Module

20W

Managing Technology and Information Technology*

LEARNING OBJECTIVES

After completing this module, you should be able to

1. Describe the roles of technology and its effects on behavior in organizations.
2. Describe the various kinds of technologies used by organizations.
3. Understand the effect of technology on individual and group behavior.
4. Understand the effect of computer-based technologies on the organization.
5. Gain an insight into the computer-based technology issues of the future.

KEY TERMS AND CONCEPTS

Adapters of IT
Adopters of IT
Business intelligence (BI)
Business-supporting technology
Cell systems
Communication technology
Computer-integrated manufacturing (CIM)
Computer-supported technology
Craft technology
Customer expectation management (CEM)
Customer relations management (CRM)
Data mining
Data warehouses
Engineering technology
Enterprise resource planning (ERP)
Flexible manufacturing systems
Fully integrated system
Information processing
Information processing engine
Information technology (IT)
Inventor of IT
Knowledge center
Knowledge worker
Knowledge discovery
Linked island system
Local area network (LAN)
Management information system (MIS)
Manufacturing technology

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Nonroutine technology
Procedure-oriented IT
Routine technology
Service technology
Stand-alone system
Supply chain management (SCM)
Technical system
Technological complexity
Technology
Tool-oriented IT system

MODULE OUTLINE

PREMODULE PREPARATION

The instructor may assign the following activity.

Activity 20–1W: Technology, Information Technology, and Human Behavior: An Exploratory Investigation

Objective:

To explore the role of technology and information technology in the management and behavior of existing organizations.

Task 1 (Homework):

a. Participants are to review current business publications (for example, *Business Week,* the *Wall Street Journal, Forbes, Fast Company, Fortune*) and identify a company that is reported to currently be addressing issues related to technology (distinct from information technology—for example, use of sensors, intelligent agents, manufacturing processes).

b. Participants are to meet as teams. After reviewing the individual findings, they are to decide on the particular company for continued focus.

c. Participants are then to independently review and scan recent business publications and perform a Web-based search for references to the chosen company that would correspond to some of the following themes:

1. How is the technological system described? What seem to be the characteristics of the technology? What terms or labels are used? How are they defined?
2. Does the technical system appear to have an impact on the managerial system? On the design of work? On the human system? On human behavior? On individual, group, business unit, and/or organizational behavior?
3. Is the technology distinct from or linked to information technology? How is the distinction or linking described?
4. What seem to be the patterns or potential relationships among human behavior, technology, and information technology?

d. Participants are to meet in their teams to discuss the findings and responses to the four questions in part (c) and then are to develop a team response to each question.

Task 2 (Classroom):

a. The instructor will have each team present its findings for each of the questions with the entire class. Key points are to be recorded on the board.

b. Based on the various team findings, the instructor will facilitate a class discussion about current organizations, their technologies, and human behavior.

c. The instructor will then present a short lecture on the technical system and human behavior.

INTRODUCTION

The impact of technology on how organizations function and change has been nothing short of profound. To sustain their competitive advantage in the dynamic global market, firms need to continually address their management of technology. All forms of technology must be managed, utilized, and deployed to enhance the firm's competitive position. Today businesses have harnessed technology through the use of knowledge derived from the technology and the corporate system. A full realization of the knowledge and expertise embedded in the firm's employees together with the firm's resident technologies forms the basis for the organization's value. The relationship between people and technology has special meaning and characteristics. Technologies themselves have no emotional capacity, though we still tend to imbue them with personalities to make our relationship with them more fulfilling. Such technologies related to computers and software, on the other hand, can become pervasive. People within the organization can become so focused on the gadgets and devices that they lose perspective of the goals and objectives of the firm. Pasmore argued that at a fundamental level, "It is our propensity to develop relationships with inanimate technological artifacts that explains why the interdependence between social and technical systems in organizations requires careful attention."[1] On the other hand, the worth of the individual and team synergy in conjunction with technology needs to be taken into account. This module examines the major features of technology and computer-based technologies—as fundamental elements of organizational behavior—and their interdependent relationship with human behavior.

TECHNOLOGIES

Technologies at the most basic level are the tools, techniques, methods, devices, configurations, knowledge, procedures, actions, and support mechanisms used by organizational members to acquire inputs from suppliers, to transform these inputs into outputs, and to

provide outputs as products or services to customers, both internal and external.[2] Organizational technology can include: choices about raw materials, semifinished goods, and even people; choices about how the technology is defined and presented; choices about work design or redesign; choices about control processes; choices about research and development; and in some sense choices about how to approach and utilize computer-based technologies to support the infrastructure framed by the other technologies, parlaying them into a competitive weapon. In many cases these choices now focus on whether to make or buy the materials and elements that define their product or service. The management of technology can transcend the concerns of production processes, machinery, and work procedures. The decisions made about the choices available and the processes used to arrive at those decisions differentiate the organization. In addition, any one of the technology-related choices could potentially influence choices made for many of the aspects of the organization. For example, a decision to change the factory floor to a paperless environment by replacing manual and semiautomated support systems with dynamic, electronic visual status and target displays as part of the facilities movement to a manufacturing enterprise system (MES) implies a shift from efficiency to reliability[3] and moreover worker involvement and empowerment. In the recent past the introduction of technologies, such as point-of-sale debit machines, automatic teller machines, toll-free phone numbers, computerized reservation systems, and having a Web presence heralded the firm's changed workforce habitat. Technology has, in many cases, replaced the worker. More frequently the job of the worker has changed to accommodate the changes and innovations in technology. A decision to apply one or more of these technologies will alter the relationship among the firm, its customers, and its suppliers.

Technology as the Defining Feature of Organizations

To start any discussion of technology we need to consider that in America there has been a shift from manufacturing to service. Approximately 80 percent of the business activity is service-based. Companies still produce products or goods, but the driving force for our economy is now various layers of service. A good is a physical product that is tangible in some fashion—we can even consume some goods. Examples of goods include fruits and vegetables, flowers, televisions, automobiles, personal computers, paper, and pencils. Some consumable goods are perishable, while others have a long shelf life. A service is any primary or complementary activity that does not directly produce a physical product. Service is the intangible part of a transaction between a buyer (the customer) and a seller (the supplier). Examples of service include service stations, hotels, restaurants, banks, amusement parks, and consulting firms.

There are significant differences between goods and services. The management of service-providing differs from management of goods-producing organizations. Goods are consumed, but services are experienced. Goods-producing industries depend on machines in the physical sense (for example, hardware) to perform work—they are used as a direct means of production. Goods can be moved, stored, and repaired. They generally require some form of physical "touch" as they are produced. Services make more use of information systems—hence the word *software.* Although both goods and services can require skills and expertise, to produce or render services generally requires more behavioral skills. Many services require that the customer be directly involved with the provider.

There are many ways that we could classify and categorize technology. The perception and definition of the **technical system** is strongly linked to any such proposed classification. One of the first typologies, proposed by Joan Woodward, organizes the firm according to its technological complexity and manufacturing processes.[4] The **technological complexity** dimension represents the extent of mechanization of the manufacturing process—a high technological complexity means that most of the work is done by machines. Based on these dimensions Woodward identified three major categories of technology: small batch and unit production (the manufacturing process is not highly mechanized and relies heavily on a human operator—for example, specialized optical equipment or custom-designed graphics), large batch and mass production (the manufacturing process is characterized by long production runs with standard parts—for example, most auto assembly lines), and continuous process production (the entire manufacturing

process is mechanized and automated machines control the process—for example, nuclear power plants and chemical plants). In either case, though, there is a reliance on some form of computer-supported technology to support and enhance these operations.

A research group at the University of Aston, England, classified technologies into three components: *operations technology* (the techniques used in the work flow activities), *material technology* (the nature of technologies used in the transformation process), and *knowledge technology* (the characteristics of the knowledge used in the organization).[5] A set of studies that focused on a wide range of technologies resulted in the classification of technology into three clusters: *long linked* (technology that involves series interdependence among subtasks, as in an assembly line); *mediating* (technology that links clients or customers with service providers in standard ways; today we would assume a link with our suppliers as well); and *intensive* (technology that involves the use of a variety of specialized techniques to bring about change in a specified object, such as the patient who is seen by various specialists in a hospital).[6] The key argument behind this set of studies is that each type of technology requires a different mode of coordinating the various interdependent performers who operate the technologies, which results in different patterns of planning, control, goal setting, work design, and human behavior. Again, the reliance on some computer-supported infrastructure must be present regardless of the pattern.

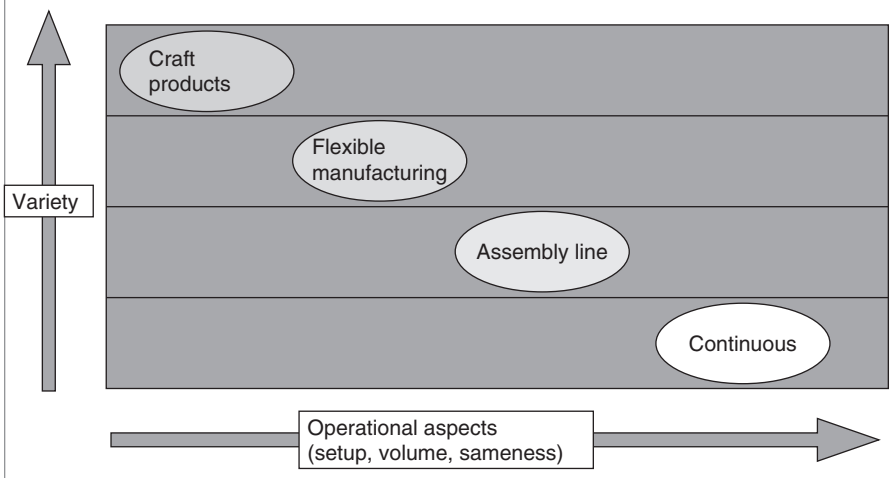
In later research, it has been proposed that technology can be examined at both the organizational and departmental levels. At the organizational level, technology can be divided into two types: **manufacturing technologies** (which include traditional manufacturing processes and advanced manufacturing systems) and **service technologies** (which include such services as law firms, consulting firms, schools, airlines, hospitals, hotels, and amusement parks). Today, somewhere in the center is the new breed of software developers that melds manufacturing with service technologies (for example, Microsoft or Sun). The department-level technologies focus on the distinct technologies and production processes operating within each department. The most influential work at the departmental level was conducted by Charles Perrow, who identified two dimensions of departmental activities: *variety* (which refers to the frequency of the unexpected events that occur in the conversion process) and *analyzability* (which refers to the degree to which work activities are analyzable).[7] These two dimensions form the basis for four major categories of technology:

1. **Routine technologies.** Characterized by little task variety that is highly analyzable (for example, an audit unit, a bank teller department, or a machine shop).
2. **Craft technology.** Characterized by limited task variety that is difficult to analyze (for example, a fine-glass manufacturing department, performing artists, or a physician in a hospital).
3. **Engineering technologies.** Characterized by a wide variety of tasks that are relatively easy to analyze (for example, a law department, an engineering department, or a software technical support group).
4. **Nonroutine technologies.** Characterized by high task variety with a conversion process that is difficult to analyze (for example, an R&D department, software development group, or the staff assigned to strategic planning). (See Figure 20–1W.)

Of special note is one of the technologies at the organizational level—that of advanced manufacturing systems. Building on early work in manufacturing–based computer support systems, such as material requirements planning (MRP), these systems have focused on more fully developed computer–based manufacturing. Studies have distinguished four levels of these systems:

1. **Stand-alone systems.** For example, robots and numeric control machine tools.
2. **Cell systems.** Consist of equipment and materials for the production of parts (for example, **flexible manufacturing system,** material requirements planning, bill of materials, and computer-aided engineering).
3. **Linked island systems.** Where some cell systems are linked together to form production islands (for example, picking lines, packaging and shipping operations, and pharmaceutical or cosmetic products that share selected process requirements).

Figure 20–1W **Classification of Technology Types (Based on C. Perrow's Typology)**



4. **Fully integrated systems.** Link the entire manufacturing function and all of its interfaces through extensive information networks [commonly known as **computer-integrated manufacturing (CIM)**].[8]

Operations Management

To compete in today's complex business world, organizations need well-designed and executed operations. Economic growth requires productivity growth. Keep in mind that this doesn't happen by just getting people to work faster and harder. It comes from being smart—the way we design a product or formulate service. We can lower costs with more efficient processes and ultimately raise profits. Being efficient is a start, but what is really needed is an understanding as to what the "customer wants and needs."[9] Technology change, capital investment, improved labor quality, and other factors are the drivers of productivity accompanied by the understanding that we want to deliver the right product to the right customer at the right time. This target can vary and depends on the right place as well. For example, in marketing the Jeep, Chrysler used the throwback to the Old West to market in America—the Wrangler with tough leather seats and even the rounded headlights to resemble a deer. Whereas in Europe (for example, Germany and France) they marketed the Jeep as the Liberty—reminiscent of the GIs in WWII.

Bringing together all of these ingredients requires strong attention to operations management. Some might say that management is a science, while others would consider it an art. Operations management is a little bit of both of these—it's about ensuring that goods and services are created and delivered successfully to the customer—creating value. Operations management is a way for managers to directly affect the value provided to all stakeholders—provide high-quality goods and services that customers expect by motivating and empowering the workers who create the goods or provide the services. Later in this chapter we will talk about various information systems that are used to keep the company running smoothly. For now though let's address some key activities that fall under the umbrella of operations management.[10] These activities include:

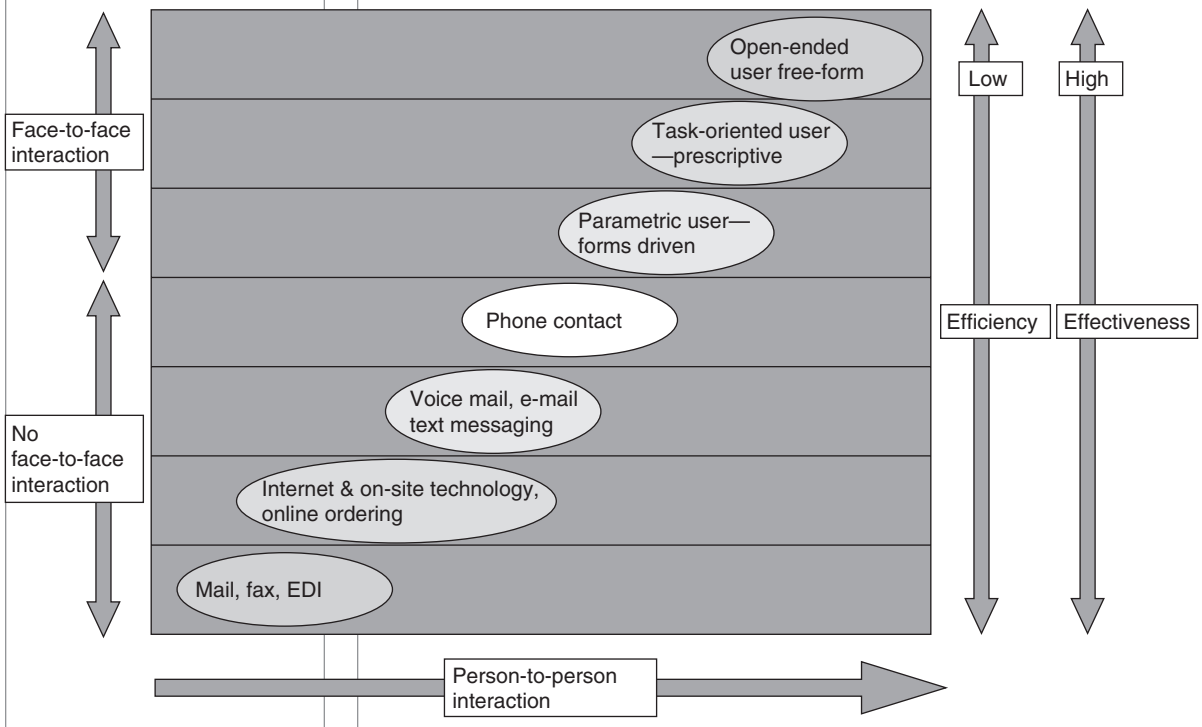
- Understanding the needs of customers through the use of **customer relations management (CRM)** technologies.
- Using information about suppliers, operations, employees, and customers through the use of **enterprise resource planning (ERP), supply chain management (SCM),** and customer relations management (CRM) technologies to make "better" decisions. This decision making implies the use of an integrating technology, called **business intelligence (BI).**
- Create an exploitative technology to deliver the "right mix" to customers by responding rapidly and flexibly to customer requirements.

- Provide the perception and affirm the reputation of *quality* in the company's goods and services.[11] Rapaille notes that for most American consumers quality is not as much of an issue as serviceability and responsiveness. Operations management needs to ensure that their products and services can meet expectations and that the company stands by their product—activities such as call and help centers are key.
- Ensure that the upstream operations and downstream production and service flow across hierarchical, organizational, and functional boundaries from the originating supplier to the end customer—this may entail the creation and use of extranet technologies to connect the company and its partners.
- Creation of a learning environment, social networks, and communities of practice to develop and support the skills of employees and motivate them through education, training, rewards, recognition, team work, empowerment, and other knowledge management technologies.

Of course, this chapter is about technology not just operations management. Let's tie this to our earlier discussion. As a starting point Woodward examined manufacturing in terms of technological complexity (extent of mechanization) and processes. Perrow identified two work activity dimensions: variety in the conversion process and analyzability. There have been other classifications as well from stand-alone to fully integrated operations. A product is generally created by manufacturing processes. These processes can span a continuum based on the specific product. Figure 20–1W depicts four process levels: continuous, assembly line, flexible manufacturing, and craft. They are related in terms of the operational considerations and variety. Continuous processes operate pretty much 24–7 all 365 days a year. Examples would be an oil refinery or a power plant—both produce "products" in a continuous fashion. It takes considerable effort to shut them down for maintenance (a service aspect that we'll discuss in the following section). Assembly lines generally operate in a discrete fashion where the product in making is moved from one station to the next. Each station performs a specific value-added transformation on the product. Obvious examples are an automobile assembly or a major part such as a wing or tail section for an airplane. Flexible manufacturing differs from the assembly line in that the product stays in one place and the work normally performed at the various stations is accomplished by the workers going to the product site. Hence, the term *flexible,* allowing a much greater variety of products to be made with minimal setup time. At the top is the craft—sometimes called a job shop. At an extreme such products are one-of-a-kind. More often they are products tailored to a specific order. Examples could be the tailor creating a suit to order. Not so distinctive is Dell computer's ability to make to order the exact configuration requested by the buyer.

Then there is the service technology—let's consider this in a similar fashion. In pure manufacturing we create some product that is purchased by a customer. Sometimes we sell or provide an intangible product that could be called a service. Other times the product that we sell has a service component that precedes, accompanies, and/or follows the product. And at other times the service is support or an underlying part for the product. For example, an airline trip assumes service from airline personnel—stewards, baggage processors, pilots, and so forth. In Figure 20–2W we portray services as a progression based on the degree of person-to-person interaction or the lack thereof. At the most basic level is the mail, fax, and electronic document reception and processing—not much interaction there—perhaps driven by machine-to-machine but very efficient. From an effectiveness standpoint this method leaves no room for exceptions—meaning perhaps customer dissatisfaction. The customer could go to the Web and place an order. Here they are most likely talking person-to-machine. But the customer does have some feedback. Alternately customers could phone in their order or more flexibly e-mail or text-message details. In many cases there could be person-to-person communications. All of these methods are not face-to-face. We all know that being there is important but many times not very efficient. At the most basic face-to-face level we are involved with a transaction that is pretty much spelled out—there is a parametric user that has a defined set of information to collect. At the next level the interaction is a little more complex as the customer has to communicate with the employee in a flexible matter—similar to flexible manufacturing. Finally at the top we

Figure 20–2W **A Classification of Service Technology Types**



have open-ended, free-form discussions between the customer and the company representative. This could be managing a portfolio of investment options.

Sociotechnical Systems and the Workplace

As we saw in Modules 13 and 16, the sociotechnical systems (STS) approach has become an increasingly popular organization design tool for examining and changing the workplace environment.[12] The sociotechnical perspective considers every organization to be made up of a *social subsystem* (the people) using tools, techniques, and knowledge (the *technical subsystem*) to produce a product or service valued by the *environmental subsystem* (of which customers and suppliers form a part). A fundamental axiom of STS is that whatever decisions are made about or within any one of the organizational subsystems, those decisions should meet the demands of the other subsystems.

The scope of STS design extends beyond work design to encompass dimensions of organizational structure and strategy. The STS provides a useful framework for assessing the systemwide implications of new manufacturing technologies. Ensuring compatibility between the technical and environmental subsystem requires that new manufacturing technologies are effective in meeting the needs of customers and are capable of enhancing the competitive position of the firm.

Introducing new manufacturing technologies ultimately requires a redefinition of the relationship between the technical environmental subsystem through adjustments to the overall business strategy. To ensure compatibility between the technical and social subsystems, a balance needs to be struck between selecting new, compatible technologies and the nature of the existing social subsystems. For many firms innovations in computer hardware and software have enabled a change in manufacturing technologies. A significant set of events occurred during the Y2K happening, or nonhappening depending on which organization you might talk to. Y2K dealt with the business transition to the year 2000. Many business computer systems used a two-character date throughout their business database systems. Most of the programs were written in COBOL—a computer software business language. These were called "legacy" systems because they were developed during the mainframe eras (1965–1990) where there was little direct

interaction with customers. They formed the foundation for the majority of business systems throughout the world. Y2K was a wake-up call for the business community. They realized that most of their information systems infrastructure was rigid, inflexible, and non-people-oriented. At the same time more flexible business software systems were being developed. These systems were termed enterprise resource planning (ERP). ERP consists of business modules or building blocks that can be styled to meet the most common business processing needs. Moreover they provided a bridge from the legacy systems to new forms of computing. Although ERP systems were and are costly and time-consuming to implement, businesses had to make the transition to these systems to stay competitive.

The first decade of the 21st century was marked by the movement from a centralized transaction-based system (legacy systems) using mainframe computer hardware to enterprise and beyond software tools using wide area networks and server-based computer hardware. IBM[13] under the leadership of President Gerstner understood that a company's future lies not in tearing itself apart but in pulling itself together under "network-centric computing." This movement provides a broad vista for both the manufacturing and service-based firms. The focus moved from operational to strategic use of information; from a departmental to a corporate view and beyond; and the deployment of computer-based technologies as competitive weapons.

A Classification of Business-Related Technologies

Technologies dealing with computer hardware, communication hardware, user interface devices, storage, software, artificial intelligence, robotics, and computer-aided manufacturing have, in the recent past been broadly categorized as **information technology (IT).** Of late there is a tendency to separate this spectrum into such categories as **communication technologies,** information technology, **computer-supported technologies,** and for better want of a word **business-supporting technologies.** The most important category though is the heart of the information processing system—the **information processing engine.** The nature of the benefits originating from these technologies depends on the technologies themselves. A number of the business-related technologies are typically part of the production process of either the product or the service provided by the firm. All businesses use some sort of technology to support their operation—be it just a small network of personal computers using an off-the-shelf accounting software or an elaborate network of computers providing a total business solution. In the providing of goods or services the technology itself can become one of the products. IT is used to exploit and aid the production process through the use of software—things that we take for granted such as e-mail, voice mail, social computing, group decision making, and communication using a Web-like interface deployed on the company's intranet (an internal version of the Internet). Computers can also be an essential part of a new product or service—for example, a car's onboard instrumentation.

Computer-Supported Technologies

Computers of various kinds are pervasive throughout most organizations. Most of these computers are not much different from devices that you use such as iPhones or Xboxes. They reside in most office automation devices such as copiers, fax machines, telephone, and voice mail systems. They provide the infrastructure for facility management (environment, security, and operation). If the firm manufactures products, there most likely are special-purpose computers for the production line (for example, numerical control, robots, intelligent agents, handheld scanners/barcode readers, RFID, and mobile computers); for the engineers [computer-aided design (CAD), plotters, scanners, and readers); and for the myriad of personnel that directly interface with the customer (workstations, scanners, handheld devices, and so forth).

Business-Supporting Technologies

Information technology—including decision support systems, expert systems and artificial intelligence, virtual offices, voice messaging, online transaction processing systems, data warehousing and mining, electronic mail, teleconferencing, and other software-based advances—fundamentally changed the nature of the workplace. Foremost was the introduction

of the Internet. We can think of the Internet as a network of networks—in reality it consists of a worldwide set of networks connecting people, businesses, governments, and even nations. There are also variations of the Internet such as the intranet and the extranet. The intranet is a subset of the Internet that uses the same technology (for example, Web browser and network equipment) and operates solely within the organization's computer network to communicate. The extranet uses Internet technologies to facilitate communication and trade between an organization and its business partners, such as suppliers and customers.

An Internet website can enhance productivity through providing product information, external e-mail, accepting orders, processing orders and payments, and conducting research. An intranet can enhance productivity through internal e-mail, collaborative processing, access to "organizational memory" residing in databases, order processing, personal Web pages, departmental Web pages, group communications, organizational communications, and product and company information. An extranet can enhance productivity through implementing electronic data interchange (EDI) with suppliers and customers, collaborating with other organizations in developing new products and services, sharing product catalogs exclusively with wholesalers, and sharing news and other information of shared interest exclusively with business partners. Wal-mart has become the master in sharing information with its partners through a common database with the goal to provide the lowest cost to the customer.

The maturity of the Internet and especially the introduction and proliferation of the use of the World Wide Web (WWW) over a very short seven-year period (1995–2002). The WWW changed the way businesses communicated with their customers and suppliers. The Web became the great equalizer—it didn't matter who you were but what you had to offer. A company can truly be a mom-and-pop operation and no one would know or care. The successes of Dell (on and off the largest provider of personal computer systems), Google, Amazon.com, and e-Bay all illustrate this phenomenon. The Web consists of compound electronic documents which are capable of containing a rich set of multimedia elements (voice, data, animation, streaming video)—almost any element can contain a hyperlink to another part of the document or another document on another Web page.

What makes the Internet hum is the intricate array of networks connected much like the worldwide telephone system. Each organization has its own internal set of networks that are connected to the outside world via an Internet service provider (ISP) or some arrangement wherein they lease lines from some commercial carrier. The Web has become one of the primary lifelines for many firms connecting them to their customers and suppliers. They can also examine and monitor their competitors and the overall business environment.

In many ways the Web and the Internet are just the tip of the iceberg for businesses. A manager can operate from "nowhere" and "everywhere." Across the breadth and depth of this great mercantile nation, executives and working people can conduct whatever orchestra they wish to in the confines of their virtual space. Being "someplace" is out of date. First there was the cell phone which gave powers land lines never dreamed of. That flexibility allowed any user to be nowhere while talking about anything or nothing. Even more important is the remote handheld device, which for most business people is either the BlackBerry or the iPhone. For most of you these are givens, but for the typical businessperson these are dramatic happenings. As late as 1999 it was necessary for a worker to check into the office in person every so often. Now no such contact must take place. With the BlackBerry or iPhone one can do a number of things from nowhere—read and answer e-mail, get interoffice gossip, and even manage subordinates who themselves may be nowhere. There are other tools as well—the fax, voice mail, and video which all can be stored and retrieved on the handheld device. The movement of dense storage capacity will permit one's entire life (music, books, e-mails, voice mails, every business document) to be stored on a single handheld device by the year 2015.[14]

A Web publishing phenomena called wikis,[15] enable users to easily edit or update an existing Web page. User-created wikis such as the Wiki Encyclopedia (Wikipedia) have been getting a lot of attention. Wikis are invading the corporate workplace along with

blogs. Several smaller companies have used wiki platforms to develop their corporate intranets. The technology is free, and it empowers the employees to engage in information sharing more actively. However, not all companies have wanted to empower their employees with the ability to edit the corporate intranet. To many companies, the intranet represents the corporate voice and therefore needs to be controlled tightly.

In a similar fashion to blogs, wikis do have a role in the workplace but only if they're used for the right purpose and if they have the right culture to flourish in. Many smaller, less structured companies have embraced wikis as their intranet technology platform. For these organizations with flatter, less formal hierarchies, the self-correcting mechanisms of a wiki create the right balance of empowering the employees to share and preventing things from spinning out of control.

Larger organizations are taking a more cautious approach to wikis. In these organizations, wikis are being used to support small project teams that need to do extensive collaboration whether it is around a product or a research article. Expect to see a lot more mini-wikis in the workplace in the near future.

Mini-Case 20–1W: Virtual Strategy Session

Event

Under CEO John Browne, British Petroleum has worked to become flatter, faster, and more democratic. That's easier said than done in a company with 53,000 employees—many of them stationed in remote locations like the North Sea and Alaska's North Slope. Where do you hold a companywide strategy session when your people are scattered around the world? On the Web. Last summer, BP convened a three-day Innovation Colloquium to devise ways for the company to become more creative. It was a high-priority event. When BP convenes these colloquia, they involve its most senior people. This session brought together CEO Browne, 70 other high-ranking BP executives, and a star-studded cast of outsiders, including a well-known futurist, a senior official from the U.S. Army, and executives from Intel and McKinsey and Co.

One other group was invited as well: the 20,000 BP employees with intranet access. "The topic was innovation, so we wanted the event to be innovative," says Pearse. "The feedback we got from all parts of the world bowled us over. We'll never do a conventional meeting again."

Agenda

The physical gathering took place at BP's training and development center, 10 miles west of London's Heathrow airport. Several days before the event, Pearse's five-person Web team sent out a companywide e-mail and included a URL so that people could attend virtually. People who logged on could review presentation slides and handouts, and hear a real-time audio broadcast of the proceedings. They could also e-mail their questions from the field—including the oil fields.

According to Pearse, 10 BP workers on an oil platform in the North Sea spent the night shift discussing one of the sessions. They then sent e-mails about innovation in their work. Pearse was amazed: "Here you have all these high-level executives participating, but you also have a bunch of engineers floating around in the North Sea. We tried to make it obvious that their comments were making it into the room."

Reviews

BP's Web event was a gusher. Thousands of employees visited the site as the session was happening; hundreds more have accessed an archive of the proceedings. Pearse says the company's next Web gathering, a Futures Forum to explore BP's competitive environment over the next 20 years, will incorporate streaming video as well as real-time audio. It will also incorporate lessons that Pearse and his team learned during the innovation sessions.

First, Pearse says, you have to make Web events feel "live"—and lively. The BP event included a clock that "counted down" to when each session would start, photos of the facility, copies of all the materials the delegates received—even dinner menus.

Second, he adds, you need to make it easy for people to be heard. Offering access to an event isn't enough. You also have to engage in dialogue and debate. BP employees could click on a Feedback button and offer their thoughts to people at the gathering. "Employees can feel excluded. This event improved BP's family feel," Pearse says. "It created shared context."

Communication Technologies

Supporting the cell phone, the fax, and all the handheld devices is a wide array of wireless networks and equipment including surface–wireless ground communication in the form of high-frequency, short radiofrequency waves. These waves could be reflected off low-level satellites—this is what most cell phones and handheld devices use. For more high-powered, detailed transmissions terrestrial microwaves are used. In the office setting each part of the typical firm is supported by a **local area network (LAN).** Typically the LANs have been connected by physical wires carrying electricity such as Ethernet cable—these lines are being replaced by either fiber-optic technology, which uses light instead of electricity to transmit data at a much higher speed, or wireless which uses the air waves. The various LANs are connected together and may span an entire campus facility. This type of network is usually called a wide area network (WAN). The media for most WANs is either fiber-optics, wireless, or a combination of these media. The WAN line is conveyed over dedicated lines that are constantly available for high-volume traffic of the firm, or over switched lines, which are shared by a number of firms and are operated either by a private or public carrier. Switched lines transmit or route the firm's data based on the entire occurring traffic.

What makes the networks run is various kinds of communication equipment. The workhouse of any network is the router. A router is a special-purpose computer that can be programmed to route traffic from and across the various interfaces connected to it. The router is the backbone that connects all of the switches and hubs (which are in turn connected to the various workstations and devices such as printers and servers). Routers have the ability to route traffic based on the Internet protocol (IP) address contained in the data transmission packet. Each device such as a workstation, print server, and database server has a unique IP address assigned to it. Each interface on a router can support an entire local area network, or the interface can be connected to another router. The connection of the various routers forms a wide area network. Of course, the local area network is not just the router interface but all of the computers (containing network interface cards), the hubs (a device that connects a number of communication lines), and switches. (The difference between the hub and switch is that switches make decisions to concentrate connectivity and traffic regulation.)

COMPUTER-BASED TECHNOLOGY

Toward an Information Technology Framework

An examination of the organizational technical system from multiple perspectives is likely to shed some light on the complexity of the technical system, its potential cause-and-effect relationships with other systems within the organization, and its potential effects on human behavior and performance. Although controlled studies of IT impacts have been few, it is widely claimed that IT improvements require changes in organizational structure and managerial processes. Studies associate IT innovations and applications with corporate downsizing, elimination of organizational levels, improved cross-department coordination, and better interorganizational relationships. Some studies associate IT advances with greater organizational flexibility, open flow of information, greater participation and voluntary input, and decentralization.[16,17] Managers seem to also use IT for greater formalization, standardization, and centralization. Managerial philosophy and corporate culture have substantial bearing on the relationship between IT and structural characteristics.[18]

At the organizational level, knowledge is generated from internal operations or from outside sources communicating with the corporate structure. This includes communication with partners (mostly suppliers or customers). Once created, knowledge is accessed when needed from sources inside and outside the firm. Knowledge is transferred in a formal manner through training or in a less formal way through work-related experiences. Information is represented and conveyed in printed or displayed forms, reports, graphs, and charts; knowledge is using the information in an appropriate way. At some point the validity of the knowledge has to be established. After validation, knowledge is internalized within the organizational framework in its processes, systems, business rules, and practices. With the need to maintain a sustainable competitive advantage, critical knowledge cannot reside passively in the minds of employees. It has to be accessed, synthesized, augmented, and deployed. A system has to be employed to use information to the firm's advantage. The organization must learn to employ knowledge rapidly and uniformly. Certain IT innovations have come forward to aid the firm in actively creating and utilizing knowledge to create an intelligent system.

Today's widespread dependence on IT requires more effective knowledge management. Improvements in IT make it easier to collect, store, and distribute information. However, to be effective, **knowledge workers** need to understand and to act on that information. Knowledge management allows them to leverage their organization's resources to achieve their business goals. The progressive firm today requires some form of an intelligence array of information technologies. These technologies are best described as four IT subsystems: the enterprise resource planning (ERP), the relationship with the organization's vendors [supply chain management (SCM)], the relationship to the organization's customers [customer relation management (CRM)], and the deployment of business intelligence (BI) to attain and sustain competitive advantage. (See Figure 20–3W.)

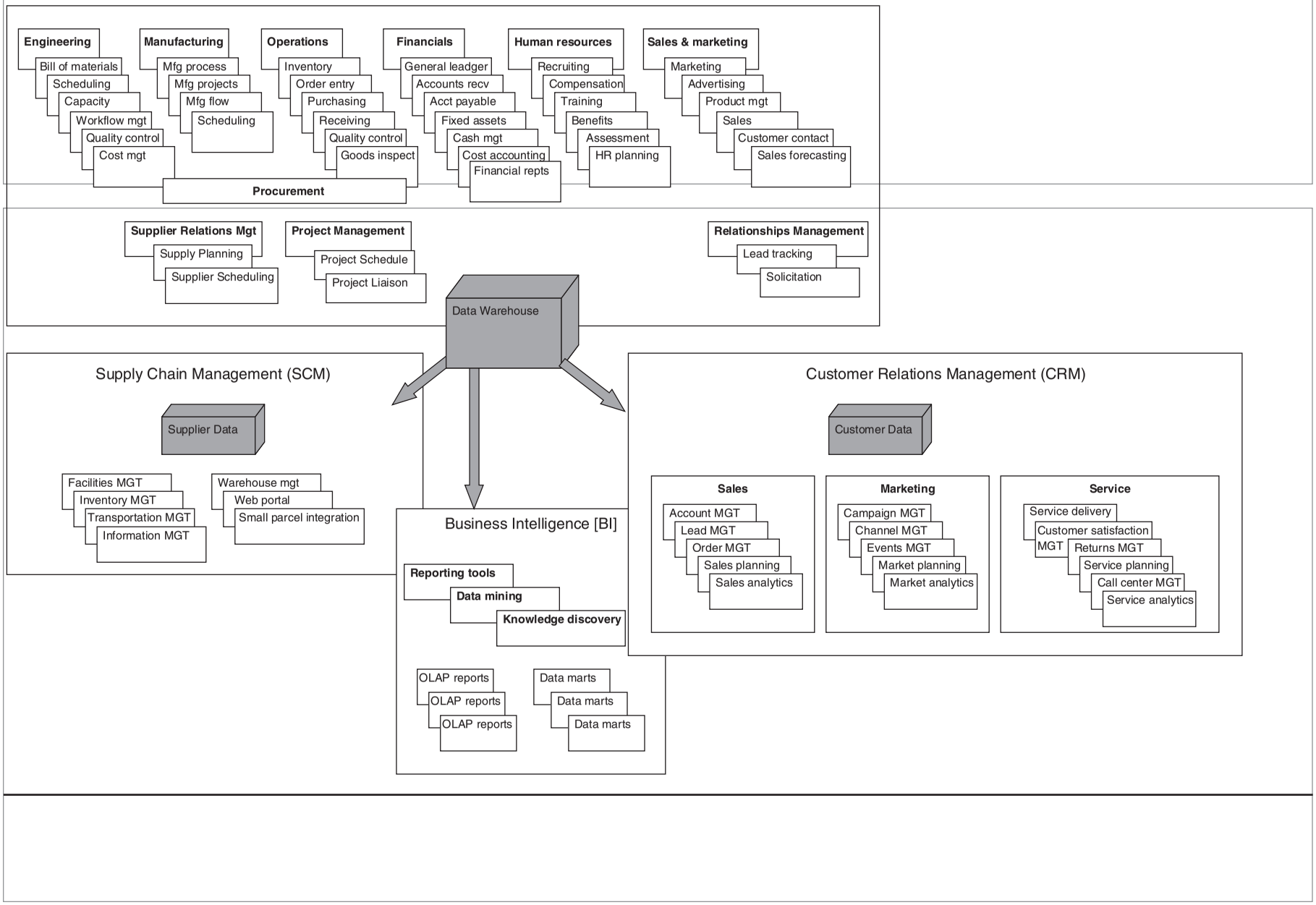
The Information Processing Engine

The core of any business is its online transaction processing systems (OLTP). All basic operations of the firm depend on the accurate and timely processing and maintenance of transactions. A transaction usually starts with some interface with a customer or a supplier. On the customer side a customer may place an order or make a payment that would set off a whole series of activities within the firm's transaction processing systems. An order could generate an inventory transaction, an assembly transaction or request, and a shipment and billing transaction. After the order has been received, processed, and shipped, an accounts receivable transaction is generated which results in the issuing of a bill to the customer. The payment by the customer would in turn generate a series of internal and external transactions. All of the transaction data is stored and maintained in the corporate database. OLTPs are now "increasingly responsible for supplying accurate data to be stored long-term in the firm's data warehouse. Furthermore, the emergence of business-to-business and business-to-consumer electronic commerce is drawing attention to well-designed OLTP systems capable of gracefully managing large volumes of transactions."[19]

From the knowledge worker's perspective, OLTP systems are extremely dynamic. New records are continually being added, and existing records are being updated or deleted. This forms an environment at the operational level of nonstop change. Historical data are maintained only to meet the requirements of operational reporting and management. The various transaction systems provide summary and exception data to management as a formalized query and reporting system—traditionally called **management information systems (MIS).**

MIS systems have been designed to support the operational and tactical decision-making of midlevel managers and their staff. An MIS, typically, is targeted to a particular functional area or business unit (for example, the controller or the sales manager). Therefore, a number of overlapping MIS systems often exists—the reason being the need for managers to have access to information that affects their sphere of operation as well as the general coordination of the firm's activities. Many organizations have a corporate information system (CIS) that provides operational and tactical data to senior management. The CIS is a formalized query and reporting system, similar to an executive information system—the difference being the CIS provides data based on the firm's OLTP activity.

Figure 20–3W Enterprise Resource Planning (ERP)



The CIS is a pulse on the firm's internal operations. The data contained in the OLTP systems, the MISs, and the CIS constitutes the corporate database.

So far we have described the traditional view of a company's **information processing.** Most companies have embraced the use of enterprise resource planning systems to automate all of their business processes and to provide a convenient, homogeneous way to convert and integrate all of the information processing systems that have evolved over the life of the organization. Today when a customer services representative (CSR) takes an order from a customer in the order fulfillment process, he or she has all the information necessary to complete the order (the customer's credit rating and order history, the company's inventory levels, and the delivery schedule). Everyone else in the company will automatically see the information that the CSR types into the ERP system. When one department finishes with its part of the order fulfillment process, it is automatically routed via the ERP system to the next department. To determine where an order is at any point in time, a user only needs to login the ERP system and track it down.

Enterprise resource planning software[20] doesn't live up to its acronym (ERP). Forget about planning—it doesn't do much of that—and forget about resource, a throwaway term. But remember the enterprise part. This is ERP's true ambition. It attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs.

This is asking a lot of any integrated system—it's pretty difficult to build a software system that really serves accounting and finance, production and materials management, and human resources. Traditionally these functional areas have constructed their own systems optimized for the particular ways they do their work. ERP systems attempt to combine them all together into a single, integrated software program that runs off a single database so that everyone can more easily share information and communicate.

Putting one of these systems into an organization is a long and costly affair. However the integration approach can have a tremendous payback if done correctly. Going back to our customer order example—previously when a customer placed an order, that order began a mostly paper-based journey from in-basket to in-basket around the company, often being keyed and rekeyed into the various functional area computer systems. The journey through the in-baskets caused delays and lost orders, and the repetitive keying into different computer systems invites errors. We humans do tend to make mistakes if given the chance. And, no one in the company likely knows the status of the order at any given point—unless, of course, each system talked to the other systems.

ERP systems and their material requirements planning (MRP) predecessors have been around for a long time. Aberdeen Group[21] found a wide range of maturity across ERP implementations. A full 31 percent are more than 10 years old. Ten years ago the breadth of functionality available from ERP solution providers was far different than it is today and the technology was worlds apart. Even less than seven years ago, at the turn of century, amidst the Y2K (year 2000) scramble, the solution landscape was far different than it is today and probably a healthy portion of those 34 percent with ERP implementations that are 5 to 10 years old were selecting from a menu of options significantly reduced from today's offerings. As a result, a wealth of homegrown and custom applications have been developed and adopted over the years to fill gaps previously left by MRP and ERP solutions of days gone by. High levels of customization, combined with aging technologies presents a significant challenge to ERP strategies today.

ERP is designed in a modular structure—allowing the company to pick and choose the software components that it needs. As modules are deployed they continue to be part of a single unified software system. Finance, manufacturing, and the warehouse all still get their own software, except now the software is linked together so that someone in finance can look into the warehouse software to see if an order has been shipped. Most vendors' ERP software is flexible enough that you can install some modules without buying the whole package. Many companies, for example, will just install an ERP finance or HR module and leave the rest of the functions for a later day.

Back Office, Front Office, and Way Back Office Systems

ERP takes a customer order and provides a software roadmap for automating the different steps along the path to fulfilling it. When a customer service representative enters a customer order into an ERP system, he or she has all the information necessary to complete the order—the customer's credit rating and order history from the finance module, the company's inventory levels from the warehouse module, and the shipping dock's trucking schedule from the logistics module. Assuming everything is put together the order process should move fast through the organization. The customers get their orders timely and error-free. It isn't just the order fulfillment process being supported; the other major business processes, such as employee benefits or financial reporting, also are supported.

We frequently call these processes the *back office.* These are the well-oiled elements that support the business—the technical system.[22] The front office is more the social system. With ERP the CSR is not just some low-level operative. Their ERP workstation makes them business people—the first and most likely the main contact with the customer. In their world they can see the customer's credit rating from the finance department and the product inventory levels from the warehouse that gives them a pretty good idea whether the customer pays on time and if the company can ship the order on time. These decisions affect the customer and every other department in the company. The customer service rep could be the make-it-or-break-it point of a sale. They don't do this alone—they depend on the back-office people in the warehouse who used to keep inventory in their heads or on scraps of paper but now need to put that information online. If they don't, customer service representatives will see low inventory levels on their screens and tell customers that their requested item is not in stock.

People don't like to change, and ERP asks them to change how they do their jobs. That is why the value of ERP is so hard to pin down. The software is less important than the changes companies make in the ways they do business. If you use ERP to improve the ways your people take orders, manufacture goods, ship them, and bill for them, you will see value from the software. If you simply install the software without changing the ways people do their jobs, you may not see any value at all—indeed, the new software could slow you down by simply replacing the old software that everyone knew with new software that no one does.

Today customers and suppliers expect to have access to the same information you as an employee might have—things like order status, inventory levels, and invoice reconciliation—except they want to get all this information simply and directly from your company website or maybe even their website. This is e-commerce the front–front end and the back–back end. E-commerce means your company has to have two channels of access into the ERP system—one for customers (otherwise known as business-to-consumer) and one for suppliers and partners (business-to-business). These need two different types of information from your ERP system. Consumers want order status and billing information, and suppliers and partners need to be able to plan and anticipate what you need from them. Most ERP systems now offer or interface with customer relations management and supply chain management in a fashion similar to adding ERP modules.

The idea behind CRM is to learn more about customers' needs and behaviors in order to develop stronger relationships with them.[23] Good customer relationships are key to a business's success. In terms of strategy for CRM to work the company needs to bring together a variety of information elements concerning customers and market trends so it can sell and market its products and services more effectively. CRM combines the technology and the social system to gain insight into the behavior of customers and the value of those customers. To keep their competitive edge the company must provide services and products that are exactly what the customer wants and to offer better service. It's important to retain existing customers and to discover new ones.

To be effective an organization must understand who its customers are and what their value is over a lifetime. The company must then determine what the needs of its customers are and how best to meet those needs. For example, most grocery stores keep track of customer buying habits and trends—they then try to stock the items the customer wants and to advertise and even send offers to the customers making them aware of related products they might also want to purchase.

In constructing the CRM system the organization must look into all of the different ways information about customers comes into a business, where and how these data are stored, and how it is currently used. Pottery Barn, for instance, interacts with customers in a myriad of different ways including mail campaigns, websites, physical stores, call centers, and other marketing and advertising efforts. CRM systems provide ways to link these points. They collect data flows to create and maintain an operational system (similar to the sales and inventory ERP modules). The other side of CRM is the analytical system used to sort through these records for patterns. Company analysts can then examine the data to obtain a big picture of each customer and identify areas where better services might make a difference.[24] For example, Dell computers has been very successful in online sales of personal computers to both businesses and the consumer public. Customer complaints about technical support being outsourced to the Far East together with a decline in repeat sales caused them to rethink their approach to the after-market sales support.

Mini-Case 20–2W: Challenges Faced by Utility Companies

Customer information systems (CIS) play a significant role in the financial and operational results of utility companies. It is the primary system for customer service orders, commodity usage, billing, credit/collections, and customer interaction. Utilities are faced with significant changes in operations and customer service due to increased energy demand, population growth, merger and acquisitions, PUC/federal mandates, and consumer demands.

Existing customer information systems were not built to react to changing requirements. On a broader level, many of the utility industry's most significant challenges and the majority of the sector's momentous opportunities revolve around legacy information technology. These outmoded and inflexible systems are costing utilities and their rate payers efficiency and money, and can hinder regulatory compliance and business growth. Most legacy systems perform well on company-specific processes and have been customized to efficiently process data in specific ways. However, these processes for billing, credit and collections, meter reading, payment processing, and other services do not accommodate new regulations, customer demand, and changing technologies. Further, legacy systems generally rely on outmoded and obsolete technology and require significant time and resources to maintain. Finally, there are only a few integrators in the market that truly understand these systems and how to tune them to maximum efficiency.

Some of the impediments to improving CIS are:

- Ability to adapt the CIS to changing business and IT strategy.
- Integration of CIS with business processes and other systems including additional customer care and billing systems.
- Difficult and costly merger and acquisition enablement and integration.
- Significant cost of application maintenance.
- Outdated technology and architecture infrastructure.

Utilities are looking for solutions that can deliver the capability to achieve operational excellence. They are also asking for individual components to address their needs for CIS/CRM or EAM. For example, in the CIS area these components must provide a complete billing solution for all rates—simple to complex—as well as transparent integration with meter data management. Another example is the need for the solution to address CRM requirements such as customer intelligence applications for contact management, targeted communications, scheduling, case management, analytic capability, and an e-business layer for customer self-service. However, achieving excellence today has to address not only the internal business process requirements of a CIS

and CRM but also the enablement of the business processes itself. Optimized business processes is where a utility will achieve its customer service and cost efficiency goals.

To make CRM work it has to be manageable and incorporated in all of the necessary departments—not just the front end but anywhere that might touch the customer. To be responsive CRM systems need to be flexible and dynamic. Unlike ERP systems that consist of modules for most every aspect and business process, CRM isn't that clean. Companies have had to construct their own solutions and think carefully about what is best for your enterprise: a solution that ties together "best of breed" software from several vendors via Web services or an integrated package of software from one vendor. They need to also consider what data to collect and store. The key is again to align the business, CRM, and technology strategies across the organization.

Going the other direction from the back office into the organization, supply chain management is the way your company acquires the components it needs to make a product or service and deliver it to customers. To understand what goes into SCM we need to look at the resources required to meet your customer demands and expectations for your company's product or service. For most companies this means planning and procurement to provide products or services that are efficient, low cost, high quality, and of value to the customer. Backing away, you as the company choose those suppliers that will deliver the goods and services to create your product. Your company builds relationships and constructs processes for managing the inventory of goods and services you receive from suppliers—this includes receiving and verifying shipments, transferring them to your manufacturing facilities, and authorizing supplier payments. It's assumed that the company has defined the quality level and communicated the logistics on delivery and return.

Your company's supply chain consists of all parties, directly or indirectly, involved in the procurement of materials and services for your products. Supply chain management involves the management of information flows between and among stages in the supply chain to maximize total supply chain effectiveness and profitability.[25] Consider Starbucks—their primary product is coffee served at their various retail outlets. Starbucks doesn't own many of the companies that comprise its supply chain. Instead it establishes ongoing relationships with coffee farmers to ensure the quality and variety of produce at a fair price. Starbucks also arranges for transportation, storage, packaging, assembly, and delivery to its retail outlets. There are many other pieces of the product and service that need to be in place—coffee machines, spices, paper, and other support products that are designed to enhance the Starbucks experience.

Similar to CRM, supply chain management software doesn't come ready packaged. The five major supply chain steps discussed earlier compose dozens of specific tasks, many of which have their own specific software. Some vendors have assembled many of these different chunks of software together under a single roof, but no one has a complete package that is right for every company. For example, most companies need to track demand, supply, manufacturing status, logistics (that is, where things are in the supply chain), and distribution. They also need to share data with supply chain partners at an ever-increasing rate. While products from large ERP can perform many or all of these tasks, because each industry's supply chain has a unique set of challenges, many companies decide to go with targeted best-of-breed products instead, even if some integration is an inevitable consequence.

Business Intelligence—Using What You've Got!

Taking the ERP, CRM, and SCM together, most businesses have the infrastructure to initiate business intelligence. Business intelligence refers to a variety of software applications used to analyze "pictures or snapshots" of data from the organizations ERP, CRM, SCM, and other available or acquired internal and external information. BI as a discipline is made up of several related activities, including data mining, online analytical processing, querying, and reporting. Companies use BI to improve decision making, cut costs, and identify new business opportunities. BI is more than just corporate reporting and more than a set of tools to massage data. Using BI tools decision makers and knowledge workers can analyze data themselves rather than solely relying on the reporting and display of information provided in the ERP, CRM, and/or SCM systems. Conveniently most

ERP systems provide several modules to funnel and extract data into a data warehouse—a time-based storage system.

Data warehousing is a collection of decision support technologies aimed at enabling knowledge workers—executives, managers, and analysts—to make better and faster decisions through the use of BI tools. A data warehouse is a "subject-oriented, integrated, time-varying, non-volatile collection of data that is used primarily in organizational decision making."[26] Typically the data warehouse is maintained apart from the organization's operational databases. They are essentially snapshots of the various databases (ERP, CRM, SCM , and so forth) at various time intervals—enabling the manager to see the changes that have occurred in the company over time. Accompanying the data warehouse is a specialized set of software routines used to preprocess the extracted data through the creation of indexes, partitions, aggregations, and summarizations to support high-performance, complex queries.

BI queries are commonly used to analyze past data by various factors and plan future strategies. Concurrent transaction updates in a data warehouse are normally not supported. Instead, data are updated on a periodic basis. **Data warehouses** typically hold considerably more data than is stored in online transaction databases, which are used for timely information requirements. Thus the extracted data gradually becomes dated. An overnight or weekend refresh of the data extracted is often used along with some form of asynchronous replication. Data warehouses are targeted for decision support. Historical, summarized, and consolidated data are more important than detailed, individual records. Warehouses contain consolidated data from many operational databases over long periods of time; they tend to be orders of magnitude larger than operational databases.

Restaurant chains such as McDonalds, Burger King, Wendy's, and T.G.I. Friday's are heavy users of BI software (CIO ABCs of BI). They use BI to make strategic decisions, such as what new products to add to their menus, which dishes to remove and which underperforming stores to close. They also use BI for tactical matters such as renegotiating contracts with food suppliers and identifying opportunities to improve inefficient processes. Because restaurant chains are so operations-driven, and because BI is so central to helping them run their businesses, they are among the elite group of companies across all industries that are actually getting real value from these systems.

Another part of BI is the *business analytics.* In retail, Wal-Mart uses vast amounts of data and category analysis to dominate the industry. Harrah's has changed the basis of competition in gaming from building mega casinos to analytics around customer loyalty and service. Amazon and Yahoo aren't just e-commerce sites; they are extremely analytical and follow a "test and learn" approach to business changes (CIO ABCs of BI).

Data mining, a more passive analysis technique, is the process of automating information discovery.[27] Data mining automates the process of discovering useful trends and patterns. Central to data mining is the process of model building. Creating representative models based on existing data sets has proven useful for understanding trends, patterns, and correlations, as well as for forming predictions based on historical outcomes.

The Knowledge Center

A knowledge worker in today's changing business environment cannot rely on informal methods for obtaining and sharing knowledge. Just walking down the hall to get a cup of coffee and engaging other knowledge workers in conversation will not suffice. **Knowledge centers,** sometimes called "virtual coffee rooms," are emerging as a place where communities of practitioners who share expertise in areas such as change management, advanced technologies, and project management can meet. By categorizing areas of knowledge, clients and employees have a way to find the appropriate contact where they need information. Knowledge center associates—subject matter experts—are responsible for adding to the company's knowledge store through research papers, documented case studies, shared client experiences, and more. The knowledge store is a complex of collaborative computer-based team support products, document managers, and intranet tools, similar to that shown in Figure 20–3W. The objective is to build a collection of reusable assets that can be deployed throughout the organization, allowing knowledge workers to enhance their work activities through the sharing of resources and ideas.

The knowledge center enables knowledge workers to get information that doesn't already reside within virtual libraries. Through means of a virtual "help desk," an e-mail to knowledge center associates and IT personnel returns answers and suggestions for problem solving. The knowledge center works because the associates are committed, as part of their scope to work, to treat the knowledge inquiries as a high priority. Without this process, a person looking for information would only be able to access the knowledge center resources and to contact individuals that he or she knows. Instead, the knowledge resources of all of the associates are available to the inquirer. Employees can work more efficiently by reusing ideas instead of starting from scratch.

Advances in Information Technology

IT plays a vital role in supporting executive judgments about the external environment and internal organizational capability, experience, and competitive advantage. In today's rapidly changing environment, information about market conditions and product acceptance must get to senior managers quickly. Strategic information systems and executive support systems are two IT tools that allow rapid movement of information to executive decision makers. Available to the executive and his or her staff are a variety of tools and techniques to access the firm's data warehouse.

There are a variety of available information technologies that can help the way that products are produced, marketed, shipped, and sold.[28] Companies have been using their integrated networks, electronic data interchange (EDI), e-mail, shared databases, digital image processing, bar coding, RFID, and interactive software to replace telephone calls and paper-processed procedures for product design, marketing, ordering, delivery, payment, and customer support. Trading partners can directly communicate with each other, bypassing middlemen and inefficient multilayered procedures. The Internet provides a public and universally available set of technologies for this purpose. The Internet is rapidly becoming the technology of choice for electronic commerce because it offers businesses an even easier way to link with other businesses and individuals at a very low cost. Websites are available to consumers 24 hours a day. New marketing and sales channels can be created.

Companies are using the Internet to make product information, ordering, and customer support immediately available and to help buyers and sellers make contact. Some of the Internet electronic commerce initiatives represent automation of traditional paper-based business processes, while others are new business models. For example, the Gap has an online catalog of the same merchandise that it stocks in its retail stores. Orders can be processed by the Web or by fax or phone. E-businesses, such as Amazon.com (a virtual bookstore) and Security First National Bank (a virtual bank), have another business model.

The Internet has created a variety of challenges to businesses. New channels of communication and interaction are creating closer but more cost-effective relationships with customers, sales, marketing, and customer support. Cisco Systems, a leading manufacturer of network equipment, conducts the majority of its sales electronically, with over a billion dollars in sales per year coming through its website. The king of electronic sales, though is Dell Computers. Virtually all of Dell's sales are over the Internet—making them one of the major providers of desktop computers in the world. Order taking, credit checking, production scheduling, technical support, and routing customer-support activities are handled online by Dell, Cisco, and now a multitude of others not just in the high-tech arena but in virtually all kinds of retail and wholesale businesses.

In light of these advances in IT, goals and strategies determine which critical tasks will be accomplished along with new work processes. **Procedure-oriented IT** innovations allow reconceptualization of basic tasks and work processes. These systems are used for repetitive tasks such as ordering and billing. They include transaction processing, management information and control, and formalized tactical and operational decision support. As applications were moved from the mainframe to network environments, newer, more flexible software technologies was utilized. Such systems facilitate changes and permit easier access to information stored in distributed databases (distributed could be either logically divided into different kinds of data or applications or physically divided or located at say multiple plant and facilities). In many case, these systems are

fundamental to the core technology or transformation process. Insurance, banking, investment, travel, and related organizations focus on selected transaction processing systems to conduct their external business operations. Within manufacturing firms, computer-aided design, computer-integrated manufacturing, and electronic document interchange (EDI) with vendors and customers have been aggressively implemented. In these examples, procedure-oriented systems are mission critical.

Tool-oriented IT systems are designed to help people communicate and make decisions at all levels and locations within the firm. Teleconferencing, e-mail, voice mail, and collaborative team-based support applications are usually categorized as tool-oriented systems. With the introduction of the PC and the later introduction of the LAN, the majority of managers and their staff used the computer as an extension of their work. The tool-oriented IT systems are made up of end-user software products ranging from spreadsheets (for example, Excel), word processors (for example, Word), data management (for example, Access), and e-mail (for example, Microsoft Outlook) to team-support products (for example, Domino and Microsoft Exchange), and software to assist in data interchange with corporate systems.

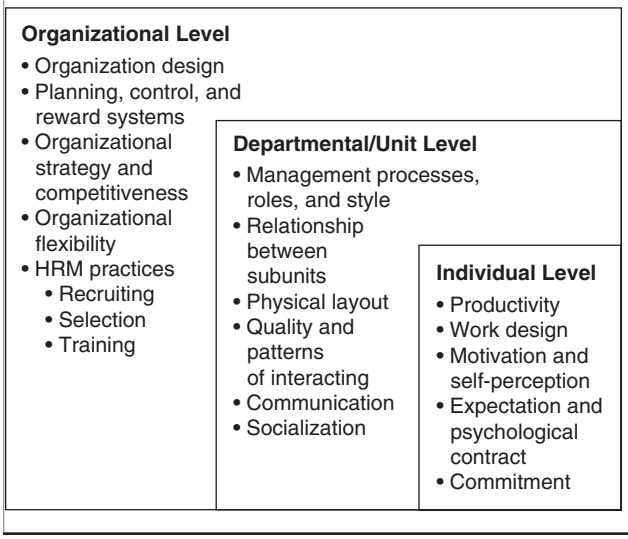
Information Technology and Organizational Behavior

The choices made by those who design and select both the technical system and the path to IT utilization will affect the way people in organizations behave, how productive people are, how teams function, and how the organization performs. To understand the specific impacts of the technical system and the permeating influence of information technologies, we need to know the specific configuration of the technical system and the planned or anticipated development of information technologies. Given the dynamic aspects of IT innovations, this may constitute a moving target. One study identified the following assumptions about the technical system: The same technology can be configured in a variety of ways to produce the same results; changes in any one component or in a set of components are likely to affect activities, interactions, and outcomes; technology is a heterogeneous rather than homogeneous concept in an organizational context; and technological changes evoke organizational changes.[29]

The impact of technology on organizational behavior is apparent at the individual, subunit or department, business unit, and organizational levels. Some of the effects are direct, immediate, and intended; others are indirect and unintended and might surface at a later evolutionary stage. Attempts to explore the effect of technology and behavior require an investigation of all levels and of the potential cause and effect among levels. (See Figure 20–4W.)

The most noticeable effect of the technical system on individual behavior has to do with productivity and performance. The nature of the technology is likely to impact how work is designed and the character of task activities. From a work design perspective

Figure 20–4W
The Effects of Technology on Organizational Behavior



(see Module 13), it can be argued that the introduction of technology or technological change is likely to affect the level of task variety, task autonomy, task significance, and feedback among core job dimensions. Beyond the direct impact on work design and productivity, technology indirectly affects the individual's psychological states such as self-perception and perception of self-worth, expectations about self and others and one's role, the psychological contract that the individual has established over time with the organization, work motivation, and potentially, the level of individual commitment to the job and to the organization.

An examination of the effects of the technical system at the subunit or department level reveals effects on basic management roles, processes, and styles; the quality of relationships between subunits and their communication patterns; and their physical layout. In a specific plant, the introduction of robotics on the manufacturing floor required a variety of changes such as revised physical layout of the assembly line; more integration between engineering, manufacturing, and maintenance; changes in the managerial roles from those that emphasized monitoring quality to those that stressed coaching and training; and changes in the reporting structure.

The technical system and the choices made about potential technological changes have an effect at the organizational level as well. Roles and relationships between functional areas and departments, the actual design and structure of the organization, planning and control processes, organizational flexibility and competitiveness, and human resource practices are all influenced by technology.

Another study identified four categories of information technology that can impact organizations in the future: (1) individual work support, (2) team work support, (3) advanced organizational automation, and (4) enhanced global communication.[30] As can be seen in Figure 20–5W, the authors identified the specific types of information technologies that are likely to have an influence on each one of these areas.

Already many of these technologies have come to pass. Not mentioned but very prevalent today is the emergence of e-commerce as a new way of conducting business.

An obvious technology trend is that the cost of IT is decreasing and its functionality is increasing at an exponential rate. "It has been observed that if automotive technology were to change at the same rate, a Rolls Royce would cost less than ten dollars, give over one hundred thousand miles per gallon, and go at a speed of over one million miles per hour."[31] The benefits of IT can be summed up as savings of human work time. Work involves many transformations of information from one medium to another. There are many shadow activities consisting of unforeseen and foreseeable time-consuming activities (for example, errors in typing, busy signals) that do not contribute to the end product. IT can improve the efficiency of such operations by automating all or some of the office processes, eliminating some of the transformation of medium, eliminating the shadow activities, and speeding up the information process itself.[32]

Figure 20–5W

Information Technology of the Future

Individual Work Support	Collaborative Team Support	Advanced Organizational Automation	Enhanced Global Communications
High-bandwidth portable computer	Collaborative support tools*	Electronic data interchange (EDI)*	Language speech translator
Knowbot	Cyberspace	Virtual reality sales	E-mail and voice mail*
Advanced forms of multimedia	Virtual reality for teams	Automated customer support response systems*	Videophone and desktop videoconferencing
Virtual reality*	3-D Web surfing (Green, MIT Technology Review)	Customer information systems (Spanke, CSC)	Videoconferencing*
Personal telephone and number	Social computing	Enterprise content management (ECM)	Telepresence
Bluetooth-enabled devices — cell phones, headsets, cameras, keyboards, printers. (Lev-Ram, Business 2.0)	Virtual teams		International highway of business communications
			Global integration networks (Smith, Forbes)

*Source: L. Thach and R. W. Woodman, "Organizational Change and Information Technology," *Organizational Dynamics* 23, no. 1 (1994), p. 34. Reprinted by permission of the publisher. All rights reserved.

Experience with many large multinational organizations has shown that corporations usually take one of three fundamental positions related to the competitive use of information technology. Corporations are either adoptors, adaptors, or inventors of IT.[33] Some companies simply buy off-the-shelf products and do not undertake more than routine applications of their purchased systems. Their goal is usually either short-term survival or catching up with competitors. At this level, virtually any organization can increase its business advantage through the proper application of IT products, but most **adoptors of IT** must build (or rebuild) a basic technological foundation. IT adoptors can often be found in stagnant industries, in regions of depressed economies, or in companies with insufficient capital resources. However, a company may find itself in this position simply because of the failure of its senior management to recognize the competitive value of IT.

Adaptors of IT are developers and users who have already made IT an essential element of their value-based planning. They have the awareness, capability, and funds to undertake internal development. They cultivate close working relationships with suppliers, an approach that allows the companies to take advantage of developments in which timing is critical. These companies generally have developed applications that match those of their competitors. This includes maintenance and enhancement of existing applications as well as a focus on expanding and innovating new and existing applications.

Adaptors of IT are found in expanding markets. They tend to be global in scope, operate with strong competition, and have rapidly changing products. They enter new markets by acquiring other businesses. Senior management members in adaptive corporations recognize the competitive value of IT and choose to involve IT as an integral part of the planning process.

Inventor companies are technology creators. **Inventors of IT** seek opportunity through scientific breakthroughs and innovative use of state-of-the-art technology. Technology inventors are often found within the IT industry, for example, computer manufacturers and software vendors or suppliers. Some software development companies' overall objective is to tailor applications to companies' needs in a given area. These developers simultaneously seek to develop resources for their own competitive technological advantage.

There may be a point where organizational effectiveness can be affected by a firm becoming too lean. There most likely is a certain minimum organizational size that must be maintained to be effective—particularly as a global marketer.[34] Networks are a form of IT and new management techniques that allow people to work together and achieve "scale power." Competitive pressures, increasing costs, "enlightened applications" of information technology, the threat of corporate control, and demands for executive accountability have induced firms to trim staff, reduce lines of business, and create autonomous subsidiary units. New technologies have reduced the optimum size of many businesses.

Information Technology, Work Design, and Organizational Flexibility

In the 1960s and 1970s, computers were used primarily for accounting and control systems. Most computing was centrally controlled and administered. In the 1980s, the personal computer was introduced, making local and departmental computer tasking possible. In the 1990s, the introduction of networks brought together the critical computer facility with the departmental systems. In the last part of the 1990s, the introduction of data warehouses and data-mining techniques facilitated the corporatewide access and sharing of vital data. By the turn of the century many companies had begun to embrace the application and use of ERP, SCM, CRM, and BI. These companies are now positioned to shape future tasks.

Information systems and other IT choices were designed to support the basic managerial structure. The traditional view was that information systems choices followed virtually every other design choice. Accordingly, an information systems plan was unnecessary if an overall strategic plan and an operational plan had not been formulated. New IT capabilities such as the widespread use and acceptance of ERP have enabled management to reverse this sequence and identify situations in which other forms of IT drive consideration of task processes, grouping, linking, and managerial process alternatives. At the minimum, IT considerations play an important role in design choices concerning administrative grouping of employees, work location of employees, and coordination of employee

activities across departments. The IT connection to grouping decisions is illustrated by the dilemma of the physical location of employees. In matrix organizations within the defense industry, executives must often decide whether to place technical employees such as systems engineers within multispecialty project teams (using a project matrix form of structure—see Module 13) or to place specialists within technical departments under the direction of functional supervisors (using a pure matrix form of structure). If this latter structure is chosen, project coordinators face the difficult problem of integrating diverse contributions from people working in diverse settings. The other extreme of grouping employees under project managers has the disadvantage of weakening professional expertise and training. Less experienced specialists are without mentors, and employees miss the ongoing support and problem solving from fellow experts in their fields. Recent advances with integrated networks and other IT systems allow reconsideration of grouping decisions. Many problems associated with matrix organizations can be alleviated through open communications among project coordinators, team members, and other specialists via integrated networks and groupware. For software development teams, the use of computer-aided software engineering tools can enhance productivity even if the team is dispersed throughout the organization.

MANAGERIAL ISSUES AND CONCERNS FOR TECHNOLOGY NOW AND IN THE FUTURE

The enabling information technologies today are faster, smaller, and cheaper. Each year, advances in microchips, optoelectronics, and other building blocks make possible new products and services that bring more people into the information age. Computers equipped with speech recognition can understand and serve as vanguards for human communication interfaces. Optoelectronics is speeding communication within and between computers. In data storage, better lasers are paving the way for denser storage and faster retrieval. Programmable software agents can do the grunt work for the firm—searching databases or sorting e-mail, performing knowledge exploration, and mining for meaningful relationships among data within the firm's data warehouse. Object-oriented programming now enables developers to reuse software components much like routine assembly lines in a factory. Wireless connections keep workers in touch with each other. Asynchronous transfer mode (ATM) switches blend voice, video, and data calls without delay. Compression gets more traffic on the information superhighway without adding lanes.[35] The problem is knowing when to switch to new capabilities and knowing when new capabilities should not be employed even though they exist. These problems are management problems, not IT problems.[36]

The office of tomorrow, long promised, is now a reality. The challenge now is the deployment of knowledge and intellectual capital as corporate assets enabled by the proper use of IT. The way a firm conducts its business may need to be rethought. Satisfactory substitutes for existing human interfaces are now being designed into new systems. Otherwise, those working in our offices of the future could potentially sabotage the potential of the new technologies.[37] IT offers the opportunity for organizations to react constructively to business turbulence and organizational change. Managing the impacts on knowledge workers is a crucial issue in developing and implementing information systems. The application of IT to work practices may provide personal opportunities for growth and make jobs more interesting and challenging. It may also devalue job skills and make jobs tedious or even obsolete.

By far the most important issue facing businesses is to integrate IT capabilities and perspective with their business operations and management.[38] Much of this integration is already in place with the introduction of operational data stores containing information related to the corporation and its partners, data warehouses, and knowledge-seeking (BI) engines. This integration, though, does not come easy. Critical IT workers should be part of the business unit management team, helping to shape and implement strategy. They should truly be at the table of those teams to address opportunities. The point of decentralization

and smaller units is to assign people the targets and accountabilities that we expect from them and then give them the opportunity to pull together resources so that they can achieve those accountabilities. That includes access to IT.

Case Study 20–3W: The Disruptive Power of Networks: The Internet Has Helped Shake up Our World. Here's What We Can Look Forward to Next

A third of a century ago Bob Kahn and I were connecting different packet-switching networks—the first stirrings of the Internet. Who knew that placing powerful, programmable assets into an interconnected communication network would be so unexpectedly disruptive, for good and ill. Consider:

- One-time receivers of information have now become the producers of it. Think of e-mail, blogs, Web pages, instant messaging, YouTube, Current TV, Facebook, MySpace.
- Virtually any digital content can be transported through the Internet at playback speed (Google Video, Skype, Vonage) and as file transfers (BitTorrent, Napster). The flat-rate pricing of Internet connections challenges the à la carte and content-based pricing traditional in telephone service, cable, and satellite radio.
- The Internet has unleashed a flood of group interaction. E-mail lists, multiplayer games, collaborative working tools, and group chat rooms are all examples of many-to-many forms of interaction largely unavailable before the Internet.
- The global Internet permits the harvesting of the "long tail" of user interest in goods and services without mass appeal. This was not possible in a world without eBay and Amazon.
- Never in the history of humankind has there been such widespread and nearly instantaneous access to such a large quantity and variety of information—or such clear evidence of the collaborative interest in the Internet user community (I think of them as Internauts) to share information. Wikipedia and the Human Genome Database are but two potent examples.
- Social networking allows thinly distributed groups to discover one another and to make common cause. Politicians have discovered that the Internet is a two-way street to relay messages to constituents—and get them back! Fundraising and political coordination have been raised to new levels of precision through the Internet and are playing a visible role in election campaign. Blogging and video-sharing demonstrate the power of individual voices to expose corruption and abuse.

There are dark sides we never anticipated:

- With more and more information about people available online, the Internet exposes us to invasions of privacy and identity theft. Anonymous postings may damage reputations, and name confusion can lead to a great deal of misinformation. Young people have been misled by interactions with predators; the Internet makes it easy to stalk people.
- Hand in hand with the privacy intrusions are security holes. Within a few minutes of being placed on the Internet a new computer may be probed by automated hackers seeking to identify new computer victims who unwittingly become the host for all sorts of pernicious activities—sending spam and launching denial-of-service attacks among them.

Overall, though, the disruptive aspects will, I believe, have positive effects, giving ample impetus to the creative energy of our global community. I have said that only 1 percent of all the applications of the Internet have yet been invented. What might a few of the other 99 percent look like?

The number of devices attached to the Internet will proliferate. Many of them will be household appliances or office gadgets. Some may be installed in automobiles or carried on our person, and many may be part of widely dispersed sensor networks. Web-based interfaces might be used to allow users to interact with and control their increasingly capable and complex entertainment or office systems.

We will see neural interfaces to computer-based systems that are the natural extension of today's cochlear implants. Some will be sensorineural (relating to nerves—for example, ocular implants) and some will be sensorimotor (spinal implants, for instance). Whether we will get a cognitive attachment (a memory implant) is still extremely speculative. How about a brain backup every few weeks or brain augmentation surgery? While the focus in the recent past on neural electronics has been on remediating impairments, there is no reason why these systems could not be used to enhance human capabilities, just as backhoes and calculators enhance human capabilities.

More predictable are self-aware buildings and cars. They will know when they are occupied. They will have the ability to keep an inventory of contents. (Have any of my wine bottles wandered off? Check the radiofrequency IDs.) Many cars are already able to navigate, and some models are aware of their surroundings, through detection of nearby obstacles or other cars. Self-guiding vehicles are a reality, thanks to the recent contest for the Darpa autonomous vehicle prize. It isn't hard to project this into a future of self-driven vehicles and self-flying aircraft.

The virtual and real worlds will merge so that Second Life will become part of First Life. Virtual interactions will have real-world consequences. Control of the electrical grid and power generation systems could be made to appear to be part of a virtual environment in which actions in the virtual space affect actions in real space. If your air conditioner is attached to the Internet, your utility might turn it off to prevent a brownout. Educational environments that mix real and virtual instruments and places will enrich the learning experience of schoolchildren.

Personal health monitoring can be aggregated into tracking entire populations to permit early detection of epidemiological threats or important health trends. Such methods might also increase the effectiveness of emergency treatment through controlled access to personal health records. Planetary monitoring and sensor networks will go a long way toward understanding and responding to the threat of global warming.

Mobile-knowledge robots will mine the data of the Internet, looking for correlations and unexpected patterns, alerting humans to items of interest. Google Alerts, which are e-mail updates of relevant news items and blog posts, are a prototype of such tools. Group alerts could become the basis for some forms of emergency management.

Customization of everyday products seems a likely avenue for development. Capturing specifications and turning these into production orders is the basic model for Dell computers and could easily be applied to many other products. Clothing, cars, and appliances of all kinds seem likely candidates.

Communication protocols, programming languages, and operating systems have created platforms for innovation unlike anything in human history. As computing power, memory, and transmission speeds continue to increase, opportunities to develop new products and services will multiply. Applications not possible in the past for lack of such resources will become feasible. The Web will continue to yield unexpected and stunningly useful services. Thankfully, the software frontier is endless.

As firms adapt to changing market conditions to meet competitive demands, they most likely will change the structure of the workplace through the formation of work teams operating in business units. Business processes can form the link between high-performance work teams and the corporation at large. Organizing around processes, as opposed to functions, permits greater self-management and allows companies to dismantle unneeded supervisory structures.[39] Organizations need to be certain that they help people understand why change is needed in the first place. They have a right to know what is going on if they are to be partners in change.[40] Technology is capable of generating enormous amounts of information. The key, again, is to transform that information into knowledge. The retrofitting of organization structure is vital. Decentralizing old corporation hierarchies and empowering employees who are making and selling products are the first steps

to improved productivity. Providing them with the right kinds of technology is the next critical step.[41] The organization's alignment with these new technologies is the third vital step.

Today, the real opportunity lies not in the infrastructure itself but in novel things that can be done with it to analyze and improve business models and find new opportunities.[42] The analysis of a business model can be complex, demanding a rigorous, disciplined approach, not unlike that of other scientific or engineering challenges. A business can be viewed as a system, with certain inputs and outputs and a great deal of churn in between. The detailed analysis of those in-between processes is where greater efficiencies can be gained, productivity improved, and new opportunities identified.[43,44,45,46] Just as with mechanical or electrical systems, developing a better understanding of how a business works can help one target improvements where they will have the most impact. Simple automation is not always the answer—as the old adage says, automate a bad process and all you have is an automated bad process.

SUMMARY

Technology is the tools, techniques, methods, devices, configurations, knowledge, procedures, and actions used by organizational members to acquire inputs, to transform inputs into outputs, and to provide outputs in terms of products or services to customers. IT is a special subset of technology that deals with computers, communications, user interfaces, storage, artificial intelligence, robotics, and computerized manufacturing. The nature and benefit of any of these technologies depends on the organization, the organizational unit as a team, and the individuals as they interact and use the various technologies.

At the organizational level, technologies can be divided into two types: manufacturing and service. These technology types are a function of the service or production processes of the firm. IT can be part of the production process or service provided by the company. IT can also be used to exploit the production process through the use of specialized hardware and software. Innovations in IT have recently played a part in corporate downsizing, elimination of organizational levels, improved cross-department coordination, and better interorganizational relationships. IT also supports executives through improved communication with the external environment, ultimately yielding a competitive advantage.

We have presented a variety of classifications of technology. We clustered technologies according to (1) the interdependence of the tasks performed, (2) whether there was a requirement to link with customers and clients, and (3) which specialized technique the technology used. At the department level we identified two dimensions of departmental activity: variety and analyzability. These dimensions formed the basis for four major departmental uses of technology: routine uses of technology, craft, engineering, and nonroutine or high-task variety. Within an organization focusing on manufacturing, there may be a wide range of computer-based systems: stand-alone systems in machining, cell systems for flexible manufacturing, linked islands to form production systems, and full integration of the manufacturing processes. We recognized the need to extend the information system to the firm's suppliers and customers. We concluded by noting that the choices made by those who design and select both the technology and the path to IT utilization will affect the way people in organizations behave, how productive the people will be, and how teams will function. As such, technology and information technology must be treated as key organizational processes that require vital managerial attention.

Study Questions

1. Although some argue that the technical subsystem is the defining feature of organizations, others argue that the technical system is only one of the many features that define organizations. State your position and provide your rationale.
2. Compare and contrast any two classifications of technology.

3. Describe a technical system in an organization that you are familiar with. How would you classify the system? How would Perrow, Woodward, or Thompson classify the same technical system? What about the process system described in this chapter?
4. Describe a technical system that is primarily service driven. Use the classification described in this chapter to define the various levels of personal interactions.
5. Describe a technical system in an organization that you are currently working for or that you have worked for in the past. Describe the relationship between the technical system and human behavior. Examine how the technical system affects human behavior.
6. Discuss and contrast the relationship between technology and information technology.
7. Describe an information technical system in an organization that you are currently working for or that you have worked for in the past.
8. Describe the relationship between the technical system and the use of information technology. Examine how the information technical system affects the business unit or group.
9. Review selected articles from *Business Week, Forbes, Fast Company,* or *Fortune* that deal with information technology. Describe the company and its use of these information technologies in terms of adoptors, adaptors, or inventors.
10. Using the various classifications of technology, develop a similar set of classifications for information technology wherein various forms of information technology support the technology classification.

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Activity 20–2W: Management Challenge of the Software Development Firm

Objective:

To explore the managerial challenge of managing changes in technology and information technology.

Task 1 (Homework):

Students are to read the following "The Software Development Firm" case and respond to the questions at the end of the case.

Task 2:

a. Individual students are to share their answers in small groups.

b. Each group is to then develop a joint response to be presented and discussed with the entire class.

c. The instructor will facilitate a class discussion of the main features of technology and information technology that have affected the Software Development Firm (SDF) and their potential impact and implications on organizational behavior.

Case Study: The Software Development Firm (SDF)

Local area networks (LANs) provide an ideal resource-sharing environment for organizational units that provide data of importance to a number of departments or work groups. SDF is a software development firm that underwent the transition from a stand-alone personal computer (PC) environment to a system of multiple interconnected LANs. Under the stand-alone environment, SDF personnel used PCs to support their work effort. Prior to creating a systemwide network, accounting used a Novell network within its area. The software development teams also used a Novell network, which did not communicate with the accounting network. These units were not connected; each worker or group operated independently of other personnel. The various units completed work using the PC for word processing, database management, spreadsheet analysis, and general

recordkeeping. As the organization grew, the need either to connect these units or to adopt a centralized system, such as a minicomputer or mainframe system, became apparent. Data were being reentered and duplicated, and inconsistencies existed between departments and between individual workers in the use of computer software, the levels of expertise, and the compatibility and quality of data. Production, marketing, and accounting were isolated islands of computing.

SDF produces utility software products for disk and file server management and backup systems for personal computers and microcomputer networks. At SDF, it was implied and expected that all in-house computer work should operate using state-of-the-art equipment and software. The company's switch to an interlinked, enterprisewide networked system was in response to advances in computer technology and corporate processing needs.

SDF is organized into six departments: two software engineering groups, accounting, sales, marketing, and administration. The two engineering groups are divided along product development lines. Several work groups were formed to support the work of more than one department. Technical support works directly with engineering groups as well as with the marketing department. International is a link-pin operation that combines both marketing and sales functions under a single work unit.

Every staff member has a personal computer on his or her desk. All of the machines are connected to a local area network, which in turn is linked to the other LANs within the enterprise. The network complex consists of four LANs, numerous shared printers, and a central database repository. A file server is a microcomputer dedicated to supporting the communication among the various personal computers. The majority of data and software are stored on disk units on the corporate database server. The PCs on the various networks all share and access these data concurrently. A print server is a PC to which a printer that can be shared is connected. Such units are not dedicated to printing; they can be used in the same way as any other PC on the network. Any user can send print work to various printer servers.

By using network software products, SDF was able to streamline all of its operations. E-mail reduced the overall time lag in phone/message tag. Voice mail was introduced to accommodate external communication; facsimile transmissions via and through the network eliminated delays in the traditional mail process. Groupware, appointment calendering, and scheduling software were introduced to allow individuals and departments to communicate and plan meetings and share their work electronically. Paper flow became an automated process as opposed to a manual process. Mailings, label generation, correspondence tracking, and surveillance were accomplished at the touch of a button. Software products that were being field tested could be monitored and tracked by the marketing staff from their offices. Coordination of effort in the development of the software products was enhanced through the sharing of software modules, which were available via groupware through the network file servers; this coordination ensured that all team members were using the same software and operating under the same standards. On a number of occasions engineering tested products internally, using the network and the support staff as a test environment. At times these internal tests created problems: work stoppages, inconsistent system performance, and system access malfunctions.

Within the support groups, the introduction of an integrated enterprise accounting system provided the mechanism to either reduce or streamline the paperwork regarding orders (for software products), requisitions for materials (e.g., sales brochures and promotions), and the delivery of merchandise to the wholesalers and dealers. Many standard manual tasks became automated.

For SDF, the introduction of an integrated network system changed not only the technology but also the entire mode of working relationships. There were both subtle and profound changes. Correspondence among workers (especially via e-mail, where privacy was ensured) allowed individuals to air out differences on issues and to share ideas. The frequency and duration of meetings, face-to-face discussions, written memos, and phone calls were reduced. The sharing of documents and in-process work reduced paper flow and errors. A new plane of communication was introduced. At the present time, there is no control over this level of communication between workers. At SDF, the electronic-desk facility for both the individual and the work group is being utilized on an increasing basis. Peer-to-peer communication (sending and receiving messages from/to other users without terminating the current task) on the workstation provided another communication facility. SDF also developed a product that allowed a user to initiate and terminate work remotely. With this facility a user could control work on multiple PCs from a single system.

With the introduction of the network at SDF, intergroup and interpersonal dependencies increased. Virtually every department and each individual's work activity relied on common/shared databases. Standards were introduced for personal software applications on the network. Many of the standard software decisions were based on network capabilities and software licensing considerations. Microsoft Office was designated as the company's suite of front-end support products.

Rather than having each manager use spreadsheets for budgeting and forecasting stored on their workstations, the controller established a template in the network version of Microsoft Excel. Each department used the same template for its budgets and forecasts, and the data were entered dynamically, that is, fed through the enterprise accounting system and other related modules. The various budgets and forecasts were consolidated so that senior management could, on demand, examine the status of the company.

A technical log system used by technical support provided a barometer of this area's activity. The log included a record of all customer inquiries and complaints and the technical nature of these problems. This system was tied directly to the registered user database. The registered user database was compiled from product registration cards. When a customer called, the help-line technician could verify that the caller was a registered user and could update the user database. The technician could also view a history of all previous communications with the customer. These data formed the nucleus for marketing, sales, and engineering support and enhancements. Figures on customer profiles, the nature of sales, noted problems, and any suggestions associated with products could be directed to and shared by various work groups.

With the introduction of the enterprise network, not only was there a redesign of work among the various organizational units at SDF, but also specific tasks were changed. Many manual or semiautomated tasks were computerized, as were stand-alone PC tasks. Instead of being entered on a log sheet, the basic information from technical support calls was entered into the technical log database.

Prior to the introduction of the enterprise network, each department constructed its own budgets and forecasts using whatever tool was appropriate (e.g., spreadsheets or handwritten notes). Some units were using Lotus and Foxbase for analysis and data storage. The move to the network and the use of standard software packages (e.g., Excel for spreadsheet analysis) facilitated uniform, consistent budgeting and forecasting. Accountability and budget tracking were available to the department managers, the accounting department, and senior management.

As a result of the implementation of the LAN, the clear lines of responsibility and use of information have become blurred. There have been conflicts regarding the content, entry, and recording of information. Before the enterprise network, all sales orders were handled by accounting, requisitions for materials were handled by production, and information requests were handled by marketing. Now any worker who has proper authority can initiate these entries from anywhere within the networks.

Before the networks were implemented, the accounting system consisted of accounts receivable, accounts payable, and general ledger software packages, operating on a LAN within the accounting department. Each package was fairly distinct, but data were imported and exported in a common form. The software packages closely followed the work of the various accounting staff members. Sales orders were written manually, and entries were made by the accounts receivable clerk. Payroll was performed by an outside service.

After the integrated system of networks was implemented, the accounting system became totally integrated with other parts of the firm. An enterprise accounting package that provided inventory control, accounts receivable and payable, payroll, general ledger, project management, bank book management, general ledger, fixed assets, and spreadsheet interfacing was selected and placed on the network. Other modules for sales and production were also acquired as part of this system. This package became the foundation for the enterprise. Virtually all departments became involved in the entry, inquiry, reporting, and use of accounting information. Many issues relating to privacy, control, credit, accountability, and responsibility arose.

Because anyone could potentially initiate a sales order, some form of control over credit approval had to be established. Previously, accounting maintained tight control over the authorization of credit. Now, the credit process within accounting became one of handling exceptions. The access and use of sales and other accounting data were no longer the sole province of accounting. Regulation of materials such as computer or office equipment, software, and supplies affected the way the departments had done business. Previously a department had been able to acquire any needed equipment that it wanted as long as the cost was within its budget.

Even though the network system provided for the integration of inventory with the accounting system, the production department has been slow to participate in the integration. There was a separate physical facility for storage and production of inventory when the network was installed. Because of this physical separation, the production area did not use the integrated accounting system, even though it had access to the network system. Overall, there was similar resistance on the part of experienced users to adopt the standard software packages. Many users opted to stick with their favorite spreadsheet (e.g., Lotus) and word processor (e.g., WordPerfect).

Assignment

1. Describe the major characteristics of the technical system at SDF.
2. How did the implementation of the network systems seem to affect the other subsystems in the organization?
3. How did the implementation of the network systems seem to affect human behavior?
4. What effect would the introduction of the integrated LANs have on planning and control processes? On work design? On creativity and innovation?
5. How would the use of the networks influence individual and organizational effectiveness?