Chapter 16
Operations and Service Management

Chapter Outline

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Annotated Learning Objectives
After studying this chapter, students should be able to:

1. Define operations management and describe its application within manufacturing and service organizations.
Operations management is defined as the field of management that specializes in the application of special tools and techniques to the physical production of goods and services.

Operating managers are concerned with all production activities within the organization. An organization can be described as a system used for transforming inputs into outputs. At the center of this transformation process is the technical core, which is the heart of the organization’s production of its product or service. Inputs into the technical core include human resources, land, equipment, buildings, and technology. Outputs from the technical core include the goods and services that are provided for customers and clients. Operations management pertains to the day-to-day management of the technical core of the transformation process. Manufacturing organizations produce physical goods, and service organizations produce nonphysical outputs such as medical, educational, or transportation services provided for customers.

2. Discuss the role of operations management strategy in the company’s overall competitive strategy.

Operations strategy is the recognition of the important role of operations in organizational success and the involvement of operations managers in the organization’s strategic planning. The stages in the evolution of operations strategy are: Stage 1, business strategy is set without considering the capability of operations; Stage 2, the operations department sets objectives according to industry practice; Stage 3, operations strategy is in concert with company strategy; and Stage 4, operations managers may pursue new technologies to do the best possible job of delivering the product or service. In the last stage customer orders are won through better price, quality, performance, delivery, or responsiveness to customer demand.

3. Explain the role of e-business in today’s partnership approach to supply chain management.

The most recent advances in supply chain management involve using Internet technologies to achieve the right balance of low inventory levels and customer responsiveness. An e-supply chain creates a seamless, integrated line that stretches from customers to suppliers by establishing electronic linkages between the organization and these external partners for the sharing and exchange of data. An important aspect of supply chain management is managing relationships with suppliers. Enterprise integration through the use of electronic linkages can create a level of cooperation not previously imaginable. With integration, more companies are opting for a partnership approach, which involves cultivating intimate relationships with a few carefully selected suppliers and collaborating closely to coordinate tasks that benefit both parties.

Electronic linkages also contribute to more rapid response to end consumers by reducing the time it takes to move critical data through the information pipeline. Manufacturers have immediate access to sales data and can deliver new products as needed. In addition, electronic linkages enable the rapid manufacture of customized products. By integrating everyone along the entire supply chain, the idea is that
every organization involved can move in lock-step to meet the customer’s product and time demands.

4. **Summarize considerations in designing an operations system, including product and service design, facilities layout, and capacity planning.**

Many firms are using, *design for manufacturability and assembly* (DFMA), which means designing a product that is easy and inexpensive to manufacture. There is an additional design requirement, timing. *Timing* is the degree to which a service meets the customer’s delivery requirements.

Once a product or service has been designed and systems set up for procurement of materials, the next consideration is planning for the actual production through facilities layout. A process layout is one in which all machines that perform a similar function or tasks are grouped together. A product layout is one in which machines and tasks are arranged according to the progressive steps in producing a single product. An innovative layout, called cellular layout, based on group-technology principles in which machines dedicated to sequences of operations are grouped into cells. The fixed-position layout is one in which the product remains in one location, and tasks and equipment are brought to it.

*Capacity planning* is the determination and adjustment of the organization’s ability to produce products or services to match customer demand. Organizations can increase capacity by adding additional shifts and hire new workers or ask current employees to work overtime. A firm can outsource or subcontract work to other firms, and expand present facilities and add more equipment. The biggest problem for most organizations is excess capacity. The challenge is for managers to add capacity as needed without developing a surplus.

5. **Explain why small inventories are preferred by most organizations.**

Inventory is the goods the organization keeps on hand for use in the production process. Most organizations have three types of inventory: finished goods, work-in-process, and raw materials.

Inventory management is important to organizations because inventory costs money. Inventory is an unproductive asset in cost-conscious firms. Most organizations try to keep inventories to a minimum, and low inventory levels often measure management effectiveness. Dollars not tied up in inventory can be used in other productive ventures. Inventory is simply the best indicator of manufacturing performance.

6. **Discuss major techniques for the management of materials and inventory.**

The most common inventory control system used for handling dependent demand inventory is materials requirement planning (MRP). MRP is a dependent demand inventory planning and control system that schedules the exact amount of all materials required to support the desired end product. Manufacturing resource planning called MRP II represents a major development beyond MRP. MRP is a technique for managing inventory; MRP II reaches into every company operation to control all resources. Just-in-time (JIT) inventory systems are designed to reduce the level of an organization’s inventory to zero.
7. Describe what is meant by lean manufacturing.

*Lean manufacturing* uses highly trained employees at every stage of the production process to cut waste and improve quality. The heart of lean manufacturing is not machines or technology, but employee involvement; employees are trained to “think lean,” and empowered to make changes. Toyota’s system combines techniques such as just-in-time inventory, continuous-flow production, quick changeover of assembly lines, and continuous improvement.

8. Define productivity and explain why and how managers seek to improve it.

Productivity is the organization’s output of goods and services divided by its inputs. This means that productivity can be improved by either increasing the amount of output using the same level of inputs or reducing the number of inputs required to produce the output. Sometimes a company can even do both.

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Lecture Outline

Suggested Opening Remarks

R.R. Donnelley, described in the chapter opening, applied new technology to increase productivity, cut costs, and improve customer satisfaction. Traditionally, preparing text and pictures for printing had created bottlenecks for Donnelley, as it does for many printers. By making plates digitally rather than from photographic film, the Roanoke plant can now complete a job that once took hours in only 12 minutes. All-digital processing also produces cleaner and sharper plates. Managers saw a tremendous surge in productivity because the digital plates were more consistent. The plant also now handles paper more efficiently. Electronic sensors measure what paper has been consumed and monitor consistency, reporting any problems electronically to the paper mill. Computers monitor the quality of printing and automatically make adjustments as needed. At the end of the press run, printed sheets are folded and stored on reels until they are cut and bound a few hours later, with specifications set by computer. Printed books with jackets are pulled off the line at regular intervals and checked by employees to confirm quality. Finally, the books are shrink wrapped and stacked by machine and shipped immediately.

The new technology has enabled Donnelley’s Roanoke plant to schedule production runs so precisely that it no longer uses warehouses to store books. Books are printed on demand, providing publishers with just-in-time product when they need it. The plant produces about 75 percent of its titles in two weeks or less, compared with four to six weeks for a four-color book in a traditional printing plant. Moreover, with automation and quick, efficient press changeovers, Donnelley can profitably print as few as 50 copies of a single-color book, 2,500 copies of a four-color book, or quickly manufacture millions of copies of a blockbuster like J.K. Rowling’s most recent Harry Potter saga.

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I. ORGANIZATIONS AS PRODUCTION SYSTEMS

- How is an organization a system?
In Chapter 1, the organization was described as a system used for transforming inputs into outputs.

Within this transformation process lies the technical core, the heart of the organization’s production of its product or service.

In a university, the technical core includes the academic activities of teaching and research. Inputs into the technical core include human resources, land, and equipment. Outputs from the technical core include goods and services that are provided for customers and clients.

Operations strategy and control feedback shape the quality of outputs and the efficiency of operations within the technical core.

Operations management is formally defined as the field of management that specializes in the production of goods and services and uses special tools and techniques for solving production problems.

Operations managers are concerned with activities that convert inputs into outputs; this includes decisions about locating facilities and installing equipment.

Operations management also requires the ability to lead people; Toyota’s lean manufacturing combines techniques, systems, and empowerment of employees.

Managers must instill the necessary attitudes, such as concern for quality and a desire to innovate.

A. Manufacturing and Service Operations

Operations management applies to all organizations; the service sector has increased three times as fast as manufacturing in the North American economy.

Manufacturing organizations are those that produce physical goods such as automobiles and clothing.

Service organizations produce nonphysical outputs such as medical, educational, communication, and transportation (e.g., doctors, consultants, and online auctions).

Services differ from manufacturing in two ways: the service customer is involved in the production process and service outputs are intangible and cannot be stored.

The service must be created and provided for the customer when he or she wants it; a hairstylist cannot wash, cut, or style the hair in advance.

Although manufacturing and service firms differ, they face similar operational problems such as: each kind of organization is concerned with scheduling.

Both must obtain materials and supplies; each must be concerned with quality and productivity.

Operations management tools and techniques can, and should, be applied to service organizations as readily as to manufacturing.

Discussion Question #1: What are the major differences between manufacturing and service organizations? Give examples of each type.
B. Operations Strategy

Many operations managers are involved in day-to-day problem solving and fail to realize that the best way to control operations is through strategic planning.

To manage operations effectively, managers must understand operations strategy.

*Operations strategy* is the recognition of the important role of operations in organizational success and the involvement of operations managers in the organization’s strategic planning.

The stages in the evolution of operations strategy include:

- **Stage 1**: Business strategy is set without considering the capability of operations.
  
  There is no positive contribution to strategy formulation. Operations department is concerned only with labor costs and operational efficiency.

- **Stage 2**: The operations department sets goals according to industry practice.
  
  The organization tries to be current with industry standards as a way to be competitive.

- **Stage 3**: Operations managers are more active and strategy is in concert with company strategy.

- **Stage 4**: Operations managers may pursue new technologies on their own in order to do the best possible job of delivering the product or service.
  
  At Stage 4, operations can be a genuine competitive weapon; operations departments develop new strategic concepts themselves.

  With the use of new technologies, operations management becomes a major force in overall company strategic planning.

  Operations can originate new products and processes that will add to or change company strategy.

  At this stage, customer orders are won through better price, quality performance, delivery or responsiveness to customer demand.

**Discussion Question #2:** *In what ways might a long-distance telephone company be more competitive if it operates at Stage 3 or Stage 4 of operations strategy?*

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C. The Integrated Enterprise

*Exhibit 21.4*
As operations managers adopt a strategic approach, they appreciate that their operations are not independent of other activities.

To operate efficiently and produce high-quality items that meet customers’ needs, the organization must have reliable deliveries of high-quality supplies and materials.

Supply chain management is the term for managing the sequence of suppliers and purchasers covering all stages of processing from obtaining raw materials to distributing finished goods to final consumers.

The most recent advances in supply chain management involve using Internet technologies to achieve the right balance of low inventory levels and customer responsiveness.

An e-supply chain creates a seamless, integrated line that stretches from customers to suppliers, by establishing electronic linkages for the sharing and exchange of data.

An important aspect of supply chain management is managing relationships with suppliers; the integration of IBM’s massive supply chains provides an illustration.

Enterprise integration through the use of electronic linkages can create a level of cooperation not previously imaginable.

Many supplier relationships used to be based on an arm’s length approach, in which an organization spreads purchases among many suppliers and encourages them to compete with one another.

With integration, more companies opt for a partnership approach, which involves cultivating relationships with a few suppliers and coordinating tasks.

Electronic linkages contribute to more rapid response to end consumers by reducing the time to move critical data through the information pipeline.

Manufactures have immediate access to sales data and can deliver new products as needed.

Discussion Question #3: What is the role of e-business in the “integrated enterprise”? How does enhanced integration of the supply chain affect the relationship between organizations and their customers and suppliers?

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II. DESIGNING OPERATIONS MANAGEMENT SYSTEMS

Every organization must design its production system based on the design, product, or service to be produced.

This starts with the design of the product or service; a restaurant designs the food items on the menu or a car manufacturer designs the cars it produces.

A. Product and Service Design
The way a product or service is designed affects its appeal for customers; it also affects how easy or expensive operations will be.

Design has become a critical aspect of product development for many companies, even old-line manufacturers of products such as appliances and tools.

Customers often think how a product looks is just as important as how it works; however, some product designs are difficult to execute properly.

Many firms are using, *design for manufacturability and assembly* (DFMA), which means designing a product that is easy and inexpensive to manufacture.

Using DFMA is extremely inexpensive, but it does require a shift in how design work is done.

DFMA requires restructuring operations, creating teams of designers, manufacturers and assemblers who collaborate on achieving four design objectives:

- **Producibility.** The degree to which a product or service can be produced for the customer within the firm’s existing operational capability.
- **Cost.** The sum of the materials, labor, design, transportation, and overhead expense associated with a product or service.
- **Quality.** Not only the excellence of the product or service but also the serviceability and value that customers gain by purchasing the product.
- **Reliability.** The degree to which the customer can count on the product or service to fulfill its intended function.

There is an additional design requirement, *timing*, the degree to which a service meets the customer’s delivery requirements.

A service cannot be stored and must be provided when the customer is present; banking by machine, pumping your own gas are services provided by organizations.

**B. Procurement**

*Procurement* is the purchasing of supplies, services, and raw materials for use in the production process.

A manufacturing company spends 50 to 60 percent of its revenues to buy materials and supplies.

Expenses for materials, supplies, and services also represent a huge expense for service companies.

Having the right materials of the correct design and quality is essential to the smooth functioning of the production process.

The Internet and business-to-business (B2B) commerce are having a tremendous impact on procurement.

Purchasing department employees can now use the Internet to search for new sources of materials, place orders, request bids via B2B marketplaces, and participate in online auctions.

Employees have access to more information about availability and cost more quickly than ever before.
Employees submit purchase orders online and track the status of orders in real time over the Web, cutting down on operating costs and speeding up procurement time. Whether they are looking for paper clips, jet engines, or consultants, companies are using the Internet to control and streamline the procurement process.

**Discussion Question #4:** Why is procurement considered such an important part of operations management? What are some of the major changes in the procurement process in recent years?

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**C. Facilities Layout**

Once a product or service has been designed and systems set up for procurement of materials, the next consideration is planning for the actual production through facilities layout.

The following are the most common facilities layouts:

1. **Process Layout**
   
   In a *process layout*, Exhibit 21.5 (a), machines or functions are grouped together and perform a similar function or task.

   The advantage is this layout has the potential for economies of scale and reduced costs.

   A disadvantage is that the actual path a product or service takes can be long and complicated.

   A product may require several different processes and must travel through many different areas before production is complete.

2. **Product Layout**

   In a *product layout*, Exhibit 21.5 (b), machines and tasks are arranged according to the progressive steps in producing a single product.

   The product layout is efficient when the organization produces large volumes of identical products; it is only economical on high volume specialized products.

3. **Cellular Layout**

   *Cellular layout*, Exhibit 21.5 (c) is based on group-technology principles in which machines dedicated to sequences of operations are grouped into cells. Grouping technology into cells provides the efficiencies of both process and product layouts.

   An advantage is that workers work in clusters that facilitate teamwork and joint problem solving.

   Staffing flexibility is enhanced because each team member can operate all the machines or complete all the tasks in the cell.
4. Fixed-Position

In a fixed-position layout, Exhibit 21.5 (d), the product remains in one location and tasks and equipment are brought to it.

This layout is used to create a product or service that is large or one of a kind such as ships or buildings.

It is not good for high volume but is necessary for bulky products and custom orders.

MANAGER’S SHOPTALK

A German Factory Shows How to Be Fast and Flexible

Many students might think a factory that makes polymer bearings and power-supply chains is not the best place to get a view of the factory of the future, but they’d be wrong. Cologne, Germany’s igus Inc. manufacturing plant represents a highly innovative approach to facilities design. The plant’s flexible design enables the factory to shrink or expand at a moment’s keeping pace with an unpredictable market. Almost nothing is bolted down on the plant floor, so that machines, modules, and entire departments can be rearranged. The president of igus offers the following tips for building a nimble organization:

- **Create a flexile environment.** A plant’s space, facilities design, and layout should accommodate the business, not the other way around.

- **Recruit carefully.** Not everyone is comfortable working in a highly flexible, fast-changing environment. Human resource managers should screen job candidates carefully.

- **Practice being fast.** Every aspect of the company should be designed to encourage speed and agility. All employees are equipped with mobile phones and get around on scooters.

- **Inspire your staff.** This last tip may be the most important of all. Flexibility hinges on innovation and creativity, which depends on employees who are inspired to think differently and express their ideas and opinions.

Discussion Question #5: What type of production layout do you think would work best in a car dealership? What type would work best for a company that produces handmade pottery? Discuss reasons for your answers.

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D. Technology Automation

One goal of many operations managers is to implement more sophisticated technologies for producing products and services.
Extremely advanced systems that can work almost unaided by employees are being designed.

1. Service Technology

The biggest growth in automation technologies in recent years has been in services.

Restaurant managers use computer programs to calculate food costs for each menu item, from building a cheeseburger to putting together a seafood buffet. In the supermarket industry, self-service checkout technology is growing in use.

Many complex technologies are revolutionizing the service industry; the rage in retailing is radio-frequency identification (RFID), a high-tech bar code.

The RFID tags read by electronic readers provide precise, real-time information about the location of merchandise as it moves through the supply chain.

Advanced technology systems are being integrated into today’s service organizations to improve efficiency.

Burlington Northern Santa Fe Railway uses advanced computer technology to reinvigorate the railroad business (e.g., remote-controlled locomotives, wireless computers, satellite–based mapping, and trip-planning software.)

Two recent approaches that are revolutionizing manufacturing are flexible manufacturing systems and CAD/CAM.

2. Flexible Manufacturing Systems

A flexible manufacturing system is a small or medium-size automated production line; computers coordinate and integrate the automated machines.

Functions such as loading, unloading, storing parts, changing tools, and machining are done automatically.

The computer can instruct the machines to change parts, machining, and tools when a new product must be produced.

Human operators make adjustments to the computer, not the production machinery itself, dramatically cutting the time and expense of making changes.

With a flexible manufacturing system, a single production line can be readily readapted to small batches of different products based on computer instructions.

3. Computer-Aided Design (CAD)

CAD is a production technology in which computers perform new-product design; it provides a visual display of a product and the implications of any design change.

New-product designs can be developed in about half the time required with traditional methods.

Computer-Aided Manufacturing (CAM) is a production technology in which computers help guide and control the manufacturing system.

CAM is similar to the use of computers in flexible manufacturing systems.
Advanced factories use *product life-cycle management (PLM)* software, which manages a product from creation through development, manufacturing, testing, and maintenance.

PLM can coordinate people and facilities around the world for the design, development, and manufacture of products of all sizes.

The software can link CAD/CAM with newer tools that can perform tasks such as simulating an assembly line or an entire factory.

PLM software is new, and those factories that have mastered the technology report profits that are 73 percent higher than other leading manufacturers.

E. Facility Location

Almost every organization must make a decision concerning the location of facilities.

The most common approach to selecting a site for a new location is with a cost-benefit analysis.

The costs associated with each location are land (purchase or lease), moving expenses, construction (zoning laws, building codes, land features), and taxes.

Benefits to be evaluated include accessibility of customers, location of competitors, working conditions, and nearness to restaurants and shops.

For each location the total benefits are divided by the total costs; the location with the highest ratio should be the optimum site.

Selecting facility location is an important and complex consideration for global corporations, and must take into account cost-based variables: transportation, exchange rates, and cost of labor.

New location scouting software is turning facilities location from guesswork into a science; these programs use sophisticated number crunching tools.

**Discussion Question #6:** *If you were asked to identify a location for a new resort catering to retirees, what steps would you take? How would you plan for the new resort’s capacity?*

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UNLOCKING CREATIVE SOLUTIONS THROUGH TECHNOLOGY

Retailers Use Mapping Software to Hit the Right Spot

In the early 2000s, Jo-Ann Stores, a fabric and craft retailer, was having great success with its 70 superstores. Top managers wanted to launch an expansion of the big-box concept, but they worried that the units might not make enough money to justify the expense of building them. Enter MapInfo, whose software predicted that the market would support as many as 700 superstores. The data analysis also showed that, rather than alienating loyal customers, the superstores simply got them to buy about 50 percent more. In addition to helping companies determine whether to open stores, MapInfo’s biggest benefit may be telling them the right spot to locate them. For companies that live by the rule of “location, location, location,” MapInfo can provide a tremendous advantage.

Important considerations in selecting an overseas location: skills of workers, infrastructure, good quality of work life, and favorable business climate.

For high-tech firms selecting a location: proximity to world-class research institutions, and access to venture capital.

F. Capacity Planning

Capacity planning is the determination and adjustment of the organization’s ability to produce products or services to match customer demand.

Organizations can increase capacity by adding additional shifts and hire new workers or ask current employees to work overtime.

A firm can outsource or subcontract work to other firms, and expand present facilities and add more equipment.

The biggest problem for most organizations is excess capacity.

The challenge is for managers to add capacity as needed without developing a surplus; for many companies, the solution is contracting work to other organizations.

Outsourcing and new organizational forms such as the virtual network organization enable companies to increase capacity and dissolve partnerships when extra help is no longer needed.

III. INVENTORY MANAGEMENT

A large portion of the operations manager’s job consists of inventory management.

Inventory is the goods the organization keeps on hand for use in the production process and generally includes:

Finished-goods inventory includes items that have passed through the entire production process but have not been sold.

Finished-goods inventory is expensive since the organization has invested labor and other costs to make the finished product.
Work-in-progress includes the materials moving through the stages of the production process that are not yet a completed product.

Raw materials inventory includes the basic inputs to the organization’s production process. This inventory is of least value because the organization has not yet invested labor and other holding and processing costs.

A. The Importance of Inventory

Inventory management is vitally important to organizations because inventory costs money.

Inventory is recognized as an unproductive asset in cost-conscious firms; dollars not tied up in inventory can be used in other productive ventures.

Many companies recognize the critical role of inventory management in organizational success.

The Japanese analogy of rocks and water describes the current thinking about the importance of inventory; the higher the water, the less managers worry about the rocks.

In operations management, these problems apply to scheduling, facilities layout, and design; when the water level goes down, managers see the rocks and deal with them.

When inventories are reduced, the problems of poorly designed and managed operations process also are reduced.

When inventory can be kept at a minimum, operations management is considered excellent.

Techniques for inventory management include economic order quantity, material requirements planning, just-in-time inventory, and distribution management.

B. Economic Order Quantity (EOQ)

Exhibit 21.7

Two basic decisions that can help minimize inventory are how much raw material to order and when to order from outside suppliers.

Ordering the minimum amounts at the right time keeps raw materials, work-in-progress, and finished goods inventory at low levels.

One technique is EOQ, which is designed to minimize the total of ordering costs and holding costs for inventory items.

Ordering costs are the costs associated with actually placing the order, such as postage, receiving, and inspection.

Holding costs are the costs associated with keeping the item on hand, such as storage space charges, finance charges, and materials-handling expenses.

The EOQ includes ordering costs (C), holding costs (H), and annual demand (D).

Reorder point is the most economical level at which an inventory item should be reordered.
In a hospital, variability in lead time and use of surgical dressings will occur; safety stock, a few extra items of inventory, ensures that the hospital doesn’t run out. Companies keep more safety stock when demand for items is highly variable; when demand is easy to predict, the safety stock may be lower. A careful inventory manager may take into account other criteria; a sizable price cut or volume discount might make a large purchase more attractive.

C. Material Requirements Planning (MRP)

The EOQ formula works well when inventory items are not dependent on one another; in a restaurant the demand for hamburgers is independent of the demand for milkshakes. A more complicated inventory problem occurs with dependent demand inventory, meaning that item demand is related to the demand for other inventory items.

MRP is a dependent demand inventory planning and control system that schedules the precise amount of all materials required to support the production of desired end products. MRP is computer based and requires sophisticated calculations to coordinate information on production scheduling, inventory location, forecasting, and ordering.

MRP can reduce inventory costs dramatically. With MRP, managers can better control the quantity and timing of deliveries of raw materials, ensuring that the right materials arrive at approximately the right time they are needed in the production process.

The computerized MRP system can slow or accelerate the inflow of materials in response to changes in the production schedule. These controls result in lower costs of labor, materials, and overhead; as competitive pressures increased, MRP evolved into the broader enterprise resource planning (ERP).

Discussion Question #8: What is material requirements planning? How does it differ from economic order quantity to reduce inventory?

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D. Just-in-Time Inventory (JIT)

*JIT inventory systems* are designed to reduce the level of an organization’s inventory and its associated costs, aiming to push to zero the amount of time that raw materials and finished products are sitting in the factory, being inspected, or in transit. JIT is sometimes referred to as stockless systems, zero inventory systems, or Kanban systems.

In JIT, suppliers deliver materials only at the exact moment needed, thereby reducing raw material inventory to zero.
Work-in-process inventory is kept to a minimum as goods are produced only as needed to service the next stage of production.

Finished-goods inventory is minimized by matching them exactly to sales demand.

An advantage of JIT inventory systems reduced inventory level frees productive capital for other company uses.

Just-in-time inventory systems require excellent employee motivation and cooperation.

Workers are expected to perform at their best because they are entrusted with the responsibility and authority to make the zero inventory system work.

Employees must help one another when they fall behind and must be capable of doing different jobs.

Workers experience the satisfaction of being in charge of the system and making useful improvements in the company’s operations.

Discussion Question #7: What are the three types of inventory? Which of these is most likely to be affected by the just-in-time inventory system? Explain.

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E. Logistics and Distribution Management

A critical aspect of managing inventory is efficiently moving raw materials into the facility and moving finished products out to customers.

*Logistics* refers to managing the movement of materials within the facility, shipping incoming materials from suppliers, and shipping outgoing products to customers.

Moving finished products out to customers is usually referred to as *distribution* or *order fulfillment*.

The faster and more accurately a company can fill customer orders, the lower the costs for the organization and the greater the likelihood that the customer will return.

Traditional organizations are finding new ways to deliver products faster and less expensively by using the Internet.

Interorganizational collaboration occurs when companies share transportation information and resources with unrelated companies to share truck space and avoid hauling an empty trailer on a return trip.

Discussion Question #9: Discuss the importance of logistics and distribution in managing inventory. Why do you think many of today’s companies outsource this function?
UNLOCKING CREATIVE SOLUTIONS THROUGH PEOPLE

Remaking Logistics at a Chicago Food Bank

When former Marine Brigadier General Michael Pl. Mulqueen took over as head of the Greater Chicago Food Depository, he made it his mission to serve the hungry people of Chicago by applying logistical genius. Mulqueen used retail giant Wal-Mart as a model for remaking the organization into a state-of-the-art food warehouse. He started with the food supply and developed strategic alliances with several companies to deliver a steady supply of needed staple products. Mulqueen set up a production line in the warehouse to organize and assemble the massive amounts of food the depository receives each day into packages that are precisely categorized and stacked for pick-up by local agencies that serve the poor. The new logistics strengthen volunteer commitment and performance.

IV. LEAN MANUFACTURING AND PRODUCTIVITY

Productivity is significant because it influences the well-being of our society as well as the well-being of individual companies.

The only way to increase the output of goods and services to society is to increase organizational productivity.

A. Lean Manufacturing

*Lean manufacturing* uses highly trained employees at every stage of the production process to cut waste and improve quality.

The heart of lean manufacturing is not machines or technology, but employee involvement; employees are trained to “think lean,” and empowered to make changes.

Toyota’s system combines techniques such as just-in-time inventory, continuous-flow production, quick changeover of assembly lines, and continuous improvement.

An employee can stop the production line at any time to solve a problem; equipment is designed to stop automatically so that a defect can be fixed.

B. Measuring Productivity

➢ *What is productivity and how do managers measure it?*

*Productivity* is the organization’s output of goods and services divided by its inputs.

Productivity can be improved by increasing the amount of output using the same level of inputs and reducing the number of inputs required to produce the output.

There are two approaches for measuring productivity:
- **Total factor productivity** is the ratio of total outputs to the inputs from labor, capital, materials, and energy.
- **Partial productivity** is the ratio of total outputs to a major category of inputs.

Measuring direct labor misses the valuable improvements in materials, work processes, and quality.

Labor productivity is easily measured, but may show an increase as a result of capital improvements; managers will misinterpret the reason for productivity increases.

**Discussion Question #10:** If you were a consultant to a local manufacturing plant that wants to improve productivity, what advice would you give managers?

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C. Improving Productivity

To improve productivity, three areas should be reviewed: technological productivity, employee productivity, and managerial productivity.

1. **Technological Productivity**

   Increased *technological productivity* refers to the use of more efficient machines, robots, computers, and other technologies to increase outputs.

   Examples include CAD/CAM and new project-life-cycle management software.

   New technology can increase productivity for service firms.

   Outsourcing can also increase productivity because a specialized firm can afford to invest in the most modern technology related to the service it provides.

2. **Employee Productivity**

   Increased *employee productivity* means having workers produce more output in the same time period.

   Companies can improve employee productivity by establishing the means for existing employees to do more by working harder or by improving work processes.

   Employees may simply need more knowledge, more resources, or improved task or workplace design.

   The company may also decide to hire employees with greater expertise or to outsource certain operations to a firm with expertise in that area.

   Improving employee productivity can be a problem if workers have an antagonistic relationship with management.

3. **Managerial Productivity**

   Increased managerial productivity means managers must do a better job of running the business.
Leading experts in productivity and quality have often stated that poor management is the reason for productivity problems in the United States. Management productivity improves when managers emphasize quality over quantity, break down communication barriers, empower employees. Managers must not over manage using numbers; they must learn to use reward systems, MBO, employee involvement, and teamwork.

It is important for managers to consider the linkage between these techniques and the company’s strategy—-not just blindly insert a technique into the firm’s activities.

Knowledge management efforts succeed when managers establish a strategy-related focus for what information is to be shared, then measure the results.

**Discussion Question #11:** Do you believe operations management can influence competitive strategy? Discuss.

**Notes**

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**Lecture Example File**

**eBP/CandleNet eBusiness Platform Solutions for Manufacturing**

**The Supply-Chain Challenge**

The idea is simple enough. Why not have a supply-chain architecture that gathers all relevant customer information into one location? This approach would simplify every aspect of the process from sales to accounting to delivery.

Unfortunately, this idea requires integrating an entire supply chain worth of back-end information. It requires sharing data from divergent applications, databases and legacy systems -- systems maintained by different partners in the supply chain.

There is a solution that can harness an entire supply chain of IT assets: Candle Corp.’s CandleNet™ eBusiness Platform™ **Powered by Roma® Technology.** CandleNet eBP™ for manufacturing integrates applications, tracks transactions across the supply chain and manages this web of inter-related components.

The CandleNet eBP approach takes each application in the supply-chain network and turns it into a reusable component. Then these components can be quickly plugged into Candle’s underlying business integration solution. And, like a PBX system, when changes are made to the network, the components can be re-plugged to create additional functionality.

CandleNet eBP handles the chore of integrating applications and messaging technologies. This frees businesses up to deliver superior product for minimal cost.
Candle Helps Improve Supply-Chain Performance

Candle's component-based infrastructure is designed to respond to changes in the supply chain. This approach allows the reconfiguration of a supply-chain system as quickly as business events dictate -- and can integrate complex application components from hundreds of suppliers.
Candle's business integration solutions can also monitor the network for security and performance, improving availability for the entire supply-chain system.

How Candle Delivers Expert Solutions to Manufacturers

CHALLENGE: A large manufacturer in the Midwest wants to eliminate the barriers between its shop floor and corporate headquarters.

CANDLE SOLUTION: The CandleNet eBP enables the integration of systems on different hardware and software platforms, written in different programming languages -- from legacy, new and ERP modules. The CandleNet eBP met this integration challenge at a major manufacturing company in half the time -- and at a significantly reduced cost.

Candle Solutions for E-business

The CandleNet eBP is a suite of products and services designed for integrating applications and business processes. The CandleNet eBP is the obvious choice for B2B companies that need to develop a responsive supply-chain approach.

Answers To End-Of-Chapter Discussion Questions

1. What are the major differences between manufacturing and service organizations? Give examples of each type.

Manufacturing organizations produce a physical good such as automobiles, toys, or clothing. Service organizations produce nonphysical goods such as medical, educational, or transportation services. Services differ from manufacturing organizations in two other ways. The service customer is involved in the actual production process, and services cannot be stored in inventory. Because the service is intangible, it is consumed at the time it is produced; hence, there is no inventory. This also means that the service organization’s employees must interact directly with customers. The patient actually visits a doctor to receive medical service, or a barber or beautician to receive a haircut. The service is provided directly to the customer, so the customer becomes involved in the production process.

Despite the differences between manufacturing and service organizations, they both need operations management. As services have become more prominent in recent years, operations management has found many applications. Service organizations need to be concerned with scheduling, they must obtain materials and supplies, and they must control service quality and productivity. These same issues are relevant to operations managers in manufacturing organizations.
2. **In what ways might a long-distance telephone company be more competitive if it operates at Stage 3 or Stage 4 of operations strategy?**

   A long-distance telephone company will become more competitive in Stage 3 and/or Stage 4 in implementing an operations strategy. At Stage 3, operations managers are more strategically active. Operations strategy is in concert with company strategy, and the operations department will seek new operational techniques and technologies to enhance competitiveness with other long distance companies. At the highest level of operations strategy, Stage 4, operations managers may pursue new technologies on their own in order to do the best possible job of delivering the product or service. At Stage 4, operations can be a genuine competitive weapon in the long-distance telephone business. A company that operates at Stage 3 or 4 will be more competitive than those that rely on marketing and financial strategies because customer orders are won through better price, quality, performance, delivery, or responsiveness to long-distance telephone customer’s demands, and all these factors are affected by operations.

3. **What is meant by supply chain management? Does supply chain management apply to service organizations even though they do not produce physical goods? Discuss.**

   Supply chain management is the term for managing the sequence of suppliers and purchasers, covering all stages of processing from obtaining raw materials to distributing finished goods to final consumers. Supply chain management can apply to service organizations by establishing criteria for sharing data and information technology.

4. **What type of production layout do you think would work best in a car dealership? What type would work best for a company that produces handmade pottery? Discuss reasons for your answers.**

   The process layout would work best for a car dealership by grouping sales people in one area, service or body shop in another area, and inventory parts department in another area. A handmade pottery operation is best suited for a process layout. An optimal layout emphasizing different process stages of clay molding, lathe operations, and painting would be required in the production of handmade pottery.

5. **If you were asked to identify a location for a new resort catering to retirees, what steps would you take? How would you plan for the new resort’s capacity?**

   The first step in determining the optimal location for a new resort catering to retirees is to do a cost-benefit analysis. The costs associated with each location are the land (purchase or lease); construction, including zoning laws, building codes, land features, and size of the parking lot; taxes; utilities; rents; and maintenance factors. Finally, an important consideration would be the cost of labor. Benefits to be evaluated are accessibility to retirees, location of major competitors, general quality of working conditions, and nearness to restaurants and shops to meet the elderly needs.
A new resort for retirees must account for plan capacity. Capacity planning is the
determination and adjustment of an organization’s ability to produce products or
services to match demand. It is important to be able to project demand for this new
facility. One must examine other retiree resorts and undertake marketing research to
project sales revenues and anticipated costs of operations to make this new venture
profitable. Finally, anticipated growth of this resort must be projected to determine
the appropriate capacity to meet its goal and objectives.

6. What are the three types of inventory? Which of these is most likely to be affected by
the just-in-time inventory system? Explain.

The three types of inventory are raw materials inventory, work-in-process inventory,
and finished-goods inventory. Raw material inventory includes basic inputs such as
steel, wire, or glass that have not been worked on. Work-in-process inventory
includes materials moving through the stages of the production process. Finished-
goods inventory consists of items that have passed through the entire production
process but have not been sold. Examples of finished goods inventory are new cars
in the storage lot at an automobile factory and hamburgers waiting to be served at
McDonald’s. Theoretically, all three types of inventory should be reduced by just-
in-time inventory systems. First, the organization receives raw materials only as
they are needed to begin the production process. At each stage of the production
process, materials are completed only as they are needed for the next stage, hence
the designation “demand pull.” Finally, the entire production sequence is started
only when there is an actual order for the product, which reduces finished-goods
inventory. As a practical matter, coordinating the sequence so that there is no
inventory of any kind is very difficult. Most organizations seem to have success in
reducing raw materials and work-in-process inventory. The reason is that once
management decides on the amount of production, it can coordinate the inflow of
raw materials and the movement of work-in-process inventory. However, when
production cannot be tailored exclusively to customer orders, goods must be
produced for finished inventory and sold at a later date. This means that finished-
goods inventory will often be somewhat larger than the other two types.

7. What is materials requirement planning? How does it differ from economic order
quantity to reduce inventory?

Materials requirement planning (MRP) is a dependent demand inventory planning
and control system that schedules the exact amount of all materials required to
support the desired end product. MRP is more sophisticated and complex than
economic order quantity. Economic order quantity (EOQ) uses a formula to order
materials with the goal of minimizing ordering and holding costs, and each inventory
item is considered to be independent of others. Under MRP, inventory use is
dependent on the number of end products being sold. With the use of a computer,
MRP keeps track of the number of end products to be produced for the next period,
develops a list of all parts and inventory pieces needed to produce that product, and
keeps track of all inventory within the company. When the computer determines
that additional end products must be produced, it automatically orders the minimum
amounts of all inventory parts needed. Thus, MRP results in precise coordination.
between inventory requirements and production schedules. EOQ on the other hand, bases inventory levels on past consumption and the desire to minimize ordering costs.

8. Imagine you are the manager of a gourmet pizza restaurant. Identify one specific item or process for each of the six steps of implementing statistical quality control in your restaurant.

Developing a statistical quality control for a gourmet pizza restaurant would be the following six steps. First, define the characteristics of a high-quality gourmet pizza. Second, decompose the work activities into the discrete elements required for producing a high-quality gourmet pizza, i.e. kneading the dough, garnishing and baking the pizza. Third, have a standard for each work element that is current and reasonable. An example would be all baking pans must be cleaned to perfection before using. Fourth, discuss specific performance expectations for every job with workers. An example would be all workers must report punctually and wear clean, white uniforms while performing their jobs. Fifth, make check-sheets and collect data for each task element. A sales order and receipt must accompany each point of contact sale. Finally, evaluate employee progress against standards at frequent intervals. A performance appraisal of each employee must be forthcoming against the standard predetermined by management.

9. If you were a consultant to a local manufacturing plant that wants to improve productivity, what advice would you give managers?

A management consultant should advise a local manufacturing plant different options to improve upon productivity. One such option would be a recommendation for capital improvement, that is, new machinery to increase output. Another option would be the introduction of financial incentives, or piece work, to improve upon productivity. Finally, a recommendation would be capital formation and financial incentives for employees to improve productivity could be recommended to the manufacturing facility.

10. Do you believe operations management can influence competitive strategy? Discuss.

Operations management can have a direct influence on competitive strategy because it is the field of management that specializes in the physical production of goods or services and uses quantitative techniques for solving manufacturing problems. In essence, operating managers are concerned with all production activities within the organization. This includes decisions about where to locate facilities and what equipment to install in them. However, as with all areas of management, operations management also requires the ability to lead people and could become a part of the organization’s competitive strategy when it has an objective of building upon quality and efficiency.
Teaching Note for Experiential Exercise

What Is Your Attitude towards Productivity?

This questionnaire could also be titled, “What is your attitude towards innovation?” The questions are geared towards a manager who is nurturing of new ideas, someone who understands if you want to have a lot of cream (successful ideas which increase productivity), you have to have a lot of milk (varied and often wild ideas). This requires an attitude of openness to new (and seemingly silly) ideas, a nurturing of those ideas, and a willingness to accept and even embrace failure. One study showed that successful managers make more bad decisions than mediocre managers. Why? Because successful managers take more risks and hence fail more often. But they also hit more home runs, too.

Companies that do not innovate are doomed to failure. Even if productivity is good now, others will be improving theirs, and your company will be left behind. Also, as Peter Drucker has stated, about half of the sales in American companies are from products only invented in the past five years. So, innovation in products and productivity is essential to survival.

Teaching Note for Ethical Dilemma

A Friend for Life?

Student responses will vary between the three options; however, it is important to consider the long-run implications and how it will impact this firm’s operations. One must give considerable weight to the input from the vice president for manufacturing and the production manager since this is a production problem pertaining to materials used for the manufacturing of the Binky-Bear. After considering the three options, it is recommended option 3 should be the course of action decided upon by Priscilla Dennis. Absorb the extra production costs. It’s the ethical thing to do, and besides, the company’s reputation for quality is too important to risk.

Surf the Net

1. Supply Chain Management. Supply chain management deals with the management of materials, information and financial flows in a network consisting of suppliers, manufacturers, distributors, and customers. The coordination and integration of these flows within and across companies are critical in effective supply chain management. It is important that the information, material and financial flows are coordinated effectively in a supply chain. Material flows involve both physical product flows from suppliers to customers through the chain, as well as the reverse flows via product returns, servicing, recycling and disposal. Information flows involve order transmission and delivery status. Financial flows involve credit terms, payment schedules, and consignment and title ownership.
arrangements. These flows cut across multiple organizations within a company as well as across companies and sometimes industries. In the last few years, the coordination and integration of these flows have attracted significant interest on the part of researchers, management, consultants and practitioners in academia and industry. Due to the recent trends of vertical disintegration, international procurements, new information technologies and increasing pressure from customers on responsiveness and reliability, and the globalization of operations and markets, supply chain management has become at once a challenge and an opportunity. Indeed, many companies have now viewed supply chain management as the core of their business strategy.

2. **CAD/CAM.** Students can vary in their responses to companies and product lines selected.

3. **Inventory Management and MRP.** One of the most important elements of a successful manufacturing system is scheduling and control--when is new production material released, at what rate, and how is it controlled in its progression through the factory? Just in Time manufacturing is a systems approach to developing and operating a manufacturing system, based on the total elimination of waste. It has been part of the Japanese manufacturing industry approach for several decades. In fact, many people believe it has been "perfected" by Toyota, using what they call the Toyota Production System, although American companies like Chrysler are using JIT as well. The term Lean Manufacturing is often used synonymously with JIT. The unifying concept of both JIT and Lean Manufacturing is the reduction of waste. Material Resource Planning (MRP) is a computer based system that is used to control production planning. It can be used to determine how much of each material needs be purchased or produced in the planning horizon to ensure orders are filled on time. To accomplish this task it utilizes the Master Production Schedule (MPS), the bill of materials (BOM), inventory status data and the forecast of orders. Production Managers adopt MRP systems to:
   - Reduce inventory levels.
   - Increase production capacity.
   - Improve customer service.
   - Accurately cost manufacturing processes.
   - Improve plant operating efficiency.
   - Provide faster response to changing conditions

**Case for Critical Analysis Solution.**

**Intel**

1. *What type of facilities layout do you think would work best at Intel’s plants? Why?*

   The facility layout should be a cellular layout for Intel. The rationale is it provides some of the efficiencies of both process and product layout. It is important to consider a U-shape cell be analyzed because it provides efficiency of material and tool handling and greater flexibility in inventory movement. An advantage is
employees can work in clusters that can facilitate teamwork and will permit joint problem solving. Increased flexibility of the manufacturing system can be enhanced due to one person being able to operate all the machines in a cell layout. Finally, an advantage is walking distance is small, and thus less physical movement would be required.

2. **How might Intel managers use MRP II to control the company’s resources?**

Intel managers could utilize MRP II because it would impact the entire organization to become more efficient and cost effective. Increased control over all resources including material flow, manpower, and utilization over machinery can be provided to management in the production of chips. Intel must coordinate its own supply levels, inventory and manufacturing capacity to meet customers’ needs and at the same time demand the same thing from its own suppliers. In addition, MRP II creates a model of the overall business that allows senior managers to control production scheduling, cash flow, human resource planning, capacity planning, inventory, distribution, and materials purchasing. MRP II also supports marketing and engineering and provides financial information. Intel put in place an enterprise resource planning system to improve inventory control, product delivery, and business integration, with an intranet designed to accelerate procurement cycles.

3. **Imagine that you are a manager at one of Intel’s manufacturing plants. What steps might you take to ensure that workers are as productive as possible?**

As a manager, improved production planning will be the result by overhauling its production line every 18 months. The key is flexible manufacturing and the result will be to speed up the production process. Speed is everything in this business. Increased efficiency is important to work within the system of open communication with suppliers and vendors with a customer focus at all times. In becoming more efficient, the importance of quality must be communicated to suppliers, and a quick turn around of processing orders and deliveries is essential in meeting their objectives. The introduction of a web-based tool will increase efficiency to permit suppliers to study new products as Intel designers work on them. Improved communication with suppliers through the intranet will promote the highest level of quality and minimize stock-outs of inventory for Intel.

**Additional Materials: Part V**

**Video Case**

**Chapter 14**

**Cannondale Has Finely Tuned Control Processes**

Organizations today face the constant challenge of controlling their activities to reduce waste, shorten time frames, and maximize profits. Their very survival depends on
how well they can streamline processes and produce high-quality products from the outset. The high-performance bicycle industry is no different; it is extremely competitive among the top handful of companies. Known for its innovative designs, Connecticut-based Cannondale Corporation believes in control before, during, and after its design and manufacturing processes. In fact, to remain a profitable viable, business, the organization needs to run as a finely tuned machine, with all parts contributing to overall goals.

Creativity drives and inspires Cannondale’s teams, but continual innovation also requires checks and balances to ensure quality. After new bicycle designs are created using a computer-aided design (CAD) software program, teams review them carefully. And before a bicycle design is approved for production, design engineers check its accuracy and feasibility through a proofing process, the first step in quality control. The goal of proofing is to answer the question; "Can the design be built as envisioned?" Once they feel confident in the new design, engineers send the CAD system’s design to a rapid prototyping machine, which constructs a plastic model so that engineers can see in three dimensions what they have planned. Overseeing this design process is the research and development project manager, who keeps an eye on design timelines and prototyping schedules. John Horn, a Cannondale R & D project manager says, “Engineers are perfectionists, but the R & D project manager must make sure the product gets to market when its needed.”

Once the design engineers have perfected a design, they transmit it electronically to the production teams in Bedford, Pennsylvania. Production engineers at the factory use the computer design to develop working samples using actual materials. New designs undergo 12 to 15 different tests to ensure impact strength, durability of the materials, and performance. Testing includes actually riding the prototype, as well as destructive testing to check the design’s limits.

Manufacturing processes are controlled through precision machinery and empowered teams. Cannondale uses computer-guided laser machines to cut the frame’s aluminum tubes to precise dimensions. Then the company relies on its craftsmen’s experience and training. Because the strength of a bicycle frame depends on the quality of its welds, welders undergo a training and certification program to ensure that they meet quality standards. During manufacturing, any employee on the assembly line can speak up and stop production anytime to fix problems immediately. Once a frame has been constructed, Cannondale’s coordinate measuring machine checks every measurement, and as a final control, a technician manually verifies the measurements. The frame is then sanded, cleaned, and hand painted, and protective finishes are applied.

Critical to bicycle design is actual testing of performance in the field. Cannondale seeks ideas from professional bicycle racers to maintain its cutting-edge designs. The company sponsors professional racing teams—two mountain bike racing teams, three road-racing teams, and a triathlon team. The feedback that the racers supply is invaluable to the company’s design and manufacturing processes. The company has won many quality awards through the years, among them Bicycling magazine’s “Publisher’s Award for Innovation,” VeloNews magazine’s “Technological Development of the Year Award,” Popular Science’s “Best of What’s New” award, Business Week’s “Best New Products of the Year Award,” Design News magazine’s “Computer-Aided Design Award, and Popular Mechanics’ “Design and Engineering Award.”

Even with such acclaim, Cannondale is not content to rest. The company can change product lines as often as every six months to remain at the forefront of bicycle design and competitive in its market. And it has been revamping its inventory and manufacturing
processes to streamline them for profitability. It recently switched its materials control computer software from a time-consuming program that took nine hours and much manual intervention to complete to one that performed profitability analyses in 2-1/2 minutes. With such timely information, the company was able to review its processes and reduce its inventory stock by roughly 25 percent, which freed up money and resources to be used elsewhere—such as research and development. Cannondale’s purchasing manager says that the new system has eliminated not only the time involved but many headaches as well. “Before, it took so much effort to work through the mountain of computer printouts to find what you were looking for that you just wouldn’t do it.” Now the company can generate that information in seconds and feed it back to critical decision makers. That kind of speed record is as critical as to Cannondale as awards and races won.

Questions

1. Review the three types of control outlined in Exhibit 14.1 in Chapter 14. From the information provided, categorize the types of control Cannondale uses in its design and manufacturing processes as feedforward, concurrent, or feedback.

   Answers may vary, and students should support their categories with facts. Some suggested answers follow. Feedforward control: proofing of designs before they are passed to production, rapid prototyping of designs, training and certification of welders. Concurrent control: research and development manager’s ongoing oversight of timeliness of design process, prototyping of the design in the testing lab, ability of production workers to stop the assembly line at any time, computer-guided laser cutting machines. Feedback control: final check of frame measurements by the coordinate measuring machine, manual check of the measurements by a technician, ideas and suggestions from the athletic teams the company sponsors, computerized inventory and manufacturing software programs.

2. Would you say that Cannondale relies more on bureaucratic control or decentralized control to ensure quality?

   Cannondale does give the research and development project managers authority to oversee the design timelines, but most processes rely of the decentralized control of specialized teams. Team members oversee and check their own work throughout the process and institute changes as needed.


   Most students will say yes because Cannondale continually looks for ways to improve its processes and designs. For a company known for innovation is bicycle design, Cannondale must ensure each of its products meets quality standards and customer expectations.

Sources: Interview with John Horn, Cannondale research and development project manager, April 9, 2002; Cannondale company Web site, www.cannondale.com, accessed
Video Case

Chapter 15

Cannondale’s Information Technology: From Office to Factory Floor—and Beyond

Information is a valuable resource for today’s organizations, and information technology can tap its potential. Cannondale Corporation, the leading designer and manufacturer of high-performance aluminum bicycles and cycling accessories, believes in the strategic use of information technology. The company employs computer systems for everything from bicycle design, precision manufacturing, quality control, and inventory and sales management. Cannondale’s director of marketing and media relations, Tom Armstrong, says the goal of using information technology is to move faster than its competitors. “We have tried to do that by innovating not only on the product front but in every other aspect as well. A lot of our own production engineering is about getting inside the development cycle of our competitors.”

Cannondale’s design engineers based in Connecticut use a computer-aided design (CAD) system called Pro/Engineer, a three-dimensional modeling program. With the program, designers can execute an idea and nearly instantly generate the measurements and parts needed for prototyping and mold making for manufacturing. They can also automatically create many different sizes in the same model style—to fit cyclists of many different shapes and sizes. With more than 80 different bicycle models currently, the CAD system gives the company flexibility—and a competitive edge.

After a design is finalized, the CAD system relays the design electronically to the production engineers in the company’s Bedford, Pennsylvania, factories. Production engineers can use the Pro/Engineer software to generate working prototypes of a bicycle that can actually be ridden. During manufacturing the company uses computer-guided lasers, which cut the frames’ tubes to precise dimensions. Once a frame is complete, the coordinate measuring machine checks the frame measurements for accuracy.

Several years ago, the company saw the promise of Internet technology and harnessed it to track its manufacturing process. It installed an intranet in its Pennsylvania manufacturing plants to reduce the complexity and costs of the manufacturing system. The company’s application engineer installed Web browser software on personal computers on the factory floor and replaced the keyboards with bar-code scanners and mouses for ease of input. As employees on the assembly line finish a step, they swipe the scanner across a bar-code on each bicycle. The company’s managers can then capture information and track the manufacturing processes to ensure that parts and supplies are available when needed.

Cannondale also uses the Internet’s communications capability to relay product specifications to its subsidiaries in the Netherlands, Japan, and Australia, which do final product assembly and finishing for overseas products. Before the use of the Web,
workers sent hard-copy drawings to the subsidiaries, and employees there placed them in binders, which had to be updated periodically. That process was time-consuming and unreliable. Now the company can instantly transmit its drawings electronically, complete with final paint colors. The result is consistency in product manufacturing, reduced time, and reduced costs.

Cannondale has focused most of its information technology system on personal computers running Windows software. This strategic decision simplifies the company’s hardware and software systems and allows employees in all divisions to share the information in word processing, spreadsheet, and other programs. Cannondale recently began working with AimNet Solutions to handle its network infrastructure. AimNet will monitor the company’s network and ensure it performs reliably. Cannondale’s vice-president of information technology, Mike Dower, explains the strategic partnership this way: “Our strategy at Cannondale has been the same since our inception. We strive to create innovative, differentiated, high-performance products. With our passion for growth… we couldn’t afford to be distracted from that strategy... We can stay focused on creating superior products” and let AimNet oversee the network infrastructure.

Cannondale has also reconstructed its inventory and sales management systems with information technology. With its new PC-based system, the company is able to track supplies more accurately and, as a result, reduced inventory stocks by approximately one quarter. The system may eventually be used to tie Cannondale’s information system with its suppliers’. Cannondale sales representatives also gather data from retail partners on which models are selling well. They relay that information to the company’s information system, and managers can switch manufacturing to needed models. This quick response to customer needs is important to Cannondale’s success. The company has also begun using its corporate Web site to inform prospective customers about tailor-made bicycles. Currently available on the company’s CAAD5 road frame, the company allows the customer to choose from over 8 million possible frame and color variations. Giving customers such wide choices and ensuring the product they want is in their local store helps solidify their relationships with the company. Cannondale’s Web site says, “Our focus is people—employees, customers, retailers, and our vendors—working together to accomplish our mission.” And Cannondale uses sophisticated information technology systems to link those people into one big network.

Questions

1. **What types of groupware does Cannondale use?**

   Cannondale’s CAD system allows team input on a design. It also allows employees in production and quality control to fine-tune designs and test them.

2. **How important is Cannondale’s process control system to its design and manufacturing?**

   Students will no doubt say very important because the technology ties together design and manufacturing seamlessly. The company uses computers to control the prototyping and manufacturing processes, and Web browser technology is placed
directly on the factory floor to capture data, which can then be shared with inventory programs. Computer systems also check the quality of the products.

3. **Cannondale uses information technology in many ways to streamline its business processes. What other ways could it use them in the future?**

Encourage students to use their creativity to generate ideas. Here are a few suggestions. Cannondale could eventually link its suppliers directly to its inventory systems via an extranet so that parts and supplies could be ordered automatically when needed. Retailers’ transaction processing systems could also be linked directly to the company to provide instant sales data. Cannondale could then sift through the data warehouse with data mining software to see whether any patterns emerged that could help them compete. The company could also consider moving into e-business, allowing customers to order custom bicycles online, but any decisions such as this would need to be made carefully to avoid damaging relationships with its retail partners. It could also conduct online customer surveys to tailor its products to their needs.


**Video Case**

**Chapter 16**

**Cannondale’s Consuming Passion for Perfection**

You’d expect a company that produces premium bicycles to care about its manufacturing processes. After all, the company knows how gears must mesh perfectly and how lightweight and durable frames must fit their riders’ bodies seamlessly to form a single unit built for speed. You’d expect the company to realize how each system must perform flawlessly. You’d expect that, and you’d be right. Cannondale Corporation pursues its mission of producing innovative, quality products with nothing short of passion.

Cannondale’s manufacturing organization produces physical goods—bicycles, cycling accessories, and off-road vehicles. And its operations strategy lies at the very heart of the company—it must produce its products quickly, efficiently, and well to survive. But Cannondale has another goal in mind besides mere survival: it strives to be an innovator. That focus places additional pressure on its operations, not only to support the company but to provide a competitive advantage.

As the Internet became more widely used in the mid-1990s, Cannondale foresaw its potential for supply chain management. Rather than install complex systems, the company used the simplicity of Web technology to manage its manufacturing processes.
It installed personal computers directly on the factory floor and used scanners and bar-code technology to track the stages of the manufacturing process. Workers simply swipe the scanner over a bar code attached to a bicycle frame, and the system automatically updates a database. The database serves as a gateway to the company’s material requirements planning (MRP) application. The database can also be accessed by management and its overseas subsidiaries for decision-making and planning.

Cannondale revamped its inventory control system in the late 1990s to allow it more flexibility. Its old system created a one- to three-week delay in analyzing design or order changes—toolong a time frame for a company that can change its product lines every six months. Frustrated with the system’s pokiness, the company invited vendor WebPlan to demonstrate its system using actual corporate data. The new system allowed the company to do an MRP run in 2-1/2 minutes. Cannondale expanded the system’s use to scheduling and planning in purchasing, finance, and other departments. Such efficiency allowed the company to reduce its inventory drastically and use the dollars previously tied up in inventory for other purposes, especially product design. The company is also planning to link its suppliers to the system via the Internet. The company’s purchasing manager says, “If [suppliers] can see our requirements on the Internet as fast as we can, then a lot of time can be saved. Buyers and planners don’t have to spend time communicating on every little detail, and parts production can begin when it’s needed, not when it’s communicated using a phone or fax.” Integrating suppliers into the system provides a unified supply chain management system.

Cannondale’s small production runs on its assembly lines allow the company to be more flexible in its manufacturing systems than other companies, which produce thousands of units at a time with robotics. Cannondale can quickly and easily change paint colors or customize decal designs to meet sales demand or customer preferences. It uses technology when appropriate for accuracy and consistency but also provides craftsmanship with skilled employees. Such flexibility enables Cannondale to ship a custom bicycle out of the factory within six weeks of a signed custom order. It can also meet its retail partners’ specific demands more quickly.

Productivity is a key to Cannondale’s success—through technology and its employees. From its Web-based factory floor software to its computer-aided design and manufacturing systems, the company has created a top-performing production line. With its redesigned production processes, the company expanded from manufacturing one product line of about 50 bike models to six lines with 120 models. But the constant push for design innovation and new materials keeps the company on its toes. Sophisticated bicycles must balance strength, flexibility, and weight for peak performance. Cannondale is meeting those challenges head on and aiming to change the bicycle world at the same time. As the company’s Web site says, “We devise flexible manufacturing processes that enable us to deliver those innovative, quality products to the market quickly and then back them with excellent customer service.” From its early beginnings in a loft above a pickle factory, Cannondale has been racing toward perfection for 30 years, and it hasn’t tired yet.

Questions

1. From this video case and those for Chapters 14 and 15, identify the inputs to Cannondale’s manufacturing organization.
Inputs for Cannondale’s manufacturing organization are the raw materials (aluminum and other metals, plastic, rubber, paint and finish products); human resources (design and production engineers, manufacturing employees such as welders, sanders, and painters, and sales representatives); land and buildings (the main company offices in Bethel, Connecticut, U.S. factories in Bedford, Pennsylvania, and subsidiaries in the Netherlands, Australia, and Japan); and technology (the company’s computer design and manufacturing systems, inventory control systems, and network infrastructure).

2. Review the basic production layouts in Exhibit 16.5. Which type of layout does Cannondale have?

Details from the plant tour video footage will determine whether the production layout is based on process, product, cellular, or fixed position layout. Students should support their decision with facts from the video.

3. How does Cannondale’s operations support its production of high-performance bicycles?

The company focuses on individual bicycles—their innovative design and quality manufacturing. Such attention to detail is appropriate for high-end products such as racing and mountain bikes.


PART V

Continuing Case

At Ford, Quality Is Job 1—Again

Suggested Answers

1. Do you think that Ford Motor Company would benefit from open-book management? Why or why not?

Answers will vary, but students are encouraged to focus on whether students see a benefit to cross-functional communication and cooperation throughout Ford, along with employee empowerment. Some students might agree, but others might say that the industry is so competitive that the company’s ideas, designs, and manufacturing
methods might be compromised by having too many people know about them.

2. *In what ways might Ford Motor Company further use information technology to manage knowledge and create a competitive strategy?*

Suggestions include involving suppliers and customers in shared information to provide superior service, increase loyalty among suppliers and customers, and enhance organizational learning.

3. *Which stage of operations strategy would you say is illustrated by Ford Motor Company in this case? Why?*

Answers will vary, but most students will probably choose stage 2 or stage 3, based on the coordinated efforts of those involved with Ford’s Best Practices program.