4

The Role of Technology in Operations

Chapter Objectives

- Introduce the different ways in which technology can add value to the operations function within an organization.
- Identify the various ways in which technology can be used in a manufacturing company.
- Describe enterprise resource planning (ERP) systems and how they impact an organization.
- Demonstrate the different ways in which technology can be integrated into service operations.
- Present a framework for defining the different types of e-services that are currently being offered.

TECHNOLOGY IS ONLY A TOOL!

After completing some business in the LA area, I returned my rental car to the Avis parking lot at Los Angeles International Airport (LAX). As I started to get out of the car and unload my bags, an Avis attendant greeted me with a handheld computer and asked me for a copy of my rental agreement.

I said to him, "Don't bother. I need to go to the check-in desk anyway, as I forgot to give Avis my frequent flyer number when I rented the car last week."

"No problem," he replied, "I can handle that here too, so you don't have to go to the desk."

Impressed by his ability to handle this non-routine activity with his handheld computer, I commented, "Today's technology is truly amazing!" To which he curtly answered, "It's only a tool!"

Caught off guard by his statement, I asked him to explain what he meant. He continued, "It's only a tool. Just like a wrench is only as good as the mechanic who has been trained to use it, so technology is only as good as the people who have been properly trained to use it in their everyday work."

To which I could only respond, "You're 100 percent right!"

Source: Mark M. Davis.

The hand-held computer is just one of many technology tools that Avis uses to improve its operations in terms of both increased efficiency and better customer service. For example, customers now have a choice of making a reservation either online at the Avis website or by speaking with a customer representative at a call center. Technology in the form of software allows Avis to (*a*) use yield management techniques (which are discussed in a later chapter) to maximize revenues, (*b*) schedule workers, and (*c*) forecast demand for both cars and customer calls.

Managerial Issues

Advances in technology are affecting every aspect of business, and operations management is no exception. From robotics and automation on the factory floor to information technology in the form of enterprise resource planning (ERP) systems and the Internet, technology, and especially information technology, is dramatically changing the way in which both manufacturing and service operations are being designed and managed.

However, as the Avis attendant correctly pointed out in the opening vignette, technology is only a tool, not an end in itself. In other words, technology should not be installed if it doesn't properly satisfy the needs of the firm with respect to being aligned with its overall goals. Having said that, managers also need to realize that there are times when only technology will provide the necessary means to meet their customers' needs in today's highly competitive environment. Equally important, managers also must recognize the need for these new technology-driven infrastructures to be compatible with all of the organization's functional elements so that information can be quickly and efficiently transmitted and shared with a minimum of errors.

To properly integrate technology into their organizations, operations managers first need to understand what technology can and cannot do. In addition, managers must recognize the need for workers at all levels to be properly trained in the use of the technology, and that this training is not just a one-shot deal, but rather a continuous, ongoing process.

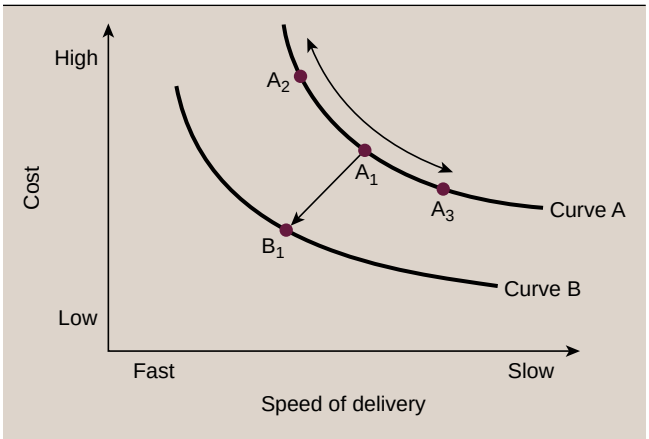
How Technology Affects Operations

Operations strategy defines the way in which a firm competes in the marketplace. Examples of these strategies include (*a*) low cost, (*b*) quality, (*c*) speed of delivery, and (*d*) customization. As we learned in Chapter 2, managers in the past had to decide which of these strategies was most applicable to the particular market segment they were serving. In so doing, they recognized that there were trade-offs involved. For example, you couldn't have both low cost and a high degree of customization, or that there was a choice to be made between providing fast product delivery and providing a highly customized product.

These traditional trade-offs are no longer valid for most businesses because technology has "raised the performance bar" by allowing firms to compete on several of these dimensions simultaneously. For example, firms using technology, such as Dell Computer, can now produce and quickly deliver individually customized products, and at a very competitive price. Technology now provides firms with the opportunity to move to a "superior" performance curve, as previously presented in Chapter 2, and shown again in Exhibit 4.1.

Exhibit 4.1

How Technology Impacts Operational Performance



In moving from A_1 to B_1, a firm, for example, can achieve superior performance in terms of both lower cost and also faster service. In comparison, a firm that doesn't use technology must remain on Curve A and consequently must revert to the traditional trade-off where improvement in one dimension is accomplished only at the sacrifice of another dimension (for example, in going from A_2 to A_3 along Curve A, where lower cost is achieved only by providing slower service).

Technology in Manufacturing

Automation

The term *automation* is familiar to all, but a commonly agreed-upon definition still eludes us. Some authorities view automation as a totally new set of concepts that relate to the automatic operation of a production process; others view it simply as an evolutionary development in technology in which machinery performs some or all of the process-control function. Automation is a set of concepts, but it is also evolutionary in the sense that it is a logical and predictable step in the development of equipment and processes.

Some major developments in manufacturing automation include machining centers, numerically controlled machines, industrial robots, computer-aided design and manufacturing systems, flexible manufacturing systems, computer-integrated manufacturing, and islands of automation.

machining centers

Operations where machine tools are changed automatically as part of the process.

Machining centers not only provide automatic control of a machine but carry out automatic tooling changes as well. For example, a single machine may be equipped with a shuttle system of two worktables that can be rolled into and out of the machine. While work is being done at one table, the next part is mounted on the second table. When machining on the first table is complete, it is moved out of the way and the second part is moved into position.

numerically controlled (NC) machines

Manufacturing equipment that is directly controlled by a computer.

Numerically controlled (NC) machines are under the control of a digital computer. Feedback control loops determine the position of the machine tooling during the work, constantly compare the actual location with the programmed location, and correct as needed. This eliminates time lost during setups, and applies to both high-volume, standardized types of products as well as low-volume, customized products.

industrial robots

Programmable machines that can perform multiple functions.

Industrial robots are substitutes for human manipulation and other highly repetitive functions. A robot is a reprogrammable machine with multiple functions that can move devices through specialized motions to perform any number of tasks. It is essentially a mechanized arm that can be fitted with a variety of handlike fingers or grippers, vacuum cups, or a tool such as a wrench. Robots are capable of performing many factory operations ranging from machining processes to simple assembly.

computer-aided (or -assisted) design (CAD)

Designing a product using a specially equipped computer.

One of the major contemporary approaches to the product design process is **computer-aided (or -assisted) design (CAD).** *CAD* may be defined as carrying out all structural or mechanical design processes of a product or component at a specially equipped computer terminal. Engineers design through a combination of console controls and a light pen that draws on the computer screen or electronic pad. Different perspectives of the product can be visualized by rotating the product on the screen, and individual components can be enlarged to examine particular characteristics. Depending on the sophistication in software, on-screen testing may replace the early phases of prototype testing and modification.

CAD has been used to design everything from computer chips to potato chips. Frito-Lay, for example, used CAD to design its O'Grady's double-density, ruffled potato chip. CAD is also now being used to custom design swimsuits. Measurements of the wearer are

fed into the CAD program, along with the style of suit desired. Working with the customer, the designer modifies the suit design as it appears on a humanform drawing on the computer screen. Once the design is decided upon, the computer prints out a pattern, and the suit is cut and sewn on the spot.

computer-aided design and manufacturing system (CAD/CAM)

Integration of design and production of a product through use of a computer.

Computer-aided design and manufacturing (CAD/CAM) uses a computer to integrate component design and processing instructions. In current CAD/CAM systems, when the design is finalized, the link to CAM is made by producing the manufacturing instructions. Because of the efficiency of CAD/CAM systems, design and manufacture of small lots can be both fast and low in cost.

Even though CAD/CAM systems are usually limited to larger companies because of the high initial cost, they do increase productivity and quality dramatically. More alternative designs can be produced, and the specifications can be more exact. Updates can be more readily made, and cost estimates more easily drawn. In addition, computer-aided process planning (CAPP) can shorten and, in some cases, even eliminate traditional process planning.

flexible manufacturing system (FMS)

Manufacturing facility that is automated to some extent and produces a wide variety of products.

A **flexible manufacturing system (FMS)** actually refers to a number of systems that differ in the degree of mechanization, automated transfer, and computer control and are sufficiently flexible to produce a wide variety of products.

A flexible manufacturing module is a numerically controlled (NC) machine supported with a parts inventory, a tool changer, and a pallet changer. A flexible manufacturing cell consists of several flexible manufacturing modules organized according to the particular product's requirements. A flexible manufacturing group is a combination of flexible manufacturing modules and cells located in the same manufacturing area and joined by a materials handling system, such as an automated guided vehicle (AGV).

A flexible production system consists of flexible manufacturing groups that connect different manufacturing areas, such as fabrication, machining, and assembly. A flexible manufacturing line is a series of dedicated machines connected by AGVs, robots, conveyors, or some other type of automated transfer device.

computer-integrated manufacturing (CIM)

Integration of all aspects of manufacturing through computer.

Computer-integrated manufacturing (CIM) integrates all aspects of production into one automated system. Design, testing, fabrication, assembly, inspection, and materials handling may all have automated functions within the area. However, in most companies, communication between departments still flows by means of paperwork. In CIM, these islands of automation are integrated, thus eliminating the need for the paperwork. A computer links all sectors together, resulting in more efficiency, less paperwork, and less personnel expense.

islands of automation

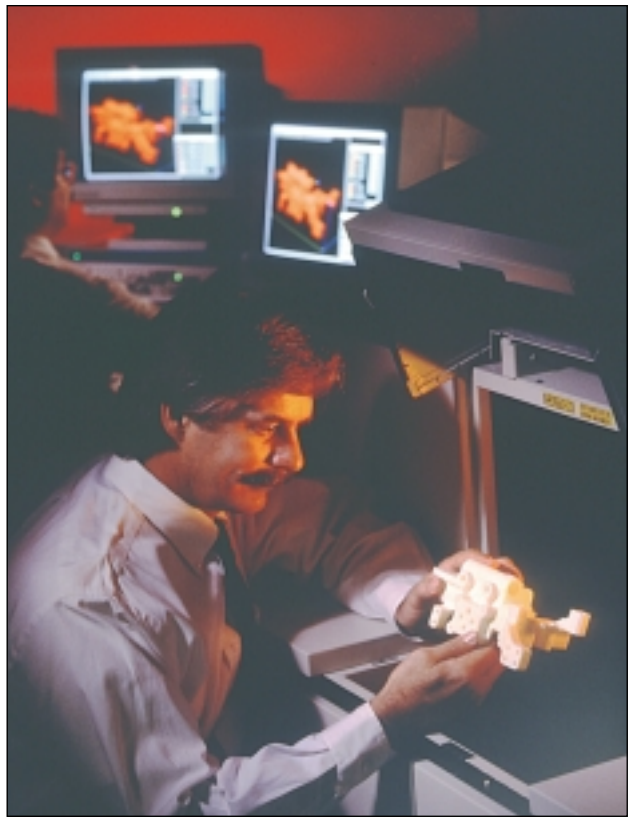
Automated factories or portions that include NC equipment, automated storage/retrieval systems, robots, and machining centers.

Islands of automation refer to the transition from conventional manufacturing to the automated factory. Typical islands of automation include numerically controlled machine tools, robots, automated storage/retrieval systems, and machining centers.

Information Technology

As illustrated in Exhibit 4.2, the use of information technology in manufacturing operations can be divided into four major groups of software systems: (*a*) enterprise resource planning (ERP), (*b*) supply chain management (SCM), (*c*) new product development (NPD), and (*d*) customer relationship management (CRM). These software packages, as the exhibit suggests, have significant overlap in terms of their capabilities and what they provide.

Enterprise Resource Planning (ERP) An ERP system provides a firm with a common software infrastructure and database. These systems are discussed in detail in the next section of this chapter.



The speed with which a company can design and develop new products is critical to its ability to introduce them quickly into the marketplace. Rapid prototyping machines are a new generation of CAD equipment that can produce three-dimensional prototypes quickly in the initial stages of the product design cycle. These rough draft models result in both higher-quality products and lower development costs.

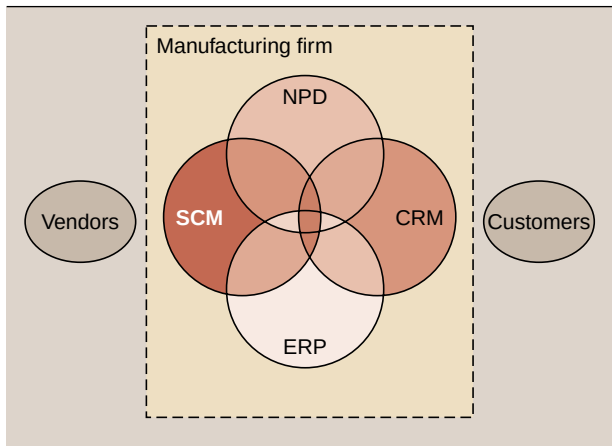


Exhibit 4.2

Major Categories of Software Systems in Manufacturing

Supply Chain Management (SCM) These software systems primarily focus on how firms interact with the suppliers that are part of their overall supply chain. Depending on where the firm is in its supply chain, this also can involve customers. The topic of supply chain management is presented in detail in Chapter 13.

New Product Development (NPD) New product development software focuses on linking the engineering function with the operations function within a firm to facilitate the

transfer of new product drawings and models into manufactured products. These software systems include CAD/CAM, which was discussed earlier in this chapter. Some software packages, such as that offered by Parametric Technology, also provide similar links with vendors who are directly involved in a firm's new product development process. The topic of new product development is addressed in detail in Chapter 3.

Customer Relationship Management (CRM) Customer relationship management software, such as that provided by Siebel Systems, focuses on the interface between the firm and its customer. In addition to having order entry capability, these systems collect customer-specific data, which allow the firm to provide customer-specific solutions. These software systems are typically addressed in marketing.

Enterprise Resource Planning (ERP) Systems

enterprise resource planning (ERP) systems

A fully integrated software system that links all of the major functional areas within an organization.

In the last decade, there has emerged a new generation of software systems that link all of the various functional areas within an organization. The goal of these systems, which are known as **enterprise resource planning (ERP) systems,** is to provide a company with a single, uniform software platform and database that will facilitate transactions among the different functional areas within a firm, and, in some cases, between firms and their customers and vendors.

Defining ERP Systems

Prior to the introduction of ERP systems, each functional area within an organization typically had its own software and database. These software packages often were incompatible with each other, which prevented transactions from taking place directly between systems. In addition, with more than one database, there often were multiple records for the same piece of data, which, in turn, caused delays and unnecessary errors throughout the firm. For example, an employee might be listed as John Smith in the Human Resources database, John S. Smith in the Accounting Department, and Dr. John Smith in the Engineering Department. From the computer systems' perspective, these would be viewed as three different people. In such an environment, transactions between functions often were done manually, which was tedious, slow, and a source of additional errors. As a result, each of the functional areas within an organization was viewed as an independent operation, as illustrated in Exhibit 4.3a.

To address this issue of incompatibility and multiple databases, ERP systems were developed to provide an infrastructure with a common information technology platform that would not only electronically link all of the functional areas with a single database, but also address their individual needs, as shown in Exhibit 4.3b.

Exhibit 4.4 illustrates how SAP, the leading ERP software firm, specifically provides this integration.

Evolution of ERP Systems

ERP Systems didn't just happen overnight. Rather, they are an outgrowth, or the next generation, of materials requirements planning (MRP) systems and manufacturing resources planning (MRP II), which were developed and introduced within the manufacturing function in the late 1960s and 1970s, and which are discussed in detail in Chapter 18.

Exhibit 4.3a

Functional Areas as Independent Operations

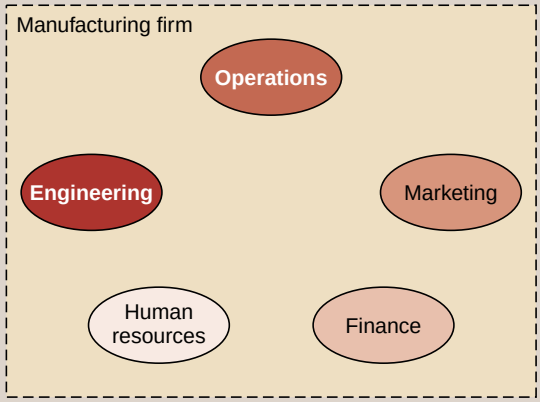
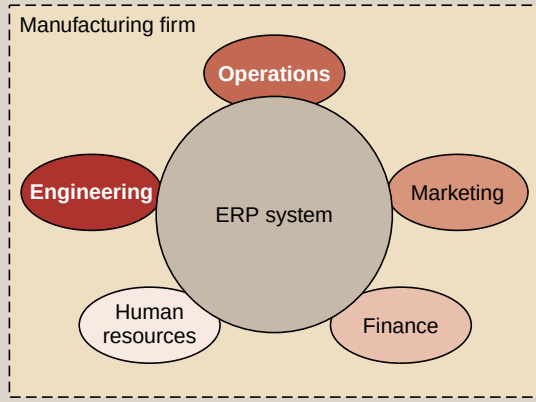


Exhibit 4.3b

ERP Systems Link Functional Areas with a Common Software Platform and Database



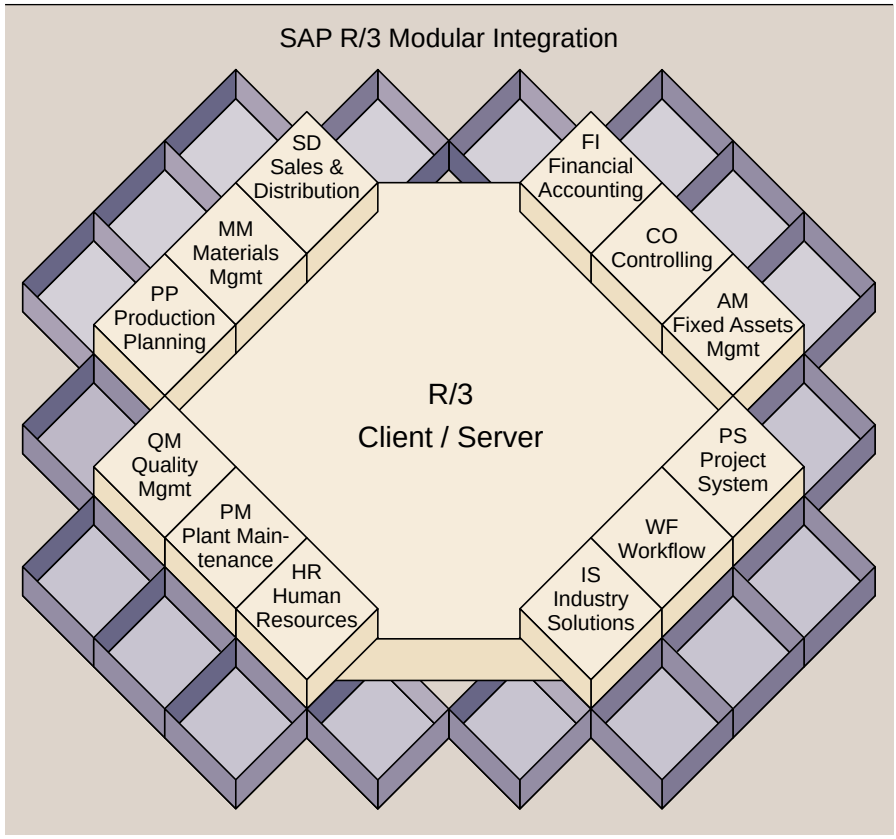
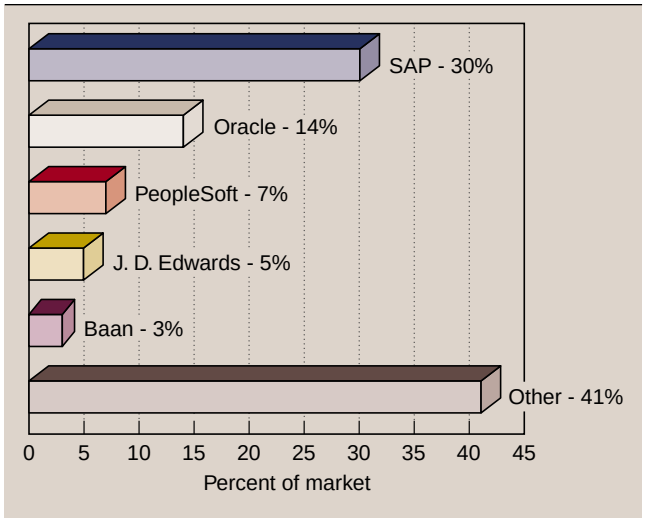


Exhibit 4.4

Example of How SAP's R/3 System Integrates an Organization

Exhibit 4.5

Leading ERP Software Companies and Respective Market Shares



(Total 1999 ERP Software and Services Revenue = $18.2 billion)
Source: AMR Research

MRP systems provided the manufacturing function with a common database and software platform to link all of its areas, which included purchasing, planning, materials, and operations. Prior to the introduction of MRP systems, each of these individual areas was managed more or less as an independent operation, which often resulted in excessive inventories of materials and slow, inefficient, and often erroneous transactions. MRP II systems were a first attempt to integrate operations, marketing, finance, and engineering.

Just as MRP systems provided a common software platform and database for the manufacturing function, ERP systems, as mentioned previously, now link all of the functional areas within an organization by providing a common software platform and shared database.

The adoption of ERP systems by major corporations was accelerated in 1998 and 1999 by possible "Y2K problems" that existed in older legacy computer systems that dated back to the 1970s. For many firms, the cost of installing a new, state-of-the-art ERP system was comparable to fixing the old legacy systems. By choosing to install an ERP system, these firms were able to update their entire information technology infrastructure, instead of merely patching up their existing and much older systems.

The leading ERP software vendors are shown in Exhibit 4.5.

Benefits of ERP Systems

When properly installed and operating, an ERP system can provide a firm with a significant competitive advantage, which can fully justify the investment of time and money. The benefits of using an ERP system can take many forms, including (*a*) reduction in the number of errors through the use of a common database, (*b*) faster customer response times, (*c*) faster order fulfillment times, and (*d*) better overall communication within the organization.

For example, Hewlett-Packard's computer system's manufacturing and distribution facility for Europe, which is located in Geulstein, Germany, achieved significant improvements in operational performance after implementing SAP's ERP system, including on time delivery exceeding 95 percent, cycle time reduced by 80 percent, inventories reduced by 30 percent, operating costs reduced by 30 percent, and distribution costs reduced by 70 percent.

Why ERP Systems Fail

The business landscape is littered with failed attempts at installing ERP systems. Hershey Foods, for example, incurred significant product distribution problems after it implemented SAP's R/3 system, resulting in its candy not being on retail shelves during its peak season between Halloween and Christmas. Whirlpool, a major appliance manufacturer, also attributed shipping delays to its difficulties in implementing SAP's R/3 system. (These difficulties in implementing ERP systems are not unique to SAP but exist with all ERP systems.) Some of the more common reasons for these difficulties and failures are presented here. It is interesting to note that many of these causes are the same as those that were identified as the reasons for MRP implementation failures 25 years ago.

Lack of Top Management Commitment By its very definition, the installation of an ERP system is an organizationwide undertaking, involving all of the functions within a firm. Therefore, the implementation of an ERP system requires a major commitment from top management in order for it to be successful. This means not only the commitment of resources, but also the commitment of top management's time to ensure the proper coordination among the various functions.

Lack of Adequate Resources Many firms underestimate the resources that are required to properly install an ERP system. In addition to the actual cost of the software, which often represents only about a third of the total implementation costs, there are also the costs of outside consultants and the costs of labor for company personnel that are assigned to the project.

Lack of Proper Training In a desire to convert to the new system quickly, there is often a shortfall in the training of personnel at all levels. Proper training is required from the technical perspective as well as from the users' perspective. The IT department within an organization needs to fully understand all of the technical characteristics of the system in order to provide the proper support to the business functions that use it. At the same time, the business functions need to understand the different procedures for entering data and generating reports. Because an ERP system is fully integrated across all functions, system users also need to know how their particular segment of the system affects other segments, so when mistakes do occur, the impact of those mistakes throughout the organization is known.

Lack of Communication Because the installation of an ERP system is an organizationwide undertaking, there is need for continuous communication within and across all functional areas with respect to the status of the implementation. All too often, as the implementation proceeds, some parts of the organization are unaware of what is occurring, and consequently fail to take the appropriate actions that are necessary. Effectively communicating the progress of the ERP implementation should be one of the primary responsibilities of top management.

Criticisms of ERP Systems

As HP's facility in Germany clearly demonstrates, there are significant advantages to installing an ERP system. However, these systems have been criticized in many respects for their failure to provide the desired infrastructure support that management expected. Two of these concerns are presented below.

A Single ERP System versus Best of Breed Each of the different ERP software packages has its particular strengths and weaknesses. One may be very strong in the financial module, while another is strong in the human resources area. Still a third may be strong in the production or marketing area. By adopting a single system, a company must accept all of the strengths and weaknesses of the system it selected. In contrast, a firm using a *best of breed* approach selects that software that has the best attributes for each functional area and then builds an interface that links all of the various software packages together. (Obviously, this approach also has its drawbacks.)

Inflexibility Each software package is designed around a specific business model with its own inherent business processes. These are usually based upon best business practices, which are determined by the software vendor. Consequently, in adopting a particular ERP system, a company also must adopt the built-in business model and its associated business processes. While this represents an improvement for many firms, especially those that never had well-designed processes, those firms that already have good businesses in place still need to reconfigure them to be compatible with those in the ERP system.

Similarly, certain ERP systems are designed to work best in process-oriented industries such as petroleum or chemicals, and consequently are not as readily applicable to discrete parts manufacturing such as automobiles or appliances.

Technology in Services

Technology Trends in Services

Advances in technology, including improved automated equipment, voice recognition systems, high-speed data transmission lines (like broadband), and faster and more powerful computers, also have had a significant impact on services. Contributing to the growing trends in services is the fact that large amounts of data are readily accessible today and can be transmitted inexpensively over long distances. We identify several major trends in the delivery of services that are a direct result of technology. It is important to note that these trends are not mutually independent; rather, the exact opposite is true: they are highly dependent on one another.

Increase in Self-Service Many service industries have seen an increase in self-service operations. Examples include self-service gas stations, ATMs at banks, and automated toll collections on highways. Self-service also is used extensively in e-businesses, ranging from the purchasing of sweaters from L.L. Bean and airline tickets from American Airlines to the purchase of stocks and bonds through Fidelity and conducting online checkbook transactions with your bank.

As another example of how technology increases opportunities for self-service, many supermarket and drug store chains have installed self-service checkout lanes. (See Operations Management in Practice box.) With this new equipment, customers scan their own purchases, bag them, and then pay by either cash or credit card. In this case, labor isn't completely eliminated, as an individual must be assigned to every three or four automated lanes to assist shoppers as the situation requires.[1]

The primary reason for the increase in self-service is that it reduces labor costs. With automated self-service equipment, gas station attendants are no longer needed to pump gas,

[1]Dinah W. Brin, "Check it Out!" *The Middlesex News* (Framingham, MA), August 11, 1996.

SELF-SERVE CHECKOUT COUNTERS INCREASE PRODUCTIVITY AND REDUCE WAITING TIMES

Kroger, one of the nation's largest supermarket chains, is introducing self-service checkout counters. The U-Scan self-service checkout system, which is manufactured by Optimal Robotics, has been installed in approximately one-third of Kroger's 2,380 stores. The U-Scan system accepts all forms of payments, including cash, credit cards, and ATMs.

One of the most common complaints about shopping at supermarkets, according to Gary Rhodes of Kroger, is the time it takes to check out. No one likes waiting in long checkout lines. The self-service units provide customers with a faster checkout alternative where they can control how long the checkout process takes. As a result, the U-Scan systems have proved to be enormously popular with Kroger's customers. In addition, the U-Scan systems are much more economical to operate than the traditional checkout counter with a cashier ringing in the items.

Source: Special thanks to Gary Rhodes of Kroger and Robin Yaffe of Optimal Robotics.

Exhibit 4.6
Methods of Pricing to Encourage Self-Service

Type of Service	Incentive to Use Self-Service
Gas station	Higher price for full-service gas
Investment firm	Higher commission for using a broker
Airline	Reduced fares available only on the Internet
Bank	Additional fee for using a teller

bank tellers are no longer needed to process customer deposits and withdrawals, and customer service representatives are no longer needed to answer telephone calls.

However, service managers need to recognize that by going entirely to a self-service delivery system, they will exclude certain market segments. For example, some customers do not want to pump their own gas at a gas station; similarly, other individuals prefer to obtain professional advice on investing in the stock market rather than doing their own analysis. Consequently, many service firms offer self-service as only one of several distribution channels for marketing their products.

Inasmuch as it is usually the least costly channel, many service firms will offer customers incentives, often in the form of discounts, to use this channel, or, conversely, charge more when the interaction with an individual is required. Exhibit 4.6 provides some examples of how firms encourage customers to use self-service delivery systems.

Decrease in the Importance of Location The combination of inexpensive data storage, transmission, and retrieval costs coupled with electronic access to virtually every corner of the world has decreased the importance of location for many services. Online banking services reduce the need for a customer to go to the bank. Home delivery services for groceries, dry cleaning, and so forth eliminate the need for customers to visit these retail locations. Similarly, any purchase made on the Internet, whether it is a book from Amazon.com or airline tickets from Expedia.com, eliminates the need for the customer to visit a specific retail location that offers these goods and services. When such services can be conducted remotely, it doesn't matter where they are located as far as the customer is concerned.

The continued development of a worldwide communication network has facilitated the location of back-office service operations to areas where labor costs are relatively inexpensive. As a result, customer call centers can be located anywhere. For example, a U.S. airline has one of its reservation call centers located in the Caribbean, while the customer call center for a major bank in the middle Atlantic states is located in Maine. For the same reasons, many firms have their call centers located in Ireland. It is important to note, however, that in addition to providing low-cost labor, these locations also must have the necessary communication infrastructure in place to provide the level of service required by these firms.

Shift from Time-Dependent to Non-Time-Dependent Transactions There is a growing trend away from time-dependent service transactions toward non-time-dependent transactions. Time-dependent transactions are those transactions that require a service worker to be available at that exact time when the customer requests the service. Examples of time-dependent service transactions can include the waitress at a restaurant who is there to serve you when you are hungry, the reservations clerk at an airline call center who answers the telephone when you call to reserve a flight, the front-desk personnel who is on duty at the hotel when you check in, and your stockbroker who is available when you want to conduct a stock transaction. Non-time-dependent transactions do not require the presence of the service worker at the exact moment when the customer requests service. Examples of non-time-dependent transactions include e-mail, faxes, and voice messages. Time-dependent transactions often are referred to as **synchronous transactions** or communications while non-time-dependent transactions are referred to as **asynchronous transactions** or communications.

synchronous transactions

Transactions that take place in real time without any time delays, usually between individuals.

asynchronous transactions

Transactions in which there is a delay in time with respect to the communication between the parties involved.

There are several reasons for the shift towards non-time-dependent transactions. First, it is more economical from the firm's perspective. As stated above, with time-dependent transactions, service workers must always be available to conduct a customer transaction. To allow for uncertainty in customer demand as well as to minimize customer waiting time, extra workers must be on duty, which adds to the expense. With non-time-dependent activities, a company has greater flexibility in scheduling workers in a more efficient manner, as well as the ability to prioritize the transactions.

Asynchronous transactions are usually more efficient from the customer's perspective too. For example, rather than trying to speak to someone in person, and playing endless rounds of "phone tag," it is much more efficient to send a single e-mail. However, an important point with asynchronous transactions is the need to have a service recovery process in place that assures personal contact when problems do occur.

In addition, with the world quickly becoming a *global village* or single world economy that is linked together electronically, a significant number of transactions do not take place during "regular business hours" (whatever that means these days!). Thus, a customer in Australia who orders something through the Internet from a firm in England can place the order at any time, regardless of what time it is in England, and that order will be processed at the beginning of the next business day. Non-time-dependent transactions permit firms to receive transactions on a *24 × 7 basis* (24 hours a day, seven days a week), and then to respond to these transactions efficiently during normal business hours.

disintermediation

The elimination of intermediate steps or organizations.

Increase in Disintermediation Stan Davis introduced the term **disintermediation** to mean the elimination of intermediate steps or organizations.[2] Technology allows buyers

[2]Stan Davis, *Future Perfect* (Reading, MA: Addison-Wesley, 1987).

and sellers to come closer together, often dealing directly with each other without having to go through any intermediate organizations. For example, when travelers purchase airline tickets directly from the airlines through the Internet, they eliminate the need for a travel agent. Likewise, trading stocks and bonds on the Internet eliminates the need for a stockbroker. Similarly, many manufacturers now sell their products directly to consumers, eliminating the need for distributors and/or retailers. eBay, the online auction firm, is doing exactly this by providing a network that directly links buyers and sellers.

Integrating Technology into Services

Technology needs to be properly integrated into an organization in order to provide a competitive advantage, in terms of both increasing the efficiency of the operations as well as increasing effectiveness with respect to better serving its customers. We identify three areas where technology can significantly contribute to the success of an organization.

Strategic Planning Strategic planning, from an operations perspective, is typically concerned with the long-range view of how an organization conducts business. As we have seen, strategic planning within the operations function of a manufacturing company is concerned with addressing such issues as (*a*) where do we locate our facilities? (*b*) how big do we make them? (*c*) when do we build them? and (*d*) what processes do we adopt to make our products?

However, a service organization, because it deals directly with its customers, also must strategically evaluate how it will interact with them. Service managers also must recognize that technology can significantly alter the way in which a company does business. For example, most of the major airlines now have home pages on the Internet that provide information about special airfare promotions. As discussed earlier, these special fares that are available only on the Web encourage customers to buy through the website, which is more cost efficient from an operations perspective. By adopting the proper strategy and associated technology, a firm can substantially increase its revenues and market share. Failure to do so can result in losing customers to competitors.

Improved Performance Service managers also must recognize that the decision to adopt technology is often driven by the need to not only to increase productivity but also to improve the existing performance of their operations. (Improved performance, as defined earlier, includes faster speed of delivery, more product variety, and improved customer responsiveness, to name a few.) Often, however, with the proper technology, both performance and productivity can be improved, creating a win–win situation for the firm.

Faster service. Technology has allowed service operations to significantly reduce and, in some cases, totally eliminate the need for customers to wait in line for service. In addition to providing faster service, technology can simultaneously reduce labor costs by entirely eliminating the customer–worker encounter.

For example, many hotels now provide an in-room checkout option. Guests who want to take advantage of this option simply follow the menu-driven instructions on the television in their room, leave their hotel keys in the room, and never have to wait in line at the front desk to check out. In this case, customer waiting time is totally eliminated and the requirement for front desk personnel is also reduced when guests take advantage of this option.

Car rental agencies have similar processes. As we saw in the opening vignette, customers are no longer required to go into the office to finalize their bills when returning their rental cars at an airport. A worker greets them at the car when they drive up and quickly

prints out a statement from a handheld computer and printer, thereby allowing the customers to go directly to the shuttle bus and the terminal.

As another example, the use of bar code readers at the checkout counters in supermarkets has significantly reduced the amount of time a customer may expect to stand in line while also reducing labor costs and errors in keying in the proper item prices. Barcoding also reduces the need to consistently check inventories, which provides managers with better control.

Improved knowledge about customers. In many services, databases now provide managers with detailed information on their customers' purchasing characteristics and their firm's past relationships with these customers. As part of their focus on attention to personal detail, for example, the Ritz-Carlton hotel chain, through its management information system, tracks individual guest preferences, including the type of bed they like to sleep in (such as a queen or king-size bed) and the type of wine they prefer. In addition, any previous incidents involving the customer, particularly complaints, also are recorded in the database to ensure that similar incidents do not occur again. (This same database also keeps tracks of habitual complainers who are eventually asked to take their business elsewhere.)

Another method of using technology for obtaining data on individual customers is through membership cards. Many retail operations now require membership cards or provide discount incentives to encourage the use of these cards. Such cards allow the retailer to track the buying patterns of individual customers, thereby providing management with in-depth information about their customers that can be used for future planning purposes. For example, BJ's Wholesale Club, Costco, and Sam's Club all require their customers to have membership cards. Shaw's, Stop & Shop, and PriceChopper are examples of supermarket chains that also have introduced a similar type of card, the use of which entitles customers to significant discounts on products.

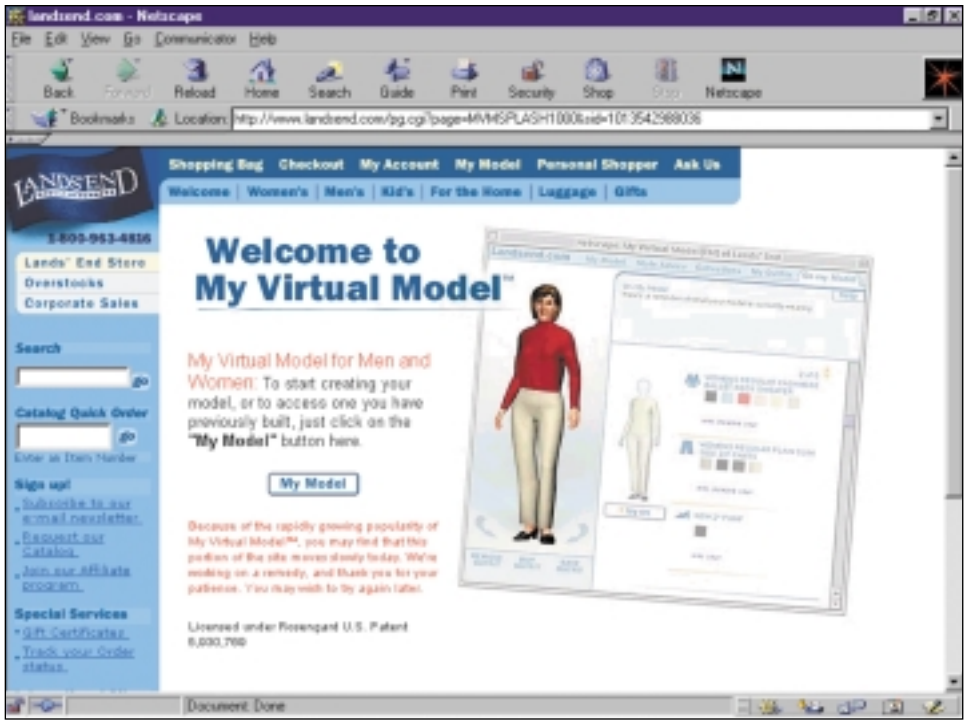
The proper use of technology thus can provide a service company with a competitive advantage through its ability to better understand the individual behavior patterns and past experiences of each of its customers.

Increased product customization. Technology also allows service managers to provide their customers with a wider variety of options than they could previously offer. The terms "micro-niching" and "mass customization" have evolved, in part, as a direct result of advances in technology that now permit firms to identify and provide customized goods and services to meet the needs of individual customers.

As an illustration, Levi Strauss now provides customers in its retail stores with the option of buying jeans that are made to the customer's exact size. The customer's specific measurements are entered into the computer and a few weeks later the jeans are delivered to the customer's home. Additional pairs can be ordered with only a telephone call, thereby eliminating the need to visit the store.

Another example is L.L. Bean, the mail-order company in Freeport, Maine, which will sew a customer's name or monogram on many of its products. Computerized sewing machines allow operators to select the style, size, and letter(s) in a matter of seconds. A monitor screen located above the sewing machine shows the operator how the name will appear on the product before it is actually stitched on the article.

Increased Efficiency As stated earlier, the initial thrust by services to adopt technology was driven primarily by the need to reduce operating costs. This is still a major reason for purchasing new technology. Just as capital equipment often is used to reduce costs in a manufacturing company, technology can be similarly applied in a service environment. The two



The Landsend's website allows the customer to create a likeness of him or herself and "try on" clothing for a custom fit.

primary ways in which the efficiency or productivity of the operation can be increased are (*a*) economies of scale and (*b*) reduced labor costs, recognizing that there is some degree of overlap between the two.

Economies of scale. Advances in communication technology have allowed service companies to reduce the number of locations for many types of activities. As an illustration, reservation operations for hotels, airlines, and car rental agencies have been consolidated to a few central locations. Economies of scale with these larger operations occur, in part, as a result of the ability to schedule a larger number of operators. For example, if the demand in a given hour (that is, the number of calls received) doubles, the number of operators necessary to provide the same level of service is less than double. Economies of scale also are reflected in the reduced overhead costs (as measured on a per-unit basis) that are typically associated with larger facilities. As stated earlier, an additional savings that frequently occurs as a result of the firm's ability to locate its operation anywhere is the reduced cost associated with locating in a low-cost-of-living area. Citibank, as an example, has located its credit card operations in South Dakota for this very reason. Similarly, many hotel central reservation call centers are located in Nebraska, rather than on either the West Coast or the East Coast of the United States, where the cost of living is more expensive.

Reduced labor costs. Technology can reduce labor costs in services in two ways. First, it can be used as a total replacement for labor. In addition, technology can provide support to existing labor, thereby increasing labor productivity.

As an example, automatic teller machines (ATMs) in banks are a total substitute for the traditional bank teller for many routine operations, but cost only a fraction of what a teller costs. Therefore, bank customers should be encouraged to use ATMs when conducting certain types of transactions.

Organizations also can use the Internet to reduce labor costs. The Massachusetts Registry of Motor Vehicles is now online, which allows motorists with speeding tickets to pay their fines over the Internet without having to appear in person, which was the previous norm. Increased use of the Internet in this manner also will reduce long lines at Registry locations and hopefully reduce its annual operating expenses.[3]

A note of caution is necessary, however, when contemplating the introduction of totally automated services. First, as we have noted already, there are some segments of the market that are not totally comfortable with using automation. In addition, while automation can usually do a good job performing routine transactions, there are often complex and highly customized transactions that can be resolved only with the customer interacting directly with a knowledgeable employee.

Technology in the form of automation also can be used in service operations to perform repetitive, time-consuming tasks. The use of technology in this manner cannot only increase worker productivity, but also reduce or eliminate errors. At the same time, it ensures the delivery of a more consistent product to the customer. In some instances, technology also can increase performance in the form of faster service.

For example, in many fast-food restaurants, the timed drink dispensers do not require servers to stand by the beverage machine holding the button. Instead, a quick push of the button begins the flow of a specific amount of beverage, permitting the server to assemble the rest of the order while the drink is being poured. Other examples of technology being used in fast-food operations include a conveyor belt broiler at Burger King restaurants that ensures a consistently cooked hamburger, again without the worker being continuously present during the cooking operation, and deep fat fryers with timers that automatically lift the french fries out of the oil when they have finished cooking.

Technology in the form of computerized order-entry devices allows waiters and waitresses to place orders in the kitchen without having to walk across the restaurant. Instead of having to make two trips to the kitchen—one to place the order and another to pick it up when it has been cooked—waitstaff are now only required to make a single trip to pick up the food when it is ready.

E-Services

Communication Network Environment

With the rapid growth in e-services, a new set of terms has emerged to describe the different types of networks through which information can flow. Each of these networks is defined by the type of users who have access to it. There are currently three major categories for e-services: (*a*) Internet, (*b*) intranet, and (*c*) extranet. A fourth type of network that is also currently being used is called electronic data interchange, or EDI, which is really a different form of the extranet. Exhibit 4.7 illustrates how these various networks link an organization with its customers, suppliers, and the general public.

Internet

A worldwide electronic network of more than 70 million computers.

Internet An **Internet** network has the fewest, if any, restrictions in terms of who has access to it. Firms use the Internet primarily when dealing with the general public. For those firms that sell directly to consumers such as Amazon.com (books, etc.) and Expedia.com (discounted airline tickets, hotel rooms, etc.), the Internet is the communication network that connects customers to these firms' websites to purchase goods and services. The Internet also provides access to websites that provide general information about a firm. This

[3]Mark Maremont, "No Waiting at This DMV," *Business Week*, August 19, 1996.

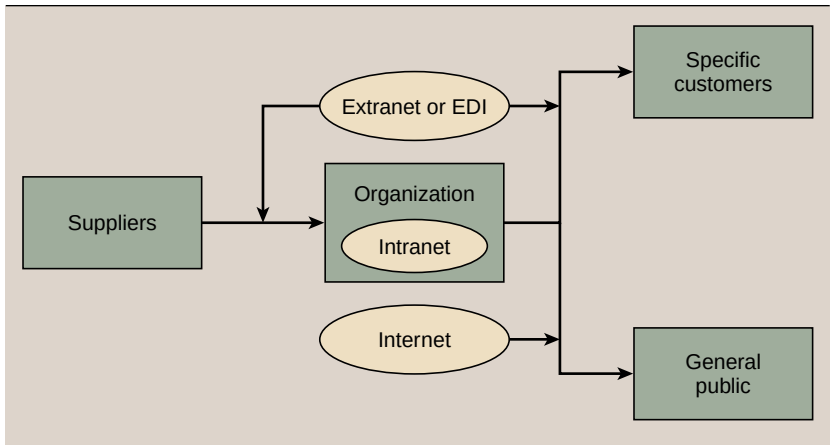


Exhibit 4.7

The Role of the Internet, Intranet, Extranet, and EDI in an Organization

type of website also can be used to disseminate news releases, provide contacts within the firm, and issue directions about how to obtain additional information about the firm. In addition, the Internet also allows firms to offer customers richer information and after-sales support with the goal of building customer loyalty.

Intranet An **intranet** is a network that operates only internally within an organization. As such, only those individuals who work within the organization have access to its intranet. Quite often the intranet is used to communicate among employees and as means for management to disseminate information quickly. For example, both Wal-Mart and FedEx have intranets that provide employees at all locations with up-to-date information on new procedures, changes in company policies, performance measurements, and recognition of outstanding employees. The FedEx intranet even includes its own television station that broadcasts company-related news 24 hours a day.

intranet

A network that operates only internally within an organization.

Extranet An **extranet** is defined as a network that allows specific external sources, be they individuals or organizations, to have limited access to a firm. As an example, an extranet will link a company with an approved group of suppliers. Electronic data interchange (to be discussed shortly) is a good example of an extranet. Organizations use an extranet to share classified or highly sensitive data with their business partners. For example, through an extranet, Procter & Gamble has access to Wal-Mart's sales and inventory data. By sharing such data, these two firms both benefit through lower costs of production and distribution as well as improved levels of customer service to the consumer.

extranet

A network that allows specific external sources to have limited access to a firm.

Electronic Data Interchange (EDI) **Electronic data interchange (EDI)** can be defined as the electronic exchange of data in highly specified formats that takes place typically between organizations. Some of the different types of transactions that can be done through EDI include (*a*) requests for quotations, (*b*) purchase orders, (*c*) acknowledgments and confirmations, (*d*) invoicing, and (*e*) payments.

While the use of EDI is very fast and efficient, it does have several shortcomings. First, companies must painstakingly link their operations to a specific EDI software and then synchronize protocols (such as which version of the software they use) with the firms with which they want to conduct business. The format for EDI is very inflexible and often does not adapt well to new applications. In addition, EDI moves data in batch mode and, consequently, there is a time delay from when the data are sent to when they are actually received

electronic data interchange (EDI)

The electronic exchange of data in highly specified formats that takes place between organizations.

(although it is still much faster than nonelectronic methods). For example, at Boston Scientific's Customer Fulfillment Center in Quincy, Massachusetts, incoming EDI orders from customers are accumulated in batches and downloaded for processing every 30 minutes.

value-added network (VAN)

A third party service that is used in conjunction with EDI to provide the link between customers and suppliers.

In addition, EDI transmissions typically take place through a third party such as General Electric Information Systems that is referred to as a **value-added network (VAN).** The cost of using a VAN can be quite expensive, often into the $10,000s per month for medium to large companies.

Because of the many shortcomings and high costs of EDI, the extranet will most likely replace EDI in the future as a medium of communication. This is already happening with many firms that are now connected electronically with their suppliers through an extranet. These suppliers now need only an extranet connection and a web browser in place of the dedicated EDI software and connections to a VAN.

Types of E-Services

E-services can be divided into several broad categories that are defined by the types of individuals and/or organizations that provide and use these services. Three of these major categories are referred to as (*a*) business-to-consumer (B2C), (*b*) consumer-to-consumer (C2C), and (*c*) business-to-business (B2B). In addition, there are also e-services that can involve a government agency, which are referred to as either government-to-business (G2B) or government-to-consumer (G2C).

Within these broad categories, there are several different types of services that can be provided. We present five of these services within the e-service framework: (*a*) e-tailers, (*b*) customer support, (*c*) network providers, (*d*) information providers, and (*e*) application service providers. Some firms provide only one type of service, while others may provide several. For example, an e-tailer will often also provide customer support.

E-tailers (Goods and Services) E-tailers are firms that provide goods and services through the Internet. Pure e-tailers are those firms that conduct business exclusively through the Internet, such as Amazon.com or e-trade. These services typically have their counterparts in brick-and-mortar establishments. In many cases, however, e-tail operations are part of a larger organization that also has brick-and-mortar locations, such as Barnes and Noble or Wal-Mart. Some of these firms (often referred to as *bricks and clicks* or *clicks and mortar*) such as The Gap also provide access to their websites at their brick-and-mortar locations, thereby making the difference between the two even fuzzier.

The major challenge for pure e-tailers that sell goods is to have the necessary infrastructure in place that can efficiently and quickly deliver the goods to its customers. The lack of such infrastructures was clearly evident during the 1999 holiday season when many irate customers who had made purchases through the Internet didn't receive delivery until well into January 2000. Some e-tailers such as Amazon have elected to build their own infrastructures in terms of distribution centers, while others have elected to partner with established brick-and-mortar retail operations.

E-tailers that offer services typically do not need the supply chain infrastructure required of those e-tailers that provide goods. This allows for faster entry into the market, significantly less investment costs, and consequently a quicker return on investment. For example, the online travel industry is one of the first e-service industries that is generating profits.

A major challenge for pure e-tailers is the lack of tangibility. With a brick-and-mortar operation, the customer has a place to go for customer service or to voice a complaint. There is nothing more frustrating for a customer than to wait endlessly on the phone for customer service, and to have no other recourse, as is the case when dealing with pure e-tailers.

Equally important for e-tailers is how they can differentiate themselves in the marketplace. Without differentiation, these services offer only commodities, and therefore must compete solely on price. This translates into very small profit margins, which cannot sustain growth.

Customer Support This type of e-service provides customer support services in a wide variety of forms. At FedEx, for example, customers are able to track the location of their packages through the Internet. Customer support also can take the form of chat rooms, which provide a forum for customers, or a web page that addresses frequently asked questions (FAQs). Many firms combine their e-service customer support activities with their call center activities. With proper design, such operations can provide fast service and be highly efficient at the same time.

As with e-tailers, there are some firms that focus solely on providing customer support, often under contract to other firms, while other customer support activities can be part of the overall organization.

A major challenge for these types of services is to persuade customers, in a positive manner, to switch from requesting customer support through call centers, which are time-dependent and involve interacting with an actual person, to Internet activities, which are non-time-dependent and are therefore more efficient.

Network Providers Network providers are e-services that provide a connected network for buyers and sellers to exchange goods and services. Electronic marketplaces are one form of network provider. These marketplaces, which are usually B2B, will typically focus on a particular commodity such as chemicals, plastic, or steel. By using these marketplaces, buyers can place their order requirements on one website and receive several quotations within a matter of hours.

Such marketplaces are very efficient in terms of their ability to link buyers and sellers, and have advantages for both parties. From the buyer's perspective, less time is required to obtain quotes from a number of vendors and the efficiency of the marketplace translates into significant savings. From the seller's perspective, the marketplace eliminates the need for a distributor or salesperson (an example of disintermediation), thereby reducing costs. These savings can either be passed on to the customer or go directly to the bottom line as additional profits.

Firms that conduct auctions are another example of network providers. Auctions can be between businesses and consumers (B2C), such as priceline.com, which auctions off airline tickets and hotel rooms, or between consumers, such as eBay, which will auction off just about anything. Again, these firms provide networks that link a large number of buyers with a large number of sellers, thereby creating a very efficient marketplace and eliminating intermediaries (except for the firm providing the network, which charges a percentage of the price for which the item was sold).

Information Providers We are clearly in the information age, and it should therefore not come as a surprise that there are some e-service businesses, often referred to as **infomediaries,** that primarily focus on providing information. Some firms focus exclusively on providing information, while others provide information as part of the value added to their core business.

infomediaries

E-service businesses that primarily focus on providing information.

These firms often provide information on several levels. Hoover's Online, as an illustration, provides information on three levels. The first level, which is free to users, is general information on companies' financial information. The second level adds value by segmenting or sorting the information to fit the needs of individual users, who pay a fee for this

service. The third level involves custom searches that are designed specifically to meet the needs of an individual customer.

Companies that provide information as part of their total offering often also provide chat rooms where customers can discuss issues relevant to the focus of the firm. For example, Magicmaman.com, an e-service firm in Paris, France, that focuses on parents with young children, provides a chat room where parents can discuss problems they are having with their children and how some parents have dealt with them (either successfully or unsuccessfully).

application service providers (ASPs)

Firms that provide remote services to customers.

Application Service Providers (ASPs) **Application service providers (ASPs)** are firms that provide remote services to customers. For example, an ASP accounting firm will have on its own server the most current accounting software package that reflects the latest changes in the tax laws. A customer then logs into the accounting firm's website and uses that accounting package to prepare its financial statements. With an accounting ASP, customers no longer need to buy a new software package every time the tax law changes.

A major challenge for ASPs is to convince customers that they are not fly-by-night operations and will be in business for the long term. Along with demonstrating financial strength to survive in the long term, ASPs also must convince customers that they provide highly reliable services and that they are very trustworthy with sensitive customer data that are given to them. Finally, customers must have confidence in the reliability of the network over which they will connect to their ASPs.

Technology-Related Issues

The integration of new technologies into an organization requires a significant amount of training and support in order for both workers and customers to reap the full benefits. The lack of proper training and support, in many instances, will not only fail to yield the expected improvements in performance and/or productivity, but could also prove disastrous financially as frustrated workers quit and unhappy customers take their business elsewhere.

Overcoming Barriers to Entry

As new technologies become available, there are often barriers that prevent customers from using them, and managers need to be aware of this. Such barriers can significantly hinder the growth of the organization. One barrier is the "fear of the unknown" that is often associated with new technologies, a good example being the first time one purchases goods and services over the Internet. Here, because there are no tangibles associated with the firm, customers are concerned about misuse of their credit cards and whether or not they will actually get delivery of the goods or services they have purchased.

Another barrier is lack of knowledge of the consumer in using the service. This is especially true for self-service operations as well as for those services that use new technologies. Self-service gas stations provide a good example here, as there are many individuals who do not know how to operate a gas pump.

ATMs provide a good example of a service involving a new technology where customers must not only overcome their fear of the unknown, but also must learn how to properly use the technology.

Training and Support

Significant amounts of up-front training must be built into the overall new technology process. This training is often required of both workers and customers. Failure to provide

proper training will lead to inefficient operations and frustration. In addition, both workers and customers must have the necessary technical support when questions arise and/or equipment malfunctions occur.

Worker Training Workers often are required to develop additional skills when a new technology is introduced into the operation. These new skills can be developed through training classes that not only describe the use of the technology but also simulate its use. This allows workers to become familiar with the new equipment and to "debug the process" prior to actually using it online in the presence of a customer. It is important for managers to recognize that worker training is an ongoing process. Many leading-edge firms, like FedEx, in fact, require their workers to spend a specific number of days each year in training.

Customer Training Customers also frequently are required to undergo some degree of training when a new technology interacts directly with them. Depending on the type of technology and the level of sophistication required to use it, customer training can vary from a simple pamphlet describing how to use the new technology to attending classes that carefully document the proper use of the technology.

Conclusion

Technology plays a significant role in the successful operation of every organization. With the constant introduction of new state-of-the-art technologies, this trend will most likely continue into the foreseeable future. However, operations managers must realize that the adoption of technology is not a simple undertaking and therefore must be carefully planned.

In the past, many firms looked to technology primarily to help them increase productivity. However, there are several additional reasons companies elect to incorporate new technologies into their processes, such as building a stronger relationship with their customers and improving their overall performance by providing better customer service.

Finally, the installation of new technology must be accompanied with the proper technical support. In addition, sufficient time must be allocated in the initial start-up phase to provide proper training to both workers and, where necessary, also customers. When deciding to purchase new technology, the service manager must ensure that there is compatibility between the desired technology and the overall long-term goals of the firm.

Key Terms

application service provider (ASP) p. 142
asynchronous transactions p. 134
computer-aided (or -assisted) design (CAD) p. 125
computer-aided design and manufacturing (CAD/CAM) p. 126
computer-integrated manufacturing (CIM) p. 126
disintermediation p. 134
electronic data interchange (EDI) p. 139
enterprise resource planning (ERP) systems p. 128
extranet p. 139
flexible manufacturing system (FMS) p. 126
industrial robots p. 125
infomediary p. 141
Internet p. 138
intranet p. 139
islands of automation p. 126
machining centers p. 125
numerically controlled (NC) machines p. 125
synchronous transactions p. 134
value-added network (VAN) p. 140

Review and Discussion Questions

1. What are the different ways in which technology can impact an operation? Use examples in both manufacturing and service operations.
2. Identify and compare the perceived benefits and costs for each of the following pairs of services:

	Traditional Service	Technology-Driven Service
a.	Traditional grocery store	Home delivery grocery service (Peapod)
b.	Neighborhood travel agent	Internet travel agent (Expedia)
c.	Local bank branch office	Internet bank (Wingspan)
d.	Traditional bookstore	Virtual bookstore (Amazon)

3. Describe how technology is adding value for each of the technology-driven services identified in Question 2.
4. What are the benefits of automation in a manufacturing company?
5. What are the different ways in which infomediaries add value?
6. Visit any of the following services and identify the various ways in which technology is changing the way in which these services are being delivered.
   a. Retail store.
   b. Restaurant.
   c. Bank office.
   d. Supermarket.

Internet Exercise

Visit the website of a major airline such as American, Northwestern, or Delta and compare the different ways to obtain information on a flight between two major cities of your choosing. Then visit the website of an online travel agency such as Expedia.com, Orbitz.com, or Travelocity.com and do a similar comparison. What are the advantages and disadvantages of using an airline's website? What are the advantages of using an online travel agency's website? What are the advantages of ordering airline tickets online versus buying them through your local travel agent, who is located in a nearby shopping mall?

Bibliography

Brin, Dinah W. "Check it Out!" *The Middlesex News* (Framingham, MA), August 11, 1996.

Collier, David A. *Service Management: The Automation of Services.* Reston, VA: Reston Publishing, 1986.

Davenport, Thomas. "Putting the Enterprise into Enterprise Systems." *Harvard Business Review* 76, no. 4 (July–August 1998), pp. 121–31.

Hackett, Gregory P. "Investing in Technology: The Service Sector Sinkhole?" *Sloan Management Review,* Winter 1990, pp. 97–103.

Judge, Paul C. "Customer Service: EMC Corp." *Fast Company,* June, 2001, pp. 138–45.

Laughlin, Stephen. "An ERP Game Plan." *Journal of Business Strategy* 20, no. 1 (January–February 1999), pp. 32–37.

Maremont, Mark. "No Waiting at This DMV." *Business Week,* August 19, 1996.

Quinn, J. B. "Technology in Services: Past Myths and Future Challenges." In *Technology in Services: Policies for Growth, Trade and Employment.* Washington, DC: National Academy Press, 1988.

Quinn, J. B., and M. N. Bailey. "Information Technology: Increasing Productivity in Services." *Academy of Management Executive* 8, no. 3 (1994).
Roach, S. S. "Services Under Siege—The Restructuring Imperative." *Harvard Business Review,* September–October 1991.
Scott, Karyl, "EMC Shores Up Its Offense." *InformationWeek,* October 2, 2000, pp. 72–82.
Stein, Tom. "The Great ERP Debate." *InformationWeek,* February 8, 1999, pp. 132–40.
Wheatley, Malcolm. "ERP Training Stinks." *CIO Magazine,* June 1, 2000, pp. 86–96.
Zellner, Wendy. "Where the Net Delivers: Travel." *Business Week,* June 11, 2001, pp. 142–44.

Case

EMC Uses Technology to Enhance Its Customer Service

The best kind of problem is no problem, or one that is anticipated and fixed before it even occurs. And no one is better at doing this than EMC Corporation, a manufacturer of data storage systems. Using state-of-the-art technology, a wide variety of sensors are installed in its storage systems. These sensors measure almost everything, from the operating environment, like temperature and vibration, to technical performance, like faulty sectors on a storage disk or abnormal power surges. In total, there are more than a 1,000 diagnostics that are done routinely. Whenever any of these parameters falls outside of its accepted tolerances, the storage system automatically "calls home" to EMC's call center in Hopkinton, MA to report the problem. In fact, more than 80 percent of the 4,000 calls received at the call center each day are not from EMC's customers themselves, but rather from EMC's storage systems. Customer support engineers then either fix the problem remotely from the call center, or if that is not possible, dispatch a technician to the site. With this ability to anticipate problems before they occur, the first time a customer is even aware of a potential problem is when the technician arrives to replace a potentially faulty component before it actually fails.

One of the key factors in EMC's significant growth over the past decade has been its fanatical devotion to customer service. Providing great customer service, however, requires more than the ability to perform remote diagnostics, it requires commitment from the entire company. For starters, the customer service call center is located right in the middle of the engineering department, easily accessible to both hardware and software engineers. If the engineer receiving the call can't resolve the problem in 15 minutes, the responsible design engineer is called in. If it still isn't resolved in another 15 minutes, the vice president for

engineering is called in. An unresolved problem will continue to escalate through EMC's organization, to the point where if it isn't solved within eight hours, Mike Ruettgers, EMC's executive chairman and Joe Tucci, EMC's president and CEO are both notified.

As further evidence of its commitment to service excellence, EMC doesn't treat its customer service organization as a profit center, as many firms do. By including the service in the cost of the product, customer service is treated as an expense item, without a need to generate profits. This allows the customer service to focus entirely on doing whatever is necessary to satisfy the customer.

Does EMC charge more for its products? Absolutely. But its customers believe that EMC products are worth the additional cost. When Forrester Research surveyed 50 big companies about their various technology suppliers, "EMC came out looking like God," says Carl Howe, a director of research at Forrester. "It has the best customer service reviews we have ever seen, in any industry."[4]

In an *InformationWeek* study conducted on enterprise storage vendors, EMC received a satisfaction score of 8.53 (on a scale of 1 to 10, where 1 is not at all satisfied and 10 is extremely satisfied), compared to scores of 7.21 for Compaq, 7.16 for IBM, and 7.05 for Dell. As further evidence of customer satisfaction, the same study asked customers to rank their enterprise storage vendors in terms of "Service-Level Guarantees" and After-Sales Service" with the following results:[5]

Customer Rankings of the Enterprise Storage Vendors

Service-Level Guarantees	After-Sales Service
1. EMC	1. EMC
2. Dell	2. Dell
3. IBM	3. IBM
4. Sun Microsystems	4. Sun Microsystems
5. Compaq	5. Compaq

Questions

1. How does technology provide EMC with a competitive advantage in the marketplace?
2. What are some of the concerns that EMC might have when potential problems are fixed remotely without the customer ever knowing about them?
3. What is the role of technology in building customer loyalty at EMC?

[4]Paul C. Judge, "Customer Service: EMC Corp.," *Fast Company,* June, 2001, pp. 138–45.

[5]Karyl Scott, "EMC Shores Up Its Offense," *InformationWeek,* October 2, 2000, pp. 72–82.