often manufactured in smaller quantities and then customized. Examples include high-end jewelry, designer apparel, custom-ordered furniture, specialized high-tech components, precision medical instruments, and customized pharmaceutical products such as chemotherapy treatments, etc. Many services are very personalized and would not lend themselves to mass production, such as a tailoring business, floral delivery, home decorating or window-treatment services.*

**4. Identify which production system—analytic or synthetic—applies to each of the following products:**

1. **logging**
2. **medical care**
3. **soybean farming**
4. **fishing**
5. **microchips**

5. Industries such as home construction and dentistry benefit from the use of CAD. In both of these, CAM could be used as well—in the manufacture of home components as well as dental implants, crowns, and the like. Choose another industry that seems like a candidate for the use of both CAD and CAM systems. Explain how the industry could use both.

*Both CAD and CAM could be used in the design of prototypes for automobiles. Design engineers use CAD to create detailed, electronic blueprints for the prototype, and then the CAM system could be used to specify the materials and instructions for manufacturing the prototype.*

**6. Sea World has facilities in Florida, Texas, and California. What specific factors might have contributed to these choices?**

*Physical variables, such as year-round warm, sunny weather and proximity to other tourist attractions, were probably the primary influence in choosing these locations. In addition, Sea World likely considered such human factors as whether there were sufficient car-rental agencies, hotels, and restaurants nearby to handle a large amount of tourists. Florida and California are also home to Disney amusement parks, so proximity to those destination tourist attractions enhances the chances that tourists will also visit Sea World.*

**7. What would be the best facility layout for each of the following?**

**a. movie rental shop** – customer-oriented and product layouts

**b. nail salon** – process layout

**c. car wash** – process layout

**d. sandwich shop** – could be either process (such as McDonald’s with grilling, wrapping, and bagging) or product (such as varying concession stands in an arena) layout

**8. What might be the factors involved in the selection of suppliers for a steakhouse restaurant?**

*Factors that might influence the selection of suppliers for a steakhouse restaurant include proximity to meat producers, meat quality, cost, and dependability and speed of delivery. Additional factors may include the restaurant’s experience with each supplier including supplier flexibility in meeting needs.*

**9. What is inventory control? Why is the management of inventory**

**crucial to a company’s success?** *Inventory control involves the responsibility of balancing the need to keep stock on hand to meet demand against the costs of carrying inventory.*

*Inventory control is crucial to a company’s success because firms waste money if they hold more inventory than they need. On the other hand, having too little inventory on hand may result in a shortage of raw materials, parts, or goods for sale that could lead to delays and unhappy customers. This could result in lost sales and profits.*

**10. What is benchmarking? How can it help a firm improve the quality of its goods and services?**

Benchmarking *is the process of determining how well other companies perform business functions or tasks. Benchmarking can help a firm improve the quality of its goods and services by making improvements to match or exceed the quality found in their competitors’ products and services.*

**Projects and Teamwork Applications**

1. Have students share which type of facility layout they chose while designing their ice cream shop. What factors caused them to choose that particular layout?

2. After each student’s or group’s presentation regarding proposed locations, ask the rest of the class to consider and propose specific factors regarding location that the presenter(s) may not have considered.

3. Have students explain which type of production process would be most effective or appropriate for their chosen businesses.

4. Have students choose a location for their house-painting business and explain what factors influenced their choice.

5. After applying the benchmarking process as much as possible (given information at hand or available on the Internet), have students share improvements that could be made to one company’s services or products.

**Web Assignments**

1. **Just-in-time inventory management systems.** Go to the Web sites listed here to learn more about just-in-time inventory management systems. Make some notes on what you learned and bring them to class to participate in a class discussion.  
<http://www.wisegeek.com/what-is-a-just-in-time-inventory.htm>  
<http://smallbusiness.dnb.com/manage/finances/12375503-1.html>  
<http://www.smcdata.com/software-choices/just-in-time-inventory-control-systems-1.html>

2. **Plant location decision.** Using an Internet news service, such as Google news (<http://news.google.com>) or Yahoo! news (<http://news.yahoo.com>), search for information on a recent plant location decision. An example is Volkswagon’ss Chattanooga plant. Research the decision and then prepare a brief report outlining the factors that went into the firm’s decision to locate the plant where it did.

<http://www.vw.com/vwbuzz/browse/en/us/detail/Volkswagen_Group_of_America_announces_it_will_produce_cars_in_Chattanooga/219>

3. **ISO certification.** Visit the Web site of the International Organization for Standardization (<http://www.iso.org>). Click on “standards development” and then “processes and procedures.” What are some of the products for which ISO standards are currently being developed?

*Note:* Internet Web addresses change frequently. If you don’t find the exact sites listed, you may need to access the organization’s home page and search from there or use a search engine such as Bing or Google.

**Case 10.1**

**Macedonia: New Apparel Manufacturing Hub?**

**Answers to Questions for Critical Thinking:**

1. **Do you think Macedonia’s strategy will be successful in the long run? Why?**

*Yes, Macedonia’s strategy of focusing on quality and flexible production will likely pay off in the long run as increasing numbers of consumers become disenchanted with the decreasing quality and variety of apparel made in competing countries.*

1. **How might Macedonian apparel manufacturers attract U.S. buyers?**

*Macedonian apparel manufacturers could attract U.S. buyers by ensuring quicker production and delivery times than those offered by competitors in China and India. In addition, Macedonian apparel manufacturers could attract U.S. buyers by providing a greater degree of customization at a low cost.*

**Case 10.2**

**The F-35 Fighter Jet Flies Over Budget**

**Answers to Questions for Critical Thinking:**

1. **Why did Lockheed Martin choose a “concurrent” production strategy, building planes while testing was still ongoing?**

*Lockheed Martin might’ve chosen a concurrent production strategy if they believed they already had an idea of how to make effective planes. Also, the company might’ve thought this was a good strategy for saving time.*

1. **What can Lockheed Martin do to compensate for government-mandated production delays that hamper its efforts to achieve cost-saving economies of scale?**

*Lockheed Martin can compensate for government-mandated production delays by focusing on testing the planes they already completed. The company could also work on benchmarking efforts and compare their work to the work of similar industries.***CHAPTER 10: COLLABORATIVE LEARNING EXERCISES**

# **1 – Consumer Feedback**

Learning Objectives: 1, 7

Purpose:

To highlight the importance of consumer feedback to the production process.

Background:

Many entrepreneurs—and even many large businesses—get caught in the trap of developing cutting-edge products, services, and technologies … but without consumer input. This exercise is designed to demonstrate the potential pitfalls of the “product-first” approach to production.

Relationship to Text:

Learning Objectives 1 & 7 – Customer Feedback

Estimated Class Time:

About 20–30 minutes

Preparation/Materials:

You’ll need to gather blank paper, ideally in different colors, enough for about half of your class. You may want to also gather paper clips and a handful of colored markers, but they aren’t absolutely necessary.

Exercise:\*

Divide your class into groups of about ten people, and then divide each group in half (i.e. 1-A, 1-B, 2-A, 2-B, etc.). Direct the groups to find comfortable workspaces away from their counterparts (i.e. 1-A should work away from 1-B, etc.).

Ask the “A” groups to gather together with you to receive their assignment. Announce that their job is to create the best possible paper airplane, using the papers and any other materials you provide. Encourage them to let their imaginations run wild, but only for 10 minutes. When you call time, each group will need to sell their plane—complete with a demonstration—to the other half of their group.

While the “A” groups get started, meet with the “B” groups. Announce that they are potential customers in the market to purchase a paper airplane. Their job is to create the specifications for the best possible airplane using today’s technology. Encourage them to be comprehensive and specific.

After 10 minutes, begin the sales presentations. After each group presents, ask the corresponding customer group to read their list of specifications, and to decide whether they would buy the plane. It will quickly become apparent that without customer input, even the best planes cannot meet expectations (although some groups may be so “wowed” that they decide to purchase anyway).

While follow-up discussion flows easily from this exercise, you may want to specifically highlight the need for a close link between customers and the production function. Your students also may be interested in learning that this link is usually created and nurtured through marketing.

\* Source: *Great Ideas for Teaching Marketing*, South-Western/Thomson Learning.

# **2 – Improving the Production Process**

Learning Objective: 5

Purpose:

To give students hands-on experience analyzing a familiar production process.

Background:

While some production processes, such as industrial manufacturing, happen outside most people’s daily experience, we are all surrounded by the almost continual production of various services. Often we don’t even notice the process, except when it goes wrong. This exercise is designed to help students notice, analyze, and develop improvement recommendations for the production of a service that affects them in a personal way.

Relationship to Text:

Learning Objective 5 – Tasks of Production Managers

Estimated Class Time:

About 15 minutes

Preparation/Materials:

Choose a service production process at your school that makes your students gripe on a regular basis. Registering for classes is a good candidate at many colleges and universities, but other possibilities include counseling, financial aid, career services, cafeteria, etc.

Exercise:

Divide your students into groups of 3 to 5 people. Announce the production process you have chosen, and direct each group to analyze that process. Points to consider (you may want to write these on the board):

* How could the process be improved?
* How could it be more customer-focused?
* What are the bottlenecks?
* How could it be streamlined? Made less time consuming?
* What is the layout of the process? How could it be optimized?
* What are the inputs and outputs?

Ask each group to share their recommendations with the class. If it makes sense at your school you may want to ask the person who runs the process to participate in your discussion; all parties would probably benefit from the learning.

# **3 – Customized Production**

Learning Objective: 1

Purpose:

To encourage students to stretch their thinking with regard to production customization.

Background:

The trend toward customized production clearly grows stronger each year, and the potential opportunities for tomorrow’s entrepreneurs are enormous. This exercise is designed to help students consider customization possibilities as they begin to emerge.

Relationship to Text:

Learning Objective 1 – Flexible Production

Estimated Class Time:

About 10 minutes

Preparation/Materials:

None needed

Exercise:

As a class, discuss the meaning of flexible production and the benefits of greater customization for individual customers. Brainstorm the most recent entries into the customized production business (e.g., Levi’s jeans, iTunes customizable “albums,” Dell laptops, etc.). Ask your students to share their experience (if any) with these organizations. Would they be willing to pay more for these kinds of products? Why or why not?

Divide your class into groups of 3 to 5 students. Give each group about 5 minutes to brainstorm a list of industries that could benefit from customized production. When you call time, ask each group to share their ideas, and develop a comprehensive list on the board (the groups will probably have quite a bit of overlap).

Spend a few moments exploring whether it would make sense to pursue any of these opportunities. Encourage them to consider the potential benefits of marketing research, and the potential drawback of increased production costs. Would any of them be interested in developing these ideas? Why or why not? Do they believe that existing companies will step in to fill the voids?

**4 – Production Location**

Learning Objective: 4

Purpose:

To help students explore the issues involved in choosing a production location.

Background:

The location of a production business clearly impacts its potential for success from a number of different standpoints. This exercise is designed to highlight the range of location factors that impact different types of businesses.

Relationship to Text:

Learning Objective 4 – The Location Decision

Estimated Class Time:

About 15 minutes

Preparation/Materials:

None needed

Exercise:

Divide your class into groups of 4 to 5 students, and ask each group to choose the perfect location for each of the following businesses (which you may want to write on the board). For each business, consider the best location (a) in the local city or town, and (b) in the world. Each group must develop a rationale for its choices, considering transportation, human, and physical factors. This should take no more than 10 minutes. Business types:

* trendy restaurant
* hair salon
* software production company
* animation firm
* snowboard manufacturer
* coffee bar
* new hip-hop music label

Class presentations should be fun … typically the choices are very thoughtful, but vastly different from one another.

# **5 – Quality Production**

Learning Objective: 7

Purpose:

To explore the meaning of quality across a range of products and services.

Background:

Clearly, quality plays a critical role in the long-term success of any business. The meaning of quality, however, varies significantly across business categories. This exercise is designed to help students understand the different potential meanings of quality.

Relationship to Text:

Learning Objective 7 – Importance of Quality

Estimated Class Time:

About 10 minutes

Preparation/Materials:

None needed

Exercise:

Ask your class what quality means in a production context. After they have shared some thoughts, ask them if the definition of quality changes depending on the type of business. You may want to illustrate this point with the example of a restaurant: A high-quality meal at McDonald’s is exactly the same as the meal you got last time, and the time before that, and the time when you were five years old. A high-quality meal at a fine French restaurant is different every time you eat there. Quality service at McDonalds might mean a cheerful “Have a nice day!” while at a fine French restaurant, it might mean a silent, respectful nod.

Divide your class into groups of 4 to 5 people, and direct each group to define what quality means—as fully as possible in 5-10 minutes—for each of the following categories:

* a visit to the dentist
* a computer
* a motorcycle
* a haircut
* a pair of blue jeans
* a cup of coffee
* a stereo system

Ask each group to share its results, and then ask the class as a whole to share what they think this means from a production perspective. Help them understand that consumer and competitive research are pivotal to a quality production process.

# **6 – Production Processes**

Learning Objective: 3

Purpose:

To help students understand the role of technology in the production process.

Background:

Technology can provide a sustainable competitive edge for a business.

Relationship to Text:

Learning Objective 3 – Technology in production

Estimated Class Time:

About 10 minutes

Preparation/Materials:

None needed

Exercise:

Divide students into groups. Have each group select a popular restaurant such as Chipotle, McDonald’s, Panera Bread, Starbucks, and Taco Bell. Ask students to discuss and list the uses and specific benefits of technology in each of these restaurants. Ask them also to identify opportunities for continued use of technology and possible benefits.