Operations Management Supplement

Learning Objectives
After studying this supplement, you should be able to:
1. Discuss four basic issues in operations management.
2. Explain four positioning strategies.
3. Provide examples of developments in office, service, and manufacturing technologies.
4. State the essentials of quality management and control.
5. Explain the basics of inventory management and control.
Preview: Toyota’s Production System

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INTRODUCTION TO OPERATIONS MANAGEMENT

The Toyota production system (TPS) is used at its Georgetown, Kentucky, complex and throughout the world. It applies not only to manufacturing but to almost everything Toyota does, from product development to supplier relations and distribution. Toyota sets the standard in efficiency, productivity, and quality. GM officials say that Toyota is the benchmark in manufacturing and product development.

Michael Cusumano, a professor at MIT’s Sloan School and a member of its international motor vehicle program, has written extensively about Toyota. He states, “I don’t know of a company that better combines superior skills in all the critical areas: manufacturing, engineering, and perhaps marketing. If they wanted to blow away GM, they could.”

Inside the plant, TPS’s success depends on highly experienced managers working with a motivated, well-trained workforce. Outside the plant, TPS requires a network of capable suppliers that can synchronize their operations completely with Toyota’s. Mike DaPrile, who runs Toyota’s Camry assembly facilities in Kentucky, describes it as having three levels: techniques, systems, and philosophy. He comments, “Many plants have put in an andon cord that you pull to stop the assembly line if there is a problem. A five-year-old can pull the cord. But it takes a lot of effort to drive the right philosophies down to the plant floor. A lot of people don’t want to give the needed authority to the people on the line who deserve it.”

Thus TPS requires a different mindset. In most plants, for instance, workers try to overproduce because, once they have filled their quotas, they can take it easy. As a result, the flow of work proceeds in fits and starts. At Toyota, overproduction is considered one of the worst forms of waste. The company designs the work to flow from process to process without peaks or valleys and still arrive in just the right quantity for the customer. That results in a more smoothly running plant, and it keeps everybody busy.

In a Toyota assembly plant, every movement has a purpose, and there is no slack. The workers experience a smooth flow: retrieving parts, installing them, checking quality, and doing it all in immaculate surroundings. Says DaPrile: “We believe in the four S’s: sweeping, sorting, siting, spick-and-span.” TPS requires a big leap of faith for any manufacturer. Because there is no stockpile of parts, suppliers and workers are under tremendous pressure to perform their jobs as scheduled and even to work overtime if they fall behind. A single weak link will hamstring an entire operation.

Toyota is always tinkering with its own system. In the early 1990s it introduced more automation in its factories, only to back away when the machinery proved too costly and inflexible. More recently, Toyota has been trying to make jobs easier for its workers in the face of persistent labor shortages. It now breaks the assembly line into segments and allows workers to stockpile small buffers of unfinished parts at the end of each segment in case of an interruption.

The capacity to adapt is a fundamental ingredient in Toyota’s success. Takahiro Fujimoto, a Harvard Business School graduate who teaches at Tokyo University and has studied the company, says that “Toyota’s real strength resides in its ability to learn. Its employees are problem-conscious and customer-oriented, and this preparedness is the source of the company’s dynamic capability. The company’s practices are constantly changing, even though its basic principles are unchanged.”

To learn more about Toyota, visit the company’s home page at http://www.toyota.com

Understand four basic issues in operations management

Every company makes mistakes, including Toyota. But Toyota has a unique ability to study its mistakes, learn from them, and improve itself. The process has become an essential part of its culture, so much so that anecdotes about failures are a big part of the company’s heritage. Moreover, TPS principles are applied to other parts of the auto firm, not just its manufacturing plants. For example, Toyota’s product development process includes creativity and freedom to develop innovative designs, but it also requires discipline and control in scheduling, resource use, and product quality. Toyota treats a drawing for a change order on an engineer’s desk (or its electronic equivalent) the way it would an unfinished component. As long as it sits there, it’s an impediment to completion of the job.
Eliminate it or move it along, and you have improved the process.\textsuperscript{2} More than most firms, Toyota sees every activity and function—not just manufacturing—as relevant to operations management. \textit{Operations management} (OM) is the systematic direction, control, and evaluation of the entire range of processes that transform inputs into finished goods or services.\textsuperscript{3}

In this supplement we describe operations management and its importance to quality and productivity in the manufacturing and service sectors. We present nine key areas of operations management decision making. We then discuss four of them in some detail: positioning strategies, technological options, quality management and control, and inventory management and control.

\textbf{Relation of OM to the Systems View}

From a systems view of organizations, OM involves four primary components: environmental factors, inputs, transformations, and outputs. Figure 1 depicts these components and illustrates their interactions.

\textit{Environmental factors}, which we have discussed in several previous chapters, influence operations management in numerous ways. Recall that such factors can be grouped into cultural, political, and market influences, examples of which are group norms (cultural), health and safety legislation and standards (political), and customer preferences (market). Toyota is especially astute in adapting itself to changes in customer preferences.

\textit{Inputs} include human resources (managers and workers), capital (equipment, facilities, and money), materials, land, energy, and information. Examples are assembly workers and dentists (human resources), a factory and zero-coupon bonds (capital), seed corn (materials), a farm (land), electric power (energy), and market analyses (information).

\textbf{Figure 1} \hspace{1cm} \textit{Operations Management as a System}

\begin{itemize}
  \item \textbf{Environmental Factors}
    \begin{itemize}
      \item Cultural influences
      \item Political influences
      \item Market influences
    \end{itemize}
  \item Customer contact
  \item \textbf{Inputs}
    \begin{itemize}
      \item Managers
      \item Workers
      \item Equipment
      \item Facilities
      \item Materials
      \item Money
      \item Energy
      \item Information
    \end{itemize}
  \item \textbf{Transformations}
    \begin{itemize}
      \item Goods
      \item Services
      \item Waste
      \item Other
    \end{itemize}
  \item \textbf{Outputs}
    \begin{itemize}
      \item Performance Feedback
    \end{itemize}
\end{itemize}
Transformations are the operations that convert inputs into outputs. Examples are turning plastics, steel, glass, and other materials into Toyota Camry autos; saltwater into freshwater through desalination; and filling cavities through dental skills (use of a drill) and materials (metal or porcelain). The five numbered circles in the transformations box in Figure 1 indicate that production of a good or service often requires several operations. An operation can be manufacturing a part (windshields for Camrys) or assembling parts manufactured elsewhere (such as assembling Camrys at the Georgetown, Kentucky, complex), combining fresh vegetables into a salad at a salad bar, or entering a code number and transaction information in an automated teller machine.4

Outputs are the goods (Camry autos), services (Toyota dealerships), and waste products (auto emissions) created through transformations. Other examples are government Social Security checks, garbage, and water pollution.

Customer contact often occurs in OM. Customers actively participate in the transformation process in self-service operations, as when they fill their cars’ gas tanks at service stations or their soft drink cups at dispensers and take them to their tables. Customers also provide essential feedback by expressing satisfaction or dissatisfaction with purchased goods and services. Performance feedback (e.g., records of the frequency of Toyota Camry repairs), much of which is provided by customers, closes the system loop. This information helps organizations decide whether to make changes in the goods or services provided, the transformation processes used, and/or the inputs utilized. As noted in the Preview feature, Toyota is continuously considering the need for such changes.

Differences between Goods and Services Providers

The application of OM concepts must recognize differences in the production of goods and the provision of services. Table 1 summarizes five such differences. These distinctions often are a matter of degree, as suggested by the continuum of characteristics. For example, Toyota may be considered a goods provider, yet it also provides services to suppliers and customers—such as its bumper to bumper warranty.

The ability of goods producers to hold items in inventory gives them flexibility in scheduling flows in the transformation process. They can partially offset peaks and valleys in demand by drawing down or adding to inventories. However, one of the special attributes of Toyota’s production system is to keep inventories at a bare minimum. Recall from the Preview feature that Toyota now allows small buffers of inventory between major assembly segments to make the jobs of production employees a little easier. Service providers are more at the mercy of day-

<table>
<thead>
<tr>
<th>Table 1 Typical Characteristics of Services and Goods Producers</th>
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<tr>
<td><strong>Primarily Services</strong></td>
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<tr>
<td><strong>Producers</strong></td>
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<tr>
<td>Mixed</td>
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<tr>
<td>Intangible, nondurable</td>
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<tr>
<td>Output can’t be inventoried</td>
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<tr>
<td>High customer contact</td>
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<td>Short response time</td>
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<td>Labor intensive</td>
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to-day and even hour-by-hour fluctuations in customer demand. The peak periods of breakfast, lunch, and dinner at restaurants are common examples.

Customers themselves often are inputs to the transformation process for service providers (e.g., doctors or hairdressers). In contrast, most customers for manufactured goods have little or no direct contact with the transformation process. Customer contact is left to the marketing department, distributors, and retailers.

Service providers often must respond quickly—within seconds, minutes or hours—to customer demand. Examples are checkout lines at supermarkets, service at fast-food restaurants, and auto repairs. Thus the matching of short-term transformation capacity (especially the number of employees) to customer demand can be much more difficult for service providers than for manufacturers. Customers for many tangible, durable goods (e.g., cars, furniture, computers, and buildings) know that they may have to wait days, weeks, or even months for those products.

Goods producers generally are capital intensive (i.e., require relatively more investment in building and equipment for their operations). Services producers generally are labor intensive (i.e., require relatively more employees for their operations). The need for larger plants and more and better equipment runs up the cost of many manufacturing operations. For example, Toyota’s manufacturing complex in Georgetown, Kentucky, contains more than 7 million square feet, but a bank branch in a supermarket often has less than 150 square feet.

**Impact on Productivity**

In recent years, productivity has increased at about 2.5 percent annually in the United States. Critics claim that government statistics understate productivity gains, especially in services. For example, telephone service has greatly improved and its price has dropped. But the productivity increase is understated because the price decrease usually doesn’t fully reflect product improvements. Quality increases—such as variety, reliability, service, and timeliness—often are unrecognized or underrecognized because they are hard to quantify.

The continuous increase in productivity is a key to maintaining the competitive positions of U.S. and Canadian firms internationally in the manufacture of automobiles, electronic equipment, bicycles, motorcycles, cameras, small appliances, and steel. International differences in rates of productivity growth influence exports, standards of living, and choice of jobs.

Operations management can greatly improve productivity, a primary concern of both goods and services producers. In particular, three applications of operations management principles have resulted in improved productivity. First, the investment of capital in new technology and carefully managing its introduction are essential to long-term productivity growth in both sectors. Second, the reduction of waste, rejects, and returns through improved quality control pays off immediately in both sectors. Third, the reduction in work-in-progress (WIP) materials in the manufacturing sector reduces the amount of money tied up in inventories and physical space requirements.

No standard measures of productivity apply to all organizations. The most commonly used general measure is **total-factor productivity**, which is the ratio of total outputs (amount of goods and services produced) to total inputs (quantities of labor, capital, and materials used). This indicator of economic efficiency is normally expressed in monetary terms. In contrast, **partial-factor productivity** is the ratio of total outputs to a single input. Examples of partial productivity ratios are (1) units produced per day divided by labor hours of production employees per day, and (2) store sales per month divided by labor hours of sales personnel per month. These and other measures are meaningful only if the outputs produced are sold.
The assessment and improvement of productivity with service operations and technologies is often challenging. The following Planning and Administration competency feature reveals how a management/employee team at Texaco substantially improved its productivity in handling employee benefits questions and issues. It demonstrates the application of skills and abilities in (1) developing plans and schedules to achieve specific goals efficiently; (2) determining the need for, obtaining, and organizing necessary resources; and (3) taking calculated risks.

**OM Decision Categories**

Operations management involves a number of categories of decisions. An effective OM system will link all of them, some of which you will recognize as strategic. Nine of the most important categories are:

1. **Product plans.** What products (goods or services) should be offered?
2. **Competitive priorities.** Should low price, high quality, fast delivery time, or product choice be emphasized?
3. **Positioning strategy.** Should resources be organized around products or processes?
4. **Location.** Should facilities be expanded on-site, at a new site abroad, or in a relocated existing facility?
5. **Technological choices.** What transformation operations should be automated to improve productivity?
6. **Quality management and control.** How can the quality levels necessary to maintain or better the organization’s competitive position be achieved?
7. **Inventory management and control.** What are the best methods of determining and maintaining the proper inventory levels?
8. **Materials management.** How should suppliers be selected and evaluated?
9. **Master production scheduling.** Should the organization make to inventory or make to order?

### Positioning Strategies

**Positioning strategy** is the approach selected for arranging resource flows in the transformation process. Figure 2 provides a framework for comparing three core positioning strategies. The vertical axis indicates that resource flows can range from sporadic (unstable and unpredictable) to continuous (stable and predictable). The horizontal axis indicates that product type and volume can range from low-volume custom products to high-volume standard products. The three boxes indicate the likely range of three core positioning strategies: process focus, intermediate, and product focus.

**Core Positioning Strategies**

A **process-focus strategy** organizes the physical layout of equipment and the workforce around each operation in the transformation process. This strategy meets the requirements of custom-made products and low-volume production. Scheduling is crucial because a variety of products share each resource and routines for different products vary. The resource flow pattern is unstable, changing from one order to the next. Similar equipment and operations (e.g., drill presses, welding sta-
Technological and organizational changes have allowed Texaco to improve the way it handles personnel questions from employees. Each business unit used to have its own benefit counselors that handled questions about employee benefits and payroll processing, according to Gary Morgan, manager of Texaco’s administrative services center. In Texaco’s downtown Houston headquarters office alone, some ten people fielded benefit questions. Recently, the function was centralized and computerized. These changes reduced the number of errors, speeded up the process, and saved the company millions of dollars a year. Only ten first-line counselors are needed, replacing the equivalent of about thirty full-time workers.

Helen Beabey, one of the ten first-line employee benefit counselors, sits in a big, airy room answering questions from employees throughout the United States about their benefits plans. With the help of a sophisticated computer program, Beabey can determine whether the company received a particular insurance form, help an employee sign up for a new health insurance plan, or answer questions about the company’s retirement plan. The system uses Social Security numbers to access data, and a counselor can immediately determine whether an employee is represented by a union, which benefit plans apply to the employee, and the employee’s length of service. If there are special circumstances—such as an employee is hard of hearing—it’s noted at the top of the file.

If one of the first-line counselors can’t answer a question, it’s referred to a supervisor. And if a question is “hot”—such as an employee trying to get into the hospital and having trouble getting admitted—it’s handled immediately.

Finances weren’t the only driving force behind the new system—Morgan indicated that Texaco wanted to improve how it handled its benefits programs. But, without question, the company also has saved money. Texaco invested $2 million and is saving about $4 million a year—it recouped its initial investment in just six months.

Although the relatively new system is quick and efficient, it is about to become even speedier. Texaco is looking into letting people change their benefit plans, addresses, and income tax withholding from their own computers.12

To learn more about Texaco, visit the company’s home page at http://www.texaco.com

Flexibility is at the heart of the process focus. The following are three common types of flexibility for manufacturing operations.

- **Product flexibility** is (1) the speed with which new products are created, designed, manufactured, and introduced; (2) the ability to design a product to a particular customer’s specifications; and (3) the ability to modify existing products for special needs.

- **Volume flexibility** is (1) the ability to respond to sudden changes in market demand for a particular product; and (2) the speed with which new manufacturing processes can go from small volumes to full-scale production.

- **Process flexibility** is (1) the ability to manufacture a variety of products over a short period of time, without modifying existing facilities; (2) the ability to
adjust smoothly to changes in product mix over the long term; and (3) the ability to accommodate variations in raw materials and raw materials substitutions.13

A **product-focus strategy** arranges the physical layout of equipment and the workforce around a few outputs. As indicated in Figure 2, this strategy is designed to fit high-volume, highly automated production of a few standard products with a continuous process or mass-production flow of resources. The transformation process is linear, with various operations arranged in a fixed sequence. This organization is typical of cafeterias, oil refineries, and assembly lines. In a traditional automobile assembly plant, welding machines are stationed along several different assembly lines to perform the same operation on different products. A service example is the automated teller machine (ATM), which provides a limited set of standard financial services (products) continuously by using a well-defined (stable) process.

An **intermediate strategy** arranges the physical layout of equipment and the workforce so that they reflect some features of both the process focus and product focus. Some batching can be done by merging and handling several similar orders at the same time. Some standard products or standard component parts might be made in advance and put in inventory. Kinko’s and other print shops adjacent to universities and colleges use an intermediate strategy. They often run off batches of course supplements in advance for later purchase by students, but they also provide immediate customer service in response to a variety of customer orders.

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Agile Strategy

The *agile strategy* is a flexible arrangement that allows mass customization of goods by means of advanced fabrication, information, and delivery technologies utilized by skilled and empowered individuals and teams.\(^\text{14}\) This strategy represents a *paradigm shift* (i.e., a fundamental change in thinking) from the three core positioning strategies. The agile strategy integrates key features of the process focus (especially customization and flexibility) with the product focus (especially continuous processes and low costs). In the past, these features were, for the most part, considered inconsistent and mutually exclusive, as suggested in Figure 2.

This positioning strategy allows switching from rapid product development to low-cost production quickly and with minimal resources. It rejects (or at least minimizes) the view that the choices have to be one or another from among the conflicting priorities of low cost, high quality, and flexibility.\(^\text{15}\) With an agile strategy, *flexibility* takes on special meaning: the ability to change or react with little or no adverse consequences in terms of the amount of time required and effort expended, the cost of resources, or the quality and quantity of performance.

Some experts forecast that many goods (e.g., autos, computers, and clothes) will be tailored to each customer’s specifications (taste and budget) within the next five to ten years. Companies moving toward the agile strategy are being forced to cut cycle times—the period between receiving orders and delivering goods. For that reason some of the production work that left the United States and Canada in the 1980s is beginning to return. In addition, one of the goals of the agile strategy is to create real-time links between the manufacturer and its customers and suppliers. Advanced information technologies allow networked retailers or manufacturers to send their orders electronically to their suppliers’ computers. These computers, in turn, relay the suppliers’ needs to their own suppliers. Ultimately, the computer-based real-time communications web will extend to individual machines on the shop floor. Robert Nagel, deputy director of Lehigh University’s Iacocca Institute (the think tank where the concept of the agile strategy was born in 1992), states, “If ever the term *paradigm shift* was appropriate, this is it.”\(^\text{16}\) The following Strategic Action Competency account reveals how Custom Foot, which started up in 1995, is pegging its future on the agile strategy. Jim Metscher, its president and CEO, recognized the evolving market niche of customers who want greater choice and better fit in their selection of shoes. Its major threat for long-term survival is the ability and interest of other premium retail shoe chains imitating Custom Foot’s agile strategy.

The Reengineering Link to Agile Strategy

The creation of an agile service or manufacturing process usually calls for organizational reengineering. As we discussed in Chapter 13, *reengineering* is the fundamental redesign of an organization’s processes (e.g., product development, logistics, distribution, customer service, and manufacturing) to lower costs, improve quality, and increase speed.\(^\text{17}\) Reengineering focuses on selected activities that can be improved to yield benefits quickly.

The purpose of reengineering is to do things right the first time: improving quality, eliminating repeated work, spending less time on bureaucratic rules and procedures by doing away with them, tearing down barriers between departments, empowering employees and teams, substituting information technologies for paper handling, and organizing processes to serve internal customers (which a human resources department or payroll department often does) or external stakeholders.
Some reengineering efforts have achieved dramatic results; others have had disappointing outcomes or have failed entirely. The essential ingredient lacking in the disappointing cases and failures often was inadequate management in terms of (1) poor goal development, (2) not creating a motivating environment, (3) inadequate empowerment at lower levels, (4) lack of meaningful measures of performance, and (5) failure to communicate with employees throughout the reengineering effort.19

Technological Options

The number and types of technologies available for improving productivity and quality continue to increase. Here, we review several of these developments in office, service, and manufacturing technologies. In Chapter 20 of Management: A Competency-Based Approach, we covered various computer-based technological options.

Office Technologies

Information technologies continue to change the office environment, with personal computers (PCs) being the dominant force. Today's most powerful PCs have more capabilities (because of software and hardware developments) than a 1970s mainframe that cost several million dollars. Managers and professionals in virtually all leading organizations use PCs to communicate with each other, subordinates, cus-
tomers and suppliers, and large computers. The following are several other uses of computer-based office technologies.

- PCs are now the workstation of choice in most organizations for accessing databases. They also are capable of inputting to fax machines or acting as telex/TWX terminals.

- Pioneering users are now applying video imaging to their use of optical disks, graphics workstations, and new control software to merge video images with text and data.

- Numerous organizations utilize voice communication systems as part of their office automation. In certain applications—in credit and collections, for instance—telephone signals interface with computer files.

- Organizations are using information technologies to exchange data and documents—everything from memos and price lists to orders and inventory status—electronically. These systems cut internal costs and create real-time networks for communication anytime and anyplace.20

**Personal communication services (PCSs)** represent an emerging set of capabilities based on wireless equipment that will enable users to stay in touch with almost anyone, anytime, anywhere. At present, PCSs extend the capabilities of cellular phones, which allowed development of mobile offices. Cellular phone technology permits oral or electronic airborne transmissions to be "handed off" automatically over special frequencies from one geographic area (cell) to another.

With PCSs, a single phone number can seamlessly follow a user, and some cellular phone providers are already moving toward this capability. Personal communication services include wireless e-mail messages, faxes, access to information services, and even video images. They operate at higher frequencies than do cellular phones, with transceiver towers twice as close together. Thus the equipment doesn’t require as much battery power and can be smaller and lighter.

**Service Technologies**

Airlines’ computerized reservation systems, banks’ ATMs, and credit card companies’ billing and customer service systems are only three of the many consumer-oriented service technologies.21 Other computer-based service technologies used by organizations are bar coding, integrated computer order systems, and voice recognition systems.

A **bar code** is a series of black lines of varying widths alternating with spaces that represent information and can be read by an optical scanner into a computer.22 Information contained in a bar code may include product name, lot number, manufacturing location, shelf location, and price. Bar coding has greatly increased productivity in supermarkets since the early 1980s. It speeds up the checkout process, reduces checkout errors, and makes inventory control more effective. Many new applications of bar coding are being developed, including some for goods producers. For example, some goods, such as appliances, are being tracked in inventories through the use of bar codes.

**Integrated order systems** involve connecting a customer’s computers to suppliers’ computers, allowing orders to be placed at any time. Such systems eliminate telephoned orders, mailed hard-copy order forms, and hard-copy invoices. Beam-scope Canada, Inc., distributes stereos, computer gear, software, and other items to mass retailers such as Wal-Mart, Sears, and 6,000 independent camera shops and
small retailers. In late 1997, it went online through the Internet with a new electronic commerce (e-commerce) integrated system that provides the following features for retailers that handle Beamscope’s items.

- Online ordering, inventory availability, and price check system computers.
- Real-time access to specific pricing, inventory availability, back order status, product specifications, and marketing specials.
- Full-color literature that retailers can download and print.
- Seven days a week, twenty-four hours a day accessibility.
- No retailer training required, just point and click. Improves order accuracy and eliminates pricing errors.

Retailers can track their shipments at the Beamscope Web site because of a live data feed from United Parcel Service (UPS), which handles Beamscope’s shipments. The server handles up to 200 customers at once, and response times usually are less than a second. Retailers can view color photos and video clips of most of the 6,500 products that Beamscope stocks. Direct costs have fallen from just over $5 to process a phone and fax order to about 50 cents online.23

Voice recognition systems analyze and classify speech or vocal tract patterns and convert them into digital codes for entry and retrieval through computer software.24 The plummeting cost of computing is aiding their adoption and use. Machine comprehension of human conversation may never be perfect, but, in late 1997, new powerful speech-recognition technology came on the market. These new systems can recognize what people say with more than 95 percent accuracy. In a recent special report, Business Week reported: “Speech technology is the next big thing in computing. Will it put a PC in every home?”25 The following are a few of the emerging applications of computer-based voice recognition systems.

- Employees at the Boston Globe can dial colleagues just by speaking their names into the telephone.
- Customers at Charles Schwab, the discount broker, can obtain price quotes and other information.
- Users of Bell South’s voice Yellow Pages can check auto ads and get stock quotes.
- Flyers on United Airlines can get seat reservations.
- Automobile drivers can retrieve e-mail and faxes while speaking into their cellular phones. This capability is achieved through text-to-speech software, which turns digital text into synthesized speech.
- Voice-based browsing enables users to scan the Web by speaking hyperlinked words into a microphone, although some use of a mouse is still required.26

Voice recognition systems are having profound impacts as aids for those with disabilities. Computer keyboard disabilities, such as carpal tunnel syndrome, are increasing rapidly. In 1997, IBM and Dragon Systems entered the market with major advances in their voice recognition systems. The following Self-Management Competency piece reveals how Brae Landon took advantage of this technology. She demonstrated (1) a sense of responsibility and willingness to innovate, (2) ambition and motivation to achieve objectives, (3) perseverance in the face of obstacles, and (4) a willingness to unlearn and relearn as her changed situation called for new skills.
Manufacturing Technologies

As we noted in the discussion of positioning strategies and reengineering, there are numerous manufacturing technologies. In this section, we describe two of the new-generation technologies: robots and computer-aided manufacturing.

Robots are reprogrammable, multifunctional machines. A robot’s frame often is a substitute for the human arm, and its microprocessor (computer) takes the place of the human brain by providing instructions for routine and standardized tasks. Robots have been programmed to perform numerous tasks in materials handling, welding, spray painting and other finishing operations, assembling, inspection and testing, materials removal, and water-jet cutting. Robots perform repetitive tasks without tiring or complaining about poor working conditions.

A robot can be programmed to move in various ways, depending on the task to be performed. Tactile (feel) and optical (sight) sensing and hand-to-hand coordination systems represent major aspects of robot development. In the Matsushita Electric factory that makes Panasonic VCRs, a robot winds wire thinner than a human hair through a pinhole in the video head sixteen times and then solders it. The 530 robots in the factory wind wire twenty-four hours a day. They do this job five times faster and much more reliably than the 3,000 Japanese homemakers who used microscopes to do the work on a subcontract basis in their homes. The robots can even inspect their own work.

In the service sector, robots have been used for years in nuclear power plants to avoid employee exposure to radiation and in the ocean to replace divers who require cumbersome and costly life-support systems. Anticipated and evolving applications of robots include assisting with the care of the handicapped and
For example, in early 1998, the first surgical robot cleared by the Food & Drug Administration (FDA) was introduced to assist with minimally invasive heart surgery procedures. The AESOP 3000 (an acronym for automated endoscopic system for optimal positioning) contains voice recognition technology, allowing surgeons to use spoken English to control precisely the endoscope. This specially designed optical tube, when connected to a medical video camera and light source, is inserted into the body to allow the surgeon to view the operation on a video monitor. Dr. Wayne Mayfield, a cardiac surgeon in Atlanta, helped test the surgical robot. He commented, “The AESOP 3000 effectively acts as a third arm that works in synchrony with my verbal commands, allowing me to have direct control of the endoscope, and provides a motionless image from which to operate, no matter how long the procedure. The robotic arm automates the tedious and often tiresome task of holding the endoscope, freeing nurse resources to perform other important tasks.”

**Computer-aided manufacturing** (CAM) represents an array of computer-based technologies used to produce goods. The complete CAM process begins with **computer-aided design** (CAD), which uses special software to instruct a computer to draw specified configurations, including dimensions and details, on a display screen. This method reduces the time spent in the design process and simplifies the exploration of alternative designs. The database resulting from CAD is used to help generate the instructions needed to guide the CAM process, including sequentially routing components to various machines, operating instructions for each machine, and providing for testing components against specifications. It also reports the unit cost of each operation, combines design information with materials specifications, and estimates waste and scrap rates that may affect purchasing requirements.

CAM is beginning to have an even greater impact on many activities in the manufacturing sector. They include process planning, production scheduling and control, machining instructions, matching performance, parts testing, assembly operations, shipping, cost accounting, personnel assignments, finished goods inventories, work in progress inventories, and procurement. The technology has become an important part of the competitive strategy of Xerox, Texas Instruments, and Hewlett-Packard, among others.

Computer-aided manufacturing is compatible with the product variety and flexibility associated with a process-focus strategy and the low per unit costs associated with a product-focus strategy (see Figure 2). Its most direct effects are reduction of the cost versus variety trade-off for goods producers and removal of rigid plant setups as a barrier to rapid product innovation. The demand for CAM has grown rapidly because flexibility is needed to meet ever-changing competition and customer demand. Thus CAM is an important aspect of implementation of the agile manufacturing strategy. Moreover, shorter product life cycles mean that manufacturing plants long outlive the goods they originally were designed to produce. The lives of many products now are so short that 50 percent of their sales often occur in less than three years after they are introduced. In addition, technological advances have accelerated to the point that new goods, materials, and processes are being introduced almost daily.

Cinnabar California, Inc., based in Burbank, is working to cut set-design times by applying the same three-dimensional CAD/CAM technology that has helped many manufacturers become world-class competitors by cutting costs and new-product time to market. The company creates sets, special effects, props, and environments for film, television, theme parks, and retail stores. For example, it
designed sets for a television commercial depicting a battle between the Energizer Bunny and Darth Vader.

Cinnabar calls its extensive 3-D digital database Art-to-Part. This database was created because product image and superior visual perception are key focuses in the entertainment industry, just as they are in engineering departments at manufacturers. As a result, directors of photography are demanding immediate turn-around of the physical models of complex characters so that they can be subjected to a “believability test” under strict lighting requirements. Doug Morris, president of Cinnabar, stated that “in the entertainment industry, time is of the essence.”

The database enables Cinnabar to digitize the intricacy of a foam model in real time and use CAD data to produce physical replicas quickly, with reduced tooling and design costs. Morris went on to say that “our ultimate goal is to create a vast compilation of 3-D digital models and provide ‘on-demand’ access for graphic applications such as animation, retail merchandising, virtual reality, and television and motion-picture special effects.”

**QUALITY MANAGEMENT AND CONTROL**

4 State the essentials of quality management and control

Quality management and control are generally viewed as key components of competitive strategy. Fortune’s annual ranking of America’s most admired corporations has always included “quality of products or services” as one of the eight key attributes of reputation. For 1999, three of the most-admired corporations that ranked highest on quality were Omnicom Group (advertising and marketing), Philip Morris (tobacco), and United Parcel Service (delivery services). The other attributes of reputation used in Fortune’s most admired companies survey include innovativeness, quality of management, employee talent, long-term investment value, financial soundness, and use of corporate assets. Many managers, professionals, and other employees recognize the organizational benefits of offering superior quality (as perceived by customers). These benefits include strong customer loyalty (more repeat purchases), lower vulnerability to price wars, ability to command a higher relative price without losing customers, and lower warranty costs.

**Competitive Strategy and Quality**

From a competitive perspective, value is the relationship between quality and price. Figure 3 presents a competitiveness value map on which an organization can determine its price versus quality position relative to competitors. Customers who perceive superior quality at a lower relative price receive outstanding value. Organizations that provide such value are likely to grow and prosper. In contrast, the provision of inferior quality at a higher relative price results in poor value for the customer. This situation is likely to invite new competitors. If organizations continue to offer poor value, they will wither and die. Figure 3 also indicates a premium value, or high price and superior quality. Competitive pressures continue to challenge organizations to provide greater relative quality at the same or lower price as competitors.

The interpretation of customer satisfaction—and how those perceptions translate into loyalty to the firm and its products—is no simple matter. For example, Xerox found that, if satisfaction is ranked on a 1 to 5 scale, from completely dissatisfied to completely satisfied, the 4’s—though satisfied—are six times more likely to defect than the 5’s. Often the assumption is made that satisfaction and loyalty move in tandem. Think of a graph with the degree of customer satisfaction on the horizontal and the degree of customer loyalty on the vertical axis. Customer reten-
Loyalty doesn’t rise diagonally (proportionality) on the graph. Rather, loyalty rises in small increments as satisfaction increases and then rises dramatically as the highest levels of customer satisfaction are reached. Researchers have found a general correlation between delighted customers and above-average stock market returns in their industries over the long term. Related research has suggested that loyal customers—those who repeat purchases regularly—can substantially increase an organization’s profits because they cost less to attract than new customers.39

As discussed in the Preview feature, Toyota is renowned for the quality of its products. However, it isn’t known for quality customer service—except for its Lexus dealerships. As of 1997, consumers ranked Toyota dealers just average, citing everything from indifferent or shabby treatment to repeated trips to the service department to fix simple problems. In 1997, only 42 percent of Toyota buyers went for another one, whereas General Motors managed to keep 62 percent of its buyers. In 1997, Toyota embarked on a program to woo its U.S. buyers. It changed incentives to reward dealers for quality customer service, increased training of technicians on how to diagnose mechanical problems swiftly over the phone, and speeded up vehicle delivery time. Now, Toyota even sells over the Internet to those who hate walking into a dealer showroom.40

Heightened global competition has been a major force behind management’s sharpened interest in quality management and control. North American manufacturers and service providers used to focus solely on the costs of maintaining or increasing quality. Now, product quality and costs increasingly are being viewed as

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**Figure 3** Competitiveness Value Map

inversely related—at least up to a point. That is, the costs of improving quality are often less than the resulting savings in reworking, scrap, warranty expenses, and product liability.41

Total costs for quality management and control typically include expenditures for prevention (quality planning, worker training, and supplier education), appraisal (product inspection and testing), internal failures (reworking and scrap), and external failures (warranty and product liability). These categories of costs suggest that improving quality can lead to increased productivity. This attitude is widely held among exceptional companies—such as General Electric, Hewlett Packard, and Toyota—and explains much of their dedication to improving product quality and ultimately attaining the goal of zero defects. This attitude is increasingly shared by managers and employees of more and more organizations.42

Meaning of Quality
In Chapter 2 of Management: A Competency-Based Approach we briefly defined quality as how well a product (good or service) does what it is supposed to do—how closely and reliably it satisfies the specifications to which it is built. However, there are two underlying views of quality: internal and external. The internal view is that quality is achieved by meeting the organization’s established specifications and standards. This view is rather limited because it ignores customers and actions by competitors. As suggested previously, the external view is that quality means achieving or exceeding the results that customers value and expect. Organizations such as Omnicon Group, Philip Morris, and UPS, among others, emphasize the external view and consider it to be the starting point in defining acceptable quality.

The quality of goods and services can’t be effectively represented as a single dimension. Nine of the most common dimensions of quality are performance, features, conformance, reliability, durability, serviceability, responsiveness, aesthetics, and reputation.43 Table 2 provides a brief definition of each dimension, along with an example of how each one is reflected in goods (e.g., for a Toyota Camry) and services (e.g., for a VISA credit card). These dimensions indicate that customers’ expectations and perceptions, as well as competitors’ products and services, must be monitored and assessed continuously to ensure effective quality management and control.

Table 2 doesn’t provide a comprehensive definition of quality. For example, we could develop indicators of service quality for a specific task or process, such as ordering and delivering goods. The following four dimensions illustrate this idea.

- **Accuracy**: whether the correct products were delivered in the ordered quantities.
- **Speed**: the elapsed time between placing the order and delivery of the product to the customer and how well that matches the customer’s expectations.
- **Information accessibility**: the degree to which information is available about a shipment when the customer requests it.
- **Ease of ordering**: the degree to which customer expectations are met or exceeded with respect to order preparation assistance, ability to receive orders electronically, or notifying customers immediately when items are out of stock.44

Traditional Versus Total Quality
In Chapter 2 of Management: A Competency-Based Approach, we discussed the quality viewpoint as a major development in the history of management thought. We defined total quality management (TQM) as the continuous process of ensuring that
every aspect of production builds in product quality. In addition, TQM is an organizational philosophy and strategy that make quality a responsibility of all employees. Organizations pursue TQM through various methods of preventive and corrective control, which are intended to ensure high levels of customer satisfaction. Total quality management involves building in quality from product planning to design to evaluation to preproduction to purchasing to production to sales and service. The TQM strategy gives quality, rather than short-term profits, top priority. The only constraints are economic feasibility and competitiveness.45

In comparison to total quality management, traditional quality control relies mainly on product inspection during or at the end of the transformation process. A particular department, such as a quality control department or a relatively small group of inspectors and lab technicians, often is given the responsibility for ensuring quality. The focus is on corrective controls, that is, fixing mistakes after the fact rather than making the product right the first time. Table 3 highlights the primary differences between TQM and traditional quality control. Let’s now consider some of the specific things that managers and employees do to implement total quality management.
Deming’s Prescriptions

In Chapter 2 of *Management: A Competency-Based Approach*, we noted that W. Edwards Deming (1900–1993) is often considered the godfather of the quality movement. We expand upon and reinforce his ideas and prescriptions that we highlighted there.

Until his death, Deming taught the Japanese about quality control. He designed a four-day seminar for Japanese executives in 1950 and subsequently became almost a guru to Japanese industry. To honor his contributions, the Japanese created the Deming Prize in 1951. Highly esteemed in Japan, this annual prize recognizes organizations that have met the qualifications for applying companywide quality control (CWQC). Ten major categories of criteria (e.g., policies and objectives, analysis, and quality assurance) are used to judge applicants for the prize, and each category is divided into subcategories. Only a small number of awards are made each year because the standards are high. The Deming Prize is awarded to several classes of applicants, including individuals, factories, and divisions or small companies.46

Until 1980, Deming’s work received relatively little notice from top management in North American industry. Then, NBC television broadcast a documentary contrasting Japanese and U.S. product quality. Prominently featured on the program as the world’s leading authority on quality control, Deming soon was in great demand and he signed a long-term consulting contract with Ford. Deming asserted, “We in America will have to be more protectionist or more competitive. The choice is very simple. If we are to become more competitive, then we have to begin with quality.”47

Deming considered poor quality to be 85 percent a management problem and 15 percent an employee problem. His perspective on total quality and prescriptions for achieving it are deceptively simple.48 They are interrelated elements in a total system, which he came to identify, just before his death, as the Deming system of profound knowledge. These interrelated ideas include the following.

- Quality is a management philosophy that has to be accepted as a way of life, as well as a way of doing business. Unless top management can adopt this philosophy and make it part of the organization’s culture, the effectiveness of specific quality assurance tools will be limited at best.
- The common goal is for everybody to gain in the long run—customers, shareholders, employees, suppliers, community, and the environment. Managing a

<table>
<thead>
<tr>
<th><strong>Total Quality Management</strong></th>
<th><strong>Traditional Quality Control</strong></th>
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<tbody>
<tr>
<td>Quality is a strategic issue.</td>
<td>Quality is a tactical issue.</td>
</tr>
<tr>
<td>Plan for quality.</td>
<td>Screen for quality.</td>
</tr>
<tr>
<td>Quality is everybody’s responsibility.</td>
<td>Quality is the responsibility of the quality control department.</td>
</tr>
<tr>
<td>Strive for zero defects.</td>
<td>Some mistakes are inevitable.</td>
</tr>
<tr>
<td>Quality means conformance to requirements that meet or exceed customers’ expectations.</td>
<td>Quality means inspection.</td>
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<tr>
<td>Scrap and reworking are only a small part of the costs of nonconformance.</td>
<td>Scrap and reworking are the major costs of poor quality.</td>
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system requires knowing the interrelationships among all its components and the people that work in the system.

- A system perspective emphasizes the need for cooperation and coordination among departments, teams, suppliers, and others. A lack of cooperation, such as intense competition for monetary rewards, can destroy the system.

- Everyone must operate on the view that poor quality is flatly unacceptable. Defective materials, workmanship, products, and service will not be tolerated. Improve constantly and forever the system of production and service, to improve quality and productivity and thus decrease costs.

- Train and educate employees to use statistical methods in their jobs and to develop other competencies.

- Encourage employees to report any conditions that hurt quality. Drive out fear so that everyone may work effectively. Remove barriers to pride of workmanship.

- Although knowledge of variation is essential, it begins with the recognition that there is always some variance in any process—between people, in output, in service, in the product. Discovering the reasons for variability and quantifying them is crucial.

- Strict deadlines, even when based on estimated averages, are not consistent with an understanding of variation. Neither are numerical goals or quotas. It is better to work on methods for improving the process, thus reducing the variation from identifiable causes and producing the desired results.

- Use statistical evidence of quality problems (unwanted variation) before (e.g., from suppliers) and on a real-time basis as they occur during the process, not at the end of the process. The earlier errors and defects are caught, the less costly is their correction.

- Don’t depend on inspection to achieve quality. Eliminate mass inspection by building quality into the product in the first place.

- Use suppliers that have historically provided quality, not on sampling inspections to determine the quality of each delivery. Select and stay with a few suppliers that furnish consistent quality. Establish long-term relationships with suppliers. Don’t award contracts to suppliers merely on the basis of price.49

**Baldrige Framework and Award**

The Malcolm Baldrige National Quality Award annually recognizes U.S. companies that excel in quality achievement and management. The award, a gold-plated medal encased in a crystal column, was created by Congress in 1987. The award receipts for 2000 included two manufacturing and two service firms:

- **Dana Corporation–Spicer Driveshaft Division**, North America’s largest, independent manufacturer and marketer of driveshafts and related components for light, medium, heavy duty, and off-highway vehicles;

- **KARLEE Company**, a contract manufacturer of precision sheet metal and machined components for the telecommunications, semiconductor, and medical equipment industries;

- **Operations Management International, Inc.**, which operates and maintains more than 160 public and private-sector wastewater and water treatment facilities in 29 states and facilities in Brazil, Canada, Egypt, Israel, Malaysia, New Zealand, Philippines, and Thailand;
• **Los Alamos National Bank**, an independent community bank that provides a full range of financial services to the consumer, commercial, and government markets in northern and central New Mexico.50

Companies participating in the award process submit applications and complete an examination. This examination is reviewed by a team of U.S. quality experts, who also visit the companies that pass the initial screening. The 2000 application guidelines and related information fill a sixty page booklet. A summary of the seven interrelated examination categories for 2000, along with their maximum point values (totaling 1,000 points), follows.

• **Leadership** (125 points): This category examines the company’s leadership system and senior leaders’ personal leadership. It examines how senior leaders and the leadership system address values, company directions, performance expectations, a focus on customers and other stakeholders, learning, and innovation. Also examined is how the company addresses its societal responsibilities and provides support to key communities.

• **Strategic Planning** (85 points): This category examines how the company sets strategic directions and develops the critical strategies and action plans to support those directions. Also examined are how plans are deployed and performance is tracked.

• **Customer and Market Focus** (85 points): This category examines how the company determines requirements, expectations, and preferences of customers and markets. Also examined is how the company builds relationships with customers and determines their satisfaction.

• **Information and Analysis** (85 points): This category examines the selection, management, and effectiveness of information and data used to support key company processes and action plans and the company’s performance management system.

• **Human Resource Focus** (85 points): This category examines how the company enables employees to develop and utilize their full potential, aligned with the company’s goals. Also examined are the company’s efforts to build and maintain a work environment and work climate conducive to performance excellence, full participation, and personal and organizational growth.

• **Process Management** (85 points): This category examines the key aspects of process management, including customer-focused design, product and service delivery, support, and supplier and partnering processes involving all work units. It evaluates how key processes are designed, implemented, managed, and improved to achieve better performance.

• **Business Results** (450 points): This category examines the company’s performance and improvement in key business areas—customer satisfaction, financial and marketplace performance, human resource results, supplier and partner performance, and operational performance. Also examined are performance levels relative to competitors.51

As suggested in Figure 4, the criteria for 2000 further strengthened the systems view of performance management. They placed a greater emphasis on the alignment of company strategy, customer and market knowledge, a high-performance workforce, key company processes, and business results. Increased focus was given to all aspects of organizational and employee learning.52 Most of Deming’s prescriptions are included in the Baldrige categories, and both emphasize a total systems approach.
Communication processes—both internally with employees and externally with customers—are embedded in various Baldrige criteria. The following Communication Competency account reveals how the management of Solectron Corporation—one of the 1997 Baldrige Award winners—makes effective use of informal and formal communication processes to achieve high levels of performance. Solectron has received more than 140 quality and service awards from its customers, in addition to the 1997 and 1991 Baldrige Awards. Solectron is the first company in the history of the program to win the Baldrige Award for manufacturing twice.

**The Quality Control Process**

The quality control process generally focuses on measuring inputs (including customer expectations and requirements), transformation operations, and outputs. The results of these measurements enable managers and employees to make decisions about product or service quality at each stage of the transformation process.

**Inputs.** Quality control generally begins with inputs, especially the raw materials and parts used in the transformation process. Recall that Toyota emphasizes quality control by its suppliers. For almost all parts, Toyota uses only one or two sup-
As we noted previously, Solectron Corporation is a worldwide provider of premanufacturing, manufacturing, and postmanufacturing services to leading electronics original equipment manufacturers (OEMs). Solectron employs more than 20,000 people at eighteen manufacturing facilities around the world.

Solectron tracks customer satisfaction weekly by means of surveys, with an 80 percent to 90 percent response rate. Scores for delivery, quality, and service are at or near the 90 percent satisfaction level. This level of satisfaction is particularly noteworthy because of the company’s stringent rating scale in which a C receives a score of 0 and a D receives a score of minus 100. Grades of B– or lower trigger Solectron’s customer complaint resolution process. Within twenty-four hours, the account’s program manager contacts the customer to acknowledge the complaint and visits the company to gain additional information. Within seventy-two hours, a corrective action plan is submitted to the customer.

Customer-satisfaction report cards are reviewed weekly by managers and employees at each site.

Solectron employees communicate with customers and suppliers at the earliest stages of a product’s design cycle. The company bases its selection and regular reviews of its suppliers on several factors—including financial strength, technology leadership, TQM system, and compatibility with Solectron’s beliefs. By building a strong partnership with its suppliers on a foundation of full and open communication, Solectron provides customers with excellent time-to-market and time-to-cost products and services.

Solectron aims to create a work environment in which employees can maximize their potential “by working both hard and smart, and doing what it takes to satisfy the customer.”

Solectron University, established in 1990, provides managers and employees with opportunities to develop their skills and competencies. This effort supports Solectron’s philosophy to “hire for traits—train for skills.” The company’s variable compensation plan extends to all members of the workforce. Employee pay is based on individual, team, site, and corporate performance in terms of revenue, profit, customer satisfaction, and operational performance.53

To learn more about Solectron, visit the company’s home page at

http://www.solectron.com

Transformation operations. Quality control inspections are made during and between successive transformation stages. Work-in-progress inspection can
result in the reworking or rejecting of an item before the next operation is performed on it.

The systematic and widespread use of statistical process control is one of Deming’s key prescriptions. **Statistical process control** is the use of quantitative methods and procedures to determine whether transformation operations are being done correctly, to detect any deviations, and, if there are any, to find and eliminate their causes. Statistical process control methods have been available for decades but only in the past twenty years have they been increasingly used. They serve primarily as preventive controls.\(^56\)

**Sigma** is a unit of statistical measurement, which in this context is used to illustrate the quality of a process. The sigma measurement scale (ranging from two to six) describes defects in parts per million. To simplify the concept, let’s consider the application of six sigma to written text. If defects were measured in misspellings, four sigma would be equivalent to one misspelling per thirty pages of text; five sigma, one misspelling in a set of encyclopedias; and six sigma, only one misspelling in an entire small library, such as a high school library.\(^57\)

Some organizations—such as Solectron, Toyota, and General Electric—have adopted the quality program and goal of *six sigma*, which means eliminating defects to the level of 1 per 3.4 per million opportunities—or a process that is 99.99966 percent defect free. Five sigma is 233 defects per million, and four sigma is 6,210 per million. Most firms operate at the four sigma level.\(^58\) A key theme in six sigma programs is the reduction of waste. Toyota trains all employees to seek opportunities to reduce waste in seven areas—called *Toyota’s Seven Wastes*. They include:

- waste of overproduction (also irregular production: the end-of-month or end-of-quarter surge),
- waste of time on hand (waiting),
- waste in transportation,
- waste of processing itself,
- waste of stock on hand (inventory),
- waste of movement, and
- waste of making defective products.\(^59\)

General Electric (GE) recently developed a quality program based on the six sigma goal. One element involves training “Black Belts” for four months in statistical and other quality enhancing measures. The Black Belts then spend full time at GE plants and set up quality improvement projects. Jack Welch, GE’s CEO, is giving this program his strong personal support.

The following example illustrates the difference this program has made. Customers of GE’s Milwaukee-based medical division were frustrated by the short life of the tubes in GE’s CT scanners. The tubes lasted for about 50,000 to 100,000 x-rays and took about four hours to replace. GE assigned a team of six-sigma Black Belts to the problem. Their job was to measure and analyze each phase of the tube manufacturing process to determine how waste could be reduced and product improvements made. They reduced by nine months the time needed to perfect new models of the x-ray tubes and increased the life of the tubes by five times. The new tubes provide sharper, more complete pictures—allowing physicians to examine images of the entire brain of a stroke victim, rather than just slices at a time. GE estimated companywide savings from the six sigma program at about $600 million.\(^60\)
Outputs. The most traditional and familiar form of quality control is the assessment made after completion of a component or an entire product, or provision of a service. With goods, quality control tests may be made just before the items are shipped to customers. The number of items returned by customers because of shoddy workmanship or other problems is one indicator of the effectiveness of the quality control process. Service providers, such as barbers and hairdressers, usually involve their customers in checking the quality of outputs by asking if everything is okay. However, the satisfactory provision of a service often is more difficult to assess than the satisfactory quality of goods.

Determining the amount or degree of the nine dimensions of quality shown in Table 2 is fundamental to quality control. The more accurate the measurement, the easier comparing actual to desired results becomes. Quality dimensions generally are measured by variable or by attribute. **Measuring by variable** assesses product characteristics for which there are quantifiable standards (length, diameter, height, weight, or temperature).

Consider the quality control process and technology used on the Mercedes-Benz M-class sport utility vehicle at the Mercedes factory in Vance, Alabama. Carmakers have traditionally tracked their body-building accuracy by taking sample vehicles off the assembly line and physically checking a large number of their dimensions with special equipment. Mercedes still does so, running about every 100th body through a measuring machine that checks 1,062 dimensions with sensitive touch probes in a process that takes about four hours.

To spot flaws that can develop between those elaborate inspections on every 100th body, Mercedes uses a new vision system. At the end of the body-building line, a **body-in-white vehicle**—factory language for an unpainted body minus doors, hood, and liftgate—arrives at the vision station. In a process that takes just forty-five seconds, thirty-eight laser cameras mounted on a superstructure check eighty-four key measurements. Slight dimensional flaws can be identified and corrected before any out-of-tolerance bodies get built. “Before laser gauging, carmakers couldn’t do 100 percent inspection. Now we do it,” stated Mike Hill, leader of the measurement team.

**Measuring by attribute** evaluates product characteristics as acceptable or unacceptable. Measuring by attribute usually is easier than measuring by variable. For example, testing PCs by turning them on as a final check results in a simple yes or no answer regarding acceptable quality. However, the setting and achievement of quality standards usually isn’t that simple. In the production of a new type of bus—called the flexible bus—several years ago, the trade-off between the strength needed in the bus frame and the light weight needed to improve fuel efficiency was misjudged. Several cities that purchased this “new generation” of bus experienced numerous problems, including cracked frames.

The assessment of product quality doesn’t reveal what the quality level should be. Desired levels of quality are strongly influenced by an organization’s strategy and culture (as at Maytag) and by its competition (as at Toyota, GM, and Chrysler). This aspect of quality assurance is a central theme in the Baldrige Award process.

**Quality Problems**

The provision of quality services and goods—constantly and from the beginning—is an ideal that isn’t always attained. Therefore the responses to quality problems are crucial. The following are three specific prescriptions for recovering from quality problems.

- **Encourage customers to complain and make it easy for them to do so.**
  Comment cards in service delivery facilities and toll-free telephone numbers are
two of the more common approaches used. Fred Brown is a key partner in Ford, Mazda, and BMW dealerships in Texas. The sales associates at these dealerships don’t just follow up with customers to determine whether there are any problems two weeks or so after the purchase of a car. They follow up by phone six months later and again a year after the purchase to determine whether the customer has had any problems with the car or the service being received. Fred Brown often follows up with a personal call when customers express concerns. His dealerships have won many awards for quality service from car manufacturers.

- **Make timely, personal communication with customers a key part of the strategy.** Organizations frequently make two fatal mistakes in problem resolution: They take too long to respond to customers, and they respond impersonally. Timely, personal communication with unhappy customers offers the best chance to regain the customer’s favor. North Carolina’s Wachovia Bank & Trust has a *sundown* rule: “Employees must establish contact with a complaining customer before sunset on the day a complaint is received.”

- **Encourage employees to respond effectively to customer problems and give them the means to do so.** Managers must market the idea of problem resolution to employees. Among other things, this approach involves setting and reinforcing problem-resolution standards and giving employees the freedom to solve customer problems. Employees are less likely to try to solve customer problems if doing so creates a small mountain of paperwork for them. When American Express cardholders telephone the 800 number on their monthly statements, they talk to a highly trained customer service representative. This person has the authority to solve 85 percent of the problems on the spot and the ability to do so by means of the company’s advanced information technology capabilities.63

As we indicated in Chapter 17, various types of teams are increasingly used to address a wide range of quality management and control issues in organizations. The following Teamwork Competency feature reveals how Lynn Mercer, a manager at one of Lucent Technologies’ plants that produce digital cellular base stations, uses teams. Her approach demonstrates: (1) the benefits of empowerment and an environment in which effective teamwork and quality are expected, recognized, praised, and rewarded; (2) appropriate staffing of teams, taking into account the value of diverse perspectives, technical skills needed, and developmental goals; and (3) the use of a system for monitoring team performance.

### Inventory Management and Control

**Inventory** is the amount and type of raw materials, parts, supplies, and unshipped finished goods an organization has on hand at any one time. **Inventory control** is concerned primarily with setting and maintaining minimum, optimum, and maximum levels of inventory. In part, such control is achieved by obtaining feedback about changes in inventory levels that signal the need for action to avoid going above or below the predetermined levels. The amount of inventory may have an enormous effect on a firm’s capital requirements and the productivity of its capital. If a small business firm can cut its average inventory value from $1 million to $800,000, with everything else being equal, it can operate with $200,000 less in capital or borrowed funds on which it would have to pay interest. This reduction in the amount of money tied up in inventory has the effect of increasing the productivity of the investment in inventory by 20 percent. Inventory management and con-
trol is of interest to goods producers and service producers alike. For example, supermarkets are constantly analyzing the quantity of each good they should stock, where it should be located, and how much shelf space should be allocated to it.

Inventory goals

Inventories are maintained to (1) achieve some independence in transformation operations, (2) allow flexibility in production schedules, (3) safeguard against problems caused by variations in delivery of input materials, (4) meet variations in product demand, and (5) take advantage of economic order quantities.

Input materials, components, and partially completed goods sometimes are stocked at each workstation to provide some independence of operation. Thus an equipment breakdown at one station won’t delay work at any of the stations farther on.

Inventories allow flexibility in the production schedule because a stockpile of finished goods lessens the pressure to produce a certain amount by a particular date and provides for shorter lead times. Lead time is the elapsed time between placing an order and receiving the finished goods. Larger finished goods inventories result in shorter customer lead times. For example, some auto dealers use the

### TEAMWORK COMPETENCY

**Lynn Mercer’s Teams**

Lynn Mercer, one of Lucent Technologies’ plant managers, provides broad goals, guidance, and measurements at her digital cellular base station manufacturing plant. The 480 employees at the plant are organized into self-directed work teams.

In two years these employees haven’t missed a single delivery deadline. Total labor costs represent an exceedingly low 3 percent of product costs. Operating statistics are displayed everywhere. Where performance trails a goal, the chart hangs behind a sheet of blood-red, see-through plastic. People with a few spare minutes consult an “urgent board” listing of orders that are behind schedule, and jump in where they’re needed most.

Phillip Dailey works on an assembly line. He strings cables inside a steel box the size of a refrigerator—a digital transmitting station for cellular phone systems. While studying a bottleneck along the line, Dailey realized that with 25 percent more staff his team could increase output by 33 percent. He recruited temporary workers from other teams, proved the concept, and thereby convinced the managers.

The work is technical but teachable. What isn’t as teachable is initiative, curiosity, and collegiality—necessities of the self-directed workforce. Mercer puts applicants through tests intended to weed out loners and difficult people. New employees are hired as contractors. They are appointed as regular employees only after proving that they’re self-starters and team players.

Teams elect their own leaders to oversee quality assurance, training, scheduling, and communication with other teams. Richard Deming, a quality leader, claims that he has more say-so in this plant than he had in his father’s electrical contracting business. “My friends and family don’t believe how much people listen to me here,” he says.

Assemblers know the destination of every product they touch. When a completed product rolls off the line, the assemblers sign an inside panel. Dozens of entry-level technicians know customers personally because Mercer sends them to trade shows and installation sites. Employees conduct plant tours when customers visit.

To learn more about Lucent Technologies, visit the company’s home page at

http://www.lucent.com
avaliaability of a large number of cars as part of their marketing strategy. They advertise that customers can get the car of their choice today.

Inventories provide a safeguard against problems caused by variations in the delivery of input materials. An operations manager can't always count on raw materials arriving on a specific date. Possible reasons for delays include labor strikes, transportation holdups, bad weather, and late shipments by suppliers. Without a backup inventory of input materials, even slight delays can shut down an entire operation.

Inventories help meet variations in market demand for the firm's outputs. A company can seldom produce or provide the number of items needed to match market demand exactly. Therefore, a common practice is to maintain a safety, or buffer, inventory to meet unanticipated market demand. For example, hospitals must maintain certain quantities of surgical supplies, blood, and medicines to be ready for possible disasters requiring treatment of many patients. Inventories also are needed to meet seasonal changes in demand for items such as swimsuits. Thus retailers constantly try to forecast shifts in customer demand in setting inventory levels.

Inventories enable management to take advantage of economic order quantities. Purchasing materials and carrying those materials in inventory costs money. These costs—along with any offsetting supplier discounts for quantity ordering—are factors in determining the most economical size of an order. Inventories are also used to achieve other goals, such as stabilizing employment, hedging against inflation, reducing the risk of possible future shortages, and eliminating the need for possible future overtime. However, agile manufacturing and service strategy is dramatically reducing the amount of inventory required to meet variations in demand by the use of highly responsive suppliers.

**Inventory costs**

*Inventory costs* are the expenses associated with maintaining inventory, including ordering costs, carrying costs, shortage costs, and setup costs. All must be considered in making decisions about inventory levels.

- **Ordering costs** are the expenses associated with placing the order and/or preparing the purchase order.

- **Carrying costs** are the expenses of holding goods in inventory. They include losses owing to obsolescence, insurance premiums, rent on storage facilities, depreciation, taxes, breakage, pilferage, and capital invested in inventory.

- **Shortage costs** are the losses that occur when there is no stock in inventory to fill a customer's order. The customer must either wait until the inventory is restored or not place the order. Determining the costs resulting from a customer's decision not to place an order or to place future orders elsewhere is difficult.

- **Setup costs** are the expenses of changing over to make a different product. They include the time required to get new input materials, make equipment changes, make changes in the sequence of transformation processes, and clear out inventories of other items. They also include the costs of additional administrative time, employee training, idle time, and overtime.

Evaluating specific inventory goals and costs is part of the control process for determining desirable inventory levels and the ideal size of orders to replenish inventories. How much should I order? is a practical question whose answer
depends on cost trade-offs that every inventory manager must evaluate. Figure 5 identifies the typical cost trade-offs involved in determining appropriate order quantities. It shows that, as the quantity ordered increases, the cost of orders declines. The total cost also declines (but not as fast because carrying costs are accumulating), reaches a low point, and then begins to rise. Why? As order quantity and average inventory level increase, the carrying cost of the inventory also increases because more money and space are tied up in inventory. The optimum order quantity yields the lowest total inventory costs. This quantity, labeled $Q_1$, is called the \textit{economic order quantity}. Calculations based on inventory records, ordering practices, and costs yield the actual values of economic order quantities.

\textbf{Inventory Systems}

Two systems that have significantly affected inventory management and control are the materials resource planning system and the just-in-time system. The materials resource planning system appears to have the greatest application with process-focus and intermediate positioning strategies (see Figure 2). In contrast, the just-in-time system provides tighter inventory control with a product-focus strategy.

\textbf{Materials Resource Planning II System.} A widely used computerized information system for managing dependent demand inventories and scheduling stock replenishment orders is the \textit{materials resource planning II system}. It is

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure5.png}
\caption{Cost Trade-Offs in Determining Inventory Levels}
\end{figure}
programmed to initiate production of various components by issuing release orders to offset inventory reductions. The dependent demands for components, subassemblies, and raw materials (inputs to the transformation process) are calculated from the demand schedules of those who will use the outputs (customers) or from forecasts. Replenishment orders are time-phased relative to the date the stock is needed. For example, if a firm needs to replenish the stock of an item in week six to avoid a stockout and the lead time is four weeks, the purchase order will be issued in week two. Ideally, items arrive just before they are needed, and finished goods are produced just before they are to be shipped. Based on the assumption of uneven demand, this system attempts to minimize inventory investment while achieving zero stockouts, maximize operating efficiency, and improve customer service.

The materials resource planning II system helps meet three basic information requirements of operations management: (1) What is needed? (2) How much is needed? (3) When is it needed? The following components provide this information.

- A **master production schedule** shows which goods are to be produced, when, and in what quantities.

- A **bill of materials** describes the inputs—raw materials, parts, or subassemblies—for each finished good or component to be produced.

- An **inventory-status file** shows inventory on hand and an order for each stock item by time period (day, week, or month), including information on lead time, order size, and supplier.

Materials resource planning II also calculates gross and net financial requirements for inputs and outputs by time period. To be successful this system requires precise information, as well as extensive coordination and cooperation among individuals and departments. The intent is to get all departments to work to the same schedules and priorities. For example, the failure of sales personnel to report sales precisely and on a timely basis could throw the entire system off. Problems involving the use of this system usually occur when individuals in different departments or organizations fail to communicate and cooperate.67

**Just-in-Time System.** The delivery of finished goods just-in-time to be sold, subassemblies just-in-time to be assembled into finished goods, parts just-in-time to go into subassemblies, and purchased materials just-in-time to be transformed into parts is called, as you may surmise, the **just-in-time system**, or JIT system. At each stage of the transformation process, a JIT system delivers the smallest possible quantities at the latest possible time in order to minimize inventory costs. Toyota and Mercedes-Benz, among others, use the system.

The JIT system affects much more than just the purchasing department. It requires fundamental changes in the relationship between a manufacturer and its suppliers. The traditional use of forcing and compromise as conflict-management styles has had to shift to the use of collaboration and compromise. The JIT system has major implications for quantities purchased and produced, quality expectations, and suppliers used. The implications for quantities purchased and produced include (1) a steady output rate by the manufacturer, (2) frequent deliveries (sometimes twice or more a day) in small quantities by suppliers to the manufacturer, (3) long-term contracts and blanket orders with suppliers, (4) variable quantities from delivery to delivery but a fixed quantity for the overall contract term, and (5) little or no overage or underage acceptable in deliveries.

The implications of the JIT system for quality expectations include (1) the manufacturer helping suppliers meet quality requirements, (2) the buyer's and suppli-
ers’ quality control people establishing and maintaining close working relationships, and (3) the manufacturer urging suppliers to use TQM in their production processes.

The implications of the JIT system for suppliers include (1) few suppliers, who often are located near the manufacturing plant, (2) repeat business with the same suppliers and competitive bidding mostly limited to new parts, (3) suppliers encouraged to extend the JIT system to their suppliers, and (4) supplier control of shipping by using company-owned trucks or contract trucks, contract warehousing, and trailers for freight consolidation storage where possible, instead of common carriers.

As these implications suggest, JIT is a very demanding system for employees and managers. It requires high levels of communication, coordination, and cooperation. With the JIT system, buffer inventories, idle time, and other forms of slack are drastically reduced. Everyone must be constantly on their toes for it to work. Even coffee breaks must be coordinated within and between work teams.68

An even more demanding version of JIT is the just-in-sequence system. The Mercedes-Benz operation in Vance, Alabama, that started up in late 1997 uses the just-in-sequence system for some of the components that go into the M-Class sport utility vehicle. For example, once a vehicle has gone through the paint shop, a computer system sends an order to a supplier, such as Johnson Controls, Inc., to deliver a dashboard within a few hours. Just-in-sequence is risky. If an electronic data interchange system (extranet) at Johnson Controls or another supplier crashes, Mercedes-Benz could be “vulnerable to a plantwide shutdown” according to Robert Sigler, an automotive analyst at Sanford C. Bernstein & Company. However, the payoffs could be enormous. With 70 percent of its components being developed by other suppliers, Mercedes-Benz will be able to slash millions of dollars in inventory management costs.69

Operations management (OM) is the systematic direction, control, and evaluation of the entire range of processes that transform inputs into goods or services. We identified nine of the principal categories of decisions in OM and discussed four of them: positioning strategies, technological options, quality management and control, and inventory management and control.

1. Discuss four basic issues in operations management.

Operations management emphasizes a systems view that includes four core components: environmental factors, inputs, transformations, and outputs. Goods and services producers differ in the degree to which (1) outputs are durable and tangible, (2) outputs can be placed in inventory, (3) there is direct customer contact, (4) response time is short or long, and (5) the operations are labor intensive or capital intensive. Improvements in an OM system often are key to productivity improvements which, in turn, affect the organization’s competitiveness.

2. Explain four positioning strategies.

There are three traditional positioning strategies: process-focus, product-focus, and intermediate. The agile manufacturing strategy represents a relatively new approach. It provides a system and a set of capabilities that allow mass customization of goods. Reengineering is one of the methods used to assist in the implementation of an agile strategy.

3. Provide examples of developments in office, service, and manufacturing technologies.

Technological options for improving quality and productivity in OM systems continue to increase rapidly. Innovative office technologies revolve around the personal computer and the revolution in software. Three increasingly used service technologies are bar
coding, integrated order systems, and voice recognition systems. In manufacturing, two important technologies are robots and computer-aided manufacturing. Recent developments in computer-aided design and computer-aided manufacturing have made agile manufacturing strategies feasible.

4. **State the essentials of quality management and control.**

Total quality management and control is a strategic approach for competing effectively and efficiently. Nine basic dimensions of quality are (1) performance, (2) features, (3) conformance, (4) reliability, (5) durability, (6) serviceability, (7) responsiveness, (8) aesthetics, and (9) reputation. Under total quality management, quality is built in from product planning through sales and services. In contrast, traditional quality control focuses on inspections that take place at the end of major phases of the production process. A comprehensive quality control process is concerned with measuring inputs (including customer expectations and requirements), transformation operations, and outputs to determine whether goods or services meet or exceed acceptable quality. Deming’s prescriptions and the Baldrige framework provide two complementary approaches to the philosophy and strategy, processes, and methods that comprise total quality management and control.

5. **Explain the basics of inventory management and control.**

Inventories may be maintained to (1) provide greater flexibility and reduce dependence between transformation operations, (2) increase flexibility in production schedules, (3) reduce the impact of unexpected delivery problems, (4) improve responsiveness to variations in customer demand, and (5) cut costs by taking advantage of economic order quantities. Decisions about how much inventory to keep on hand usually involve evaluation of four types of costs: ordering, carrying, shortage, and setup. The optimum inventory level (and economic order quantity) is determined by weighing certain cost trade-offs. The materials resource planning II system is a computerized system for managing inventories and scheduling orders. The just-in-time system aims to deliver the smallest possible quantities at the latest possible date at all stages of the transformation process in order to minimize inventory costs.

**QUESTIONS FOR DISCUSSION**

1. Give an example of each of the following for both a good (e.g., Toyota Camry) and a service (e.g., VISA card): (a) inputs, (b) transformation process, (c) outputs, and (d) feedback.

2. Choose a good (e.g., soft drink) or service (e.g., checking account) that you consume. Assume that you are a manager of the organization that provides this good or service. What measures might you use to track changes in its productivity?

3. Why is operations management important in the service sector?

4. Do positioning strategies apply to both large and small organizations? Why or why not?

5. Describe and evaluate in terms of five of the nine dimensions of quality shown in Table 2 an organization (nonprofit or for-profit) with which you have had one or more transactions during the past three months.

6. Why is reengineering often a component of implementing an agile manufacturing strategy?

7. What types of problems should management anticipate because of the increasing use of robots?

8. Assume that you tried to follow Deming’s prescriptions in your role as a student. How closely do your student-related activities and attitudes match his prescriptions?

9. Why is the just-in-time system not useful for all types of transformation operations?
1. **Global Awareness Competency.** Amid the public outcry over foreign sweatshops, consider this manufacturer who strives to be different. Engin Altas owns and manages a company called Gön (pronounced gune) that primarily crafts fine leather purses and belts in Istanbul, Turkey. Altas could have used cheap labor to expand his growing manufacturing business, but he chose a different route.

After three years of supplying only belts to New York-based Coach, he began investing in the labor and equipment needed to provide Coach purses—from cutting the imported leather to shipping to Coach—a premier marketer of high-quality leather goods and accessories. To learn Coach’s standards, two factory engineers were trained in Coach plants in the United States. They in turn trained employees at the Istanbul factory. Also, a Coach representative regularly visits the plant in Turkey. Under Coach’s supervision, Altas discontinued the use of the assembly-line approach and the work schedule that used to stretch into the evenings and over weekends. Altas instituted a team approach that involves employees working together in groups of seven or eight. This flexible approach allows quick and effective solutions to production problems “and makes a creative atmosphere,” says Altas.

Wages have risen 40 percent to nearly $3 an hour, which is far above the industry average in Turkey. Although employees are still responsible for quotas, they rarely work past their 8:00 A.M. to 6:00 p.m. shift.70

Review the dimensions of the global awareness competency in Table 1.6 (page 23) of your text. What aspects of this competency does Engin Altas demonstrate? What are two explanations for Gön being able to pay much higher wages than other such foreign manufacturers? To learn more about Gön’s primary customer—Coach Leatherware—visit the company’s home page at [http://www.coach.com](http://www.coach.com)

2. **Planning and Administration Competency.** If you wear jeans or khakis from The Gap or Calvin Klein, they probably came from the factory owned by Yul Ku. His company, Koos Manufacturing, makes more than 90,000 pairs of pants a week for the two companies, generating $100 million annually in sales. Ku, a Korean immigrant, employs nearly 1,000 people in his Los Angeles facility, which includes fabric storage, pattern marking and grading, sewing, laundry, finishing, and shipping. Many competitors locate cutting or laundry operations in different plants. However, Ku shaves as much as a week off the manufacturing process by having all his operations under one roof, providing evidence of his commitment to fast customer response.

He recently installed a new conveyor system that reduces labor by 25 percent. It takes eight days for Koos to create a pair of pants from start to finish. The company can deliver a significant rush order in less than four weeks. “No one is quicker than us,” Ku says.

Two issues could potentially cloud the future of Koos Manufacturing: its limited customer base and its location. Ku produces for only the two customers, The Gap and Calvin Klein. Also, he built his current facility when many competitors were shifting production to Mexico. Ku is considering opening a facility in Mexico near the California border to gain further cost advantages without losing the time advantages of his Los Angeles location. He stated, “Personally, I’d like to stay in the U.S. because of the appeal of made in the USA.” Many of Ku’s competitors operate factories in Asia.71

Review the dimensions of the planning and administration competency in Table 1.3 (page 18) of your text. What aspects of this competency are demonstrated by Yul Ku? What are two potential advantages of the current location of Koos Manufacturing? What are two potential disadvantages?

3. **Teamwork Competency.** Burley Design Cooperator may be one of the more unusual businesses in the United States. As the name suggests, its workers own the Eugene, Oregon, company. It produces $9 million worth of bicycle trailers, tandem bicycles, and rain gear a year, which it markets through independent bike shops. Bruce Creps is the general manager, but his business card bears only his name—no title. He stated, “We’re not real heavy on titles around here.” In this cooperative, every employee receives the same pay rate, $10.50 an hour. Creps gets paid the same as the employees at the sewing machines. When asked why he didn’t just go and get a higher paying job, he replied that there were “oodles of potential here and a lot of work for a lot of people.” Creps believes in the cooperative. About half the company’s profits go back
into the business, with the other half being divided equally among the 95 cooperative employees. At meetings, workers raise a hand when they have something to say, utilizing a parliamentary style of group decision making.

Creps points out that the pay is enough to provide a decent living in Eugene, Oregon, but that the cooperative represents much more. Burley Design Cooperative employees earn a “second paycheck.” According to Creps, “It’s the involvement in work, the freedom from arbitrary dismissal.”

Review the dimensions of teamwork competency in Table 1.4 (page 20) of your text. What aspects of this competency are demonstrated by Bruce Creps? Consider the loose management hierarchy and team decision-making process at Burley Design Cooperative. What are two potential limitations of this organizational approach in terms of growth? What are two potential opportunities? To learn more about the Burley Design Cooperative, visit the company’s home page at http://www.burley.com

4. **Strategic Action Competency.** Georgia-Pacific Corporation is the second largest producer of gypsum products in North America. This highly integrated business maintains a strong market position, pursuing a low-cost leadership strategy. It operates twenty wallboard manufacturing centers and four recycled gypsum paper plants that employ about 3,000 workers in the United States and Canada.

In 1997, the company announced plans to build a $65 million gypsum wallboard facility in Wheatfield, Indiana, deciding not to reopen its Florence, Colorado, plant. It will dismantle and sell the equipment from that location. David R. Fleiner, vice president of the Gypsum Division, explains that Georgia Pacific decided to build a new efficient facility, rather than modernize existing facilities. This approach is in keeping with the firm’s low-cost strategy. He explained that “the strategic location of the new facility in northern Indiana, compared to older, higher-cost plants in the region, will better position us to serve the Midwest metropolitan markets more effectively.”

Review the dimensions of the self-management competency in Table 1.7 (page 25) of your text. What aspects of this competency—and/or lack of—are demonstrated by Matt Scott? Imagine that you are in Scott’s place. What are two things that you could do in order to become a more effective manager? How might you better balance the roles of team leader and team member? To learn more about Fore Systems, Inc., visit the company’s home page at http://www.fore.com

5. **Self-Management Competency.** The transition from working on a team to leading one is filled with challenges. Matt Scott is a software engineer and manager at Fore Systems, Inc., headquartered in Warrendale, Pennsylvania. He was placed in charge of a six-member team of engineers about a year after joining the company. He possessed little management experience, learning about team concepts and practices over a few long lunches with his manager.

For Scott, leading a team proved to be difficult and provided mixed results. He fostered an informal atmosphere and excelled in the roles of cheerleader, coach, referee, and player. Says team member David Spencer about Scott: “There aren’t many jobs where I could go in and shoot the boss with a Nerf gun.” However, Scott struggled with his new role as manager, growing frustrated with mounting paperwork and meetings. On top of that, he viewed himself as a peer of his team members and disliked conducting performance reviews. Scott noticed himself spending more time performing management duties instead of doing what he loves best—designing and writing computer code. He stated, “I’m sick and tired of planning. That’s not what I came here for.”

Review the dimensions of the self-management competency in Table 1.7 (page 25) of your text. What aspects of this competency—and/or lack of—are demonstrated by Matt Scott? Imagine that you are in Scott’s place. What are two things that you could do in order to become a more effective manager? How might you better balance the roles of team leader and team member? To learn more about Fore Systems, Inc., visit the company’s home page at http://www.fore.com

6. **Communication Competency.** At the Consumers Distribution SuperStore, a Canadian-based catalog showroom retailer, a strategic goal is no out-of-stock inventory. The company emphasizes customer service and heavily utilizes information technology to achieve that goal. For example, a customer places an order for a stereo system at the Consumers Distributing store near her home. The sales associate informs her that this particular store doesn’t currently have the item in stock but uses the computer to communicate with all the company’s nearby stores and distribution centers to review their inventories. Consumers Distributing then offers the customer several options, including home delivery of the item at no extra charge within seventy-two hours.

Once plagued with customer service problems, Consumers Distributing used cutting-edge tech-
nologies to build a customer-driven management process. Previously, the company’s customers would have to stand in line for twenty minutes, only to be told that the product they wanted was out of stock. Perry Caicco, president and CEO, stated, “The company would antagonize 30 percent of its customers every single day and nobody outside of the counter staff and store managers seemed to care.” The combination of an interstore inventory computer information system and a climate for open communication helped turn Consumers Distributing into an efficient and successful chain now known for always having goods in-stock.75

Review the dimensions of the communication competency in Table 1.2 (page 16) of your text. What aspects of this competency are demonstrated as companywide imperatives at Consumers Distributing? How does the integrated inventory system affect communication and create a competitive advantage for the company?

**REAL-TIME CASE ANALYSIS**

**BOEING OVERHAULS ITS DESIGN AND MANUFACTURING PROCESS**

Boeing Company is beginning to employ auto industry manufacturing techniques to drastically change the way it designs and builds aircraft and, in the process, reducing new-plane development time to twelve months. A team of 100 of the company’s top personnel has been charged with devising new development techniques in a plan known within Boeing as the “cheaper-better-faster” project. Ron Woodard, president of the Boeing Commercial Airplane Group, explains that the objective is “to go from sixty-some months to twelve” months in launching new aircraft models. In addition, the company seeks cost efficiencies in the design and manufacturing processes.

Past Boeing manufacturing facilities involved assembly lines and “product-specific” manufacturing tools and equipment. However, the company intends to sustain its competitive advantage into the foreseeable future by adopting an approach that will allow rapid shifts in production in response to customer demand for different airplane models.

Boeing’s production process has been less than optimal. Minor changes—such as moving the location of the emergency flashlight holder—required thousands of hours of engineering attention, hundreds of pages of detailed sketches, and could potentially cost millions of dollars to implement. Despite this cumbersome process, Boeing prospered when airlines and the Department of Defense spent heavily on planes and there were no major competitors in its market. With airline deregulation, defense cutbacks, and stiff competition from Airbus Industrie, commercial airline firms have become more price-sensitive.

Boeing continues to have two-thirds of the $65 billion global market for commercial planes with 100 or more seats. In addition, the company has experienced a string of huge orders from major airlines in Asia, Europe, and North America. For example, in late 1997, China signed a $3 billion contract to buy fifty jets for its state-owned carriers.

In 1998, Boeing more than doubled its 1996 output of 18.5 planes per month to a record 43 planes per month. To meet rising demand, Boeing managers hired more than 38,000 workers over a twenty-month period. However, because of quality problems, the company had to take a series of expensive and embarrassing actions, including stopping production on two major assembly lines for a full month.

Boeing’s production reform team has developed the reengineering plan around the strategy that airlines should order airplanes the way consumers order automobiles. Previously, Boeing responded to each customer’s unique demands, even offering 109 shades of white paint. Under the new plan, customers will be able to pick from a limited selection of option packages, with any special requests costing extra.

The team is replacing more than 400 computer programs currently in use. Information systems are being integrated through the use of four off-the-shelf software packages—one each for manufacturing, purchasing, inventory, and configuration management. In addition, employees meet in five-day accelerated improvement workshops where they brainstorm more efficient ways to perform their jobs. By moving machines, designing new tools, and cutting unnecessary inventory, employees at the factory that builds wings for the 747s have been able to shave production time from 56 to 28 days.76 To learn more about Boeing, visit the company’s home page at

**http://www.boeing.com**
1. What positioning strategy is Boeing moving toward? Explain.

2. What are two potential threats that Boeing could encounter by enacting this reengineering plan at a time when demand for its jets is so high?

3. What impact are Boeing’s new design and manufacturing processes likely to have on quality? Explain.

4. Boeing has only one real competitor: European Airbus Industrie. What are two advantages and two disadvantages of this type of competitive environment for Boeing?

5. Investigate the Boeing home page. What other products do they offer in the aerospace industry?

ENDNOTES


2See note 1.


12Adapted from L. M. Sixel. More, better, faster. Houston Chronicle, June 22, 1997, pp. 1E, 2E.


33G. Bylinsky. Industry’s amazing instant prototypes. Fortune, January 12, 1998, pp. 120(b)–120(c).


