Now that you are acquainted with how business is done at the beginning of the twenty-first century and the supporting role of IT in general, we turn attention to the foundations of information systems in organizations and how they help organizations solve problems and seize opportunities.

The two major determinants of IT support are organizational structure and the functions that employees perform within organizations. As this chapter shows, information systems tend to follow the structure or the organization, and they are based on the needs of individuals and groups.

Information systems are scattered throughout organizations, often in several locations and sometimes in two or more organizations. For example, suppliers and customers may allow each other access to their databases, so as to better coordinate inventory and logistics. Such diversity of information systems creates difficulty in managing them. This chapter looks at the types of support that information technologies give to various workers in organizations, at how IT systems are managed in organizations, and at the careers available in IT.

**LEARNING OBJECTIVES**

1. Discuss major information systems concepts such as architecture and infrastructure.
2. Describe the hierarchical structure of organizations and the corresponding information systems.
3. Describe the support provided to different types of employees in an organization.
4. Describe how information resources are managed.
5. Describe IT careers and personnel.
INFORMATION SYSTEMS AT BURLINGTON COAT FACTORY

The Business Problem

Burlington Coat Factory Warehouse Corporation operates over 240 clothing retail stores, five subsidiaries, and two distribution centers in 46 states of the United States. Its headquarters are in New Jersey. In addition to being the largest retailer of coats in the United States, Burlington and its subsidiaries sell clothes, linens, luggage, jewelry, baby furniture, and accessories. The competition in all these lines is extremely strong. Burlington’s major strategy is to offer a large selection of the world’s leading manufacturers, at savings up to 60 percent off department store prices. The problem is how to do it.

Burlington needs to receive daily sales information, by item sold, from all of its merchandise from its suppliers and its own factories in rapid response to sales. Also, it needs to communicate and collaborate with both store managers and suppliers quickly and effectively.

The IT Solution

The company installed a corporate communication system based on client/server architecture. This architecture (i.e., the design that specifies the parts of the system and how they interact) excels at fast connections of the various different sizes and types of information technology and added flexibility in the tasks that each computer performs. The cash registers and other PCs in each store (the clients) are networked to a main in-store processor. The processor (the server), in turn, is connected through a communication gateway to the corporate mainframe computers for processing. Sales data are transferred every night after the stores close, using satellite technology. At headquarters, data can be processed, stored, and if needed, moved to external destinations such as the VISA/MasterCard system for payment processing. Routine transactions are executed on the headquarters’ computers. Managers at individual stores can feed information from the corporate databases into spreadsheets or word processors on their desktop computers for end-user computing and decision support. The system also handles information other than sales data. This information ranges from Internet access, whereby Burlington managers and clerical employees can enter queries to communicate with suppliers, to inventory and ordering decision support.

The Results

Since the system was installed in 1994 and upgraded in 1998–99, corporate communication problems have decreased dramatically, planning is more accurate, and both sales volume and profits have increased steadily.

What We Have Learned from This Case

This opening case illustrates a networked corporate information system with characteristics that can be found in many organizations:

- Several different information systems exist in one organization. For example, Burlington’s information system contains hundreds of smaller information systems. Thus, a collection of a number of information systems is also referred to as an information system.

- Some of these systems may be completely independent, but most are interconnected.

- Information systems are connected by means of electronic networks. If the entire company is networked and people can communicate with each other and access
information throughout the organization, the arrangement is known as an enter-
prise-wide system.

- The information system is composed of large and small computers and other hard-
ware connected by different types of networks (the Internet, as well as networks that
connect hardware within stores, between individual stores, and the entire company).
This arrangement, used by many information systems, is known as a client/server
architecture.

These characteristics point to the complexities involved in organizing and managing
information systems, which are issues we address in this chapter.

2.1 BASIC CONCEPTS OF INFORMATION SYSTEMS

Before we discuss in detail IT and its management, we need to define some major
concepts and organize them in a logical way. We look first, therefore, at the concepts
of information infrastructure and architecture, and follow with descriptions of com-
mon types of information systems.

Information Infrastructure

An information infrastructure consists of the physical facilities, services, and manage-
ment that support all computing resources in an organization. There are five major
components of infrastructure: computer hardware, general-purpose software, net-
works and communication facilities (including the Internet), databases, and informa-
tion management personnel. Infrastructures include these resources as well as their
integration, operation, documentation, maintenance, and management. The infra-
structure also tells us how specific computing resources are arranged, operated, and
managed. Specific components of infrastructures are further discussed in Chapters 3
through 7.

Architecture

An information architecture is a high-level map or plan of the information require-
ments in an organization and the manner in which these requirements are being satis-
fied. It is a guide for current operations and a blueprint for future directions. It helps
ensure that the organization’s IT meets the organization’s strategic business needs.
Therefore, it must tie together the information requirements, the infrastructure, and
the applications. Note that information architecture is different from computer archi-
tecture, which describes the hardware needs of a computer system. For example, the
architecture for a computer may involve several processors, or special features to in-
crease speed. Our interest here is in information architecture only.

Information architecture is similar to the conceptual planning of a house. When
preparing a conceptual high-level drawing of a house, the architect needs to know the
purpose of the house, the requirements of the dwellers, and the building constraints
(time, money, materials, etc.). In preparing the information architecture, the designer
needs similar information, which can be divided into two parts:

1. The business needs for information—that is, the organizational objectives and
problems, and the contribution that IT can make. The potential users of IT must
play a critical role in this part of the design process.
2. The existing and planned information infrastructure and applications in the organi-
zation. This information includes how the planned system and its applications can
be combined among themselves or with future systems to support the organization’s information needs.

**Transaction Processing Systems**

Organizations perform routine, repetitive tasks. For example, employees are paid at regular intervals, customers place purchase orders and are billed, and expenses are monitored and compared to budgets. Table 2.1 presents a partial list of routine business transactions in a manufacturing organization.

The information system that supports such tasks is called a **transaction processing system (TPS)**. A TPS supports the monitoring, collection, storage, processing, and dissemination of the organization’s basic business transactions. It also provides the input data for many other applications, including computerized decision making. Frequently, several transaction processing systems exist in one company. They are considered critical to the success of any organization because they support the core business operations, such as purchasing of materials, billing customers, preparing a payroll, and shipping goods to customers. The repetitive number-crunching systems introduced in the 1950s were transaction processing systems. Such systems are as useful to organizations today as they were then. The difference is that today’s transaction processing systems are much more sophisticated and complex. (We will study TPSs in further detail in Chapter 8.)

**Management Information Systems**

As the cost of computing decreased and computer capabilities increased, it became possible to justify using information technology for more analytical tasks than transaction processing. In the 1960s, a new breed of information system started to develop. These systems accessed, organized, summarized, and displayed information for supporting routine decision making in the functional areas. Such systems are called functional **management information systems (MISs)** and are geared toward middle managers.

Functional information systems are put in place to ensure that business activities (functions) are done in an efficient manner. Typically a functional MIS provides periodic reports about such topics as operational efficiency, effectiveness, and productivity. It prepares these reports by extracting information from the corporate database.

<table>
<thead>
<tr>
<th>Payroll</th>
<th>Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Monitor employee time cards</td>
<td>• Prepare production reports</td>
</tr>
<tr>
<td>• Track employee pay and deductions</td>
<td>• Prepare quality-control reports</td>
</tr>
<tr>
<td>• Issue payroll checks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Purchasing</th>
<th>Finance and Accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Issue purchase orders</td>
<td>• Prepare and issue Financial statements</td>
</tr>
<tr>
<td>• Accept and record deliveries</td>
<td>• Maintain tax records</td>
</tr>
<tr>
<td>• Pay accounts payable</td>
<td>• Monitor and pay expense accounts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sales</th>
<th>Inventory Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Keep sales records</td>
<td>• Track materials usage</td>
</tr>
<tr>
<td>• Issue invoices and billings</td>
<td>• Monitor inventory levels</td>
</tr>
<tr>
<td>• Track accounts receivable</td>
<td>• Reorder inventory as needed</td>
</tr>
<tr>
<td>• Record and credit sales returns</td>
<td></td>
</tr>
<tr>
<td>• Keep shipping records</td>
<td></td>
</tr>
</tbody>
</table>
and processing it according to the needs of the user. For example, an organization’s TPS records every order as it is generated, and its marketing MIS can generate from these records weekly and monthly summaries by product, customer, or salesperson.

Initially, management information systems had a **historical orientation**; they described events after they occurred. Later, they also came to be used to support routine decisions, to provide answers to queries, and to forecast trends. Today, MIS reports might also include summary reports for the current period or for any number of previous periods. MISs are used for monitoring, planning, and control. For example, the accounting department might produce a weekly report on the status of delinquent accounts receivable. Or, a sales forecast by region, as shown in Figure 2.1, could help the marketing manager make better decisions regarding advertising and pricing of products. Besides being useful in making routine decisions, MISs also enable managers to detect possible problems in their early stages. Table 2.2 summarizes some of the major outputs of a functional MIS. (We’ll discuss MIS in more detail in Chapter 8.)

**Support Systems**

Managers are not the only organizational employees who can benefit from information systems. Support systems for **office employees** began to emerge in the late 1960s and early 1970s when networked computing and electronic communication became more prevalent. Airline reservation systems are perhaps the best example of this development. Electronic communication is only one aspect of what is now known as an **office automation system (OAS)**. Another form of OAS, word processing systems, spread to many organizations in the late 1970s and early 1980s. Later on, document management and other productivity software was added as part of office automation support. Since the 1970s, computers have also been introduced to the manufacturing environment. Applications range from robotics to computer-aided design and manufacturing (CAD/CAM to inventory and logistics management).

By the early 1970s, the demand for all types of information technology, for all levels of workers, had begun to accelerate. Increased capabilities and reduced costs justified computerized support for a growing number of nonroutine and even onetime applications, and the **decision support system (DSS)** concept was born. The basic objective of a DSS is to provide computerized support for complex, sometimes nonrou-

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical summaries</td>
<td>Summaries of raw data such as daily production, and weekly and monthly usage of electricity.</td>
</tr>
<tr>
<td>Exception reports</td>
<td>Highlights of data items that are larger or smaller than designated levels.</td>
</tr>
<tr>
<td>Periodic reports</td>
<td>Statistical summaries and exception reports provided at scheduled, regular periods.</td>
</tr>
<tr>
<td>Ad-hoc reports</td>
<td>Special, unscheduled reports provided on demand.</td>
</tr>
<tr>
<td>Comparative analysis</td>
<td>Performance comparison to that of competitors, past performance, or industry standards.</td>
</tr>
<tr>
<td>Projections</td>
<td>Advance estimates of trends in future sales, cash flows, markets share, etc.</td>
</tr>
</tbody>
</table>
tine decisions, as illustrated in IT’s About Business Box 2.1. (Chapter 11 will provide more detail on DSSs.)

At first, the high cost of building DSSs constrained their widespread use. However, the microcomputer (personal computer) revolution, which started around 1980, changed that. The availability of desktop computers made it possible for someone who knows little about programming to build DSS applications. This was the beginning of the era of end-user computing, in which the principal users of a system’s output—analysts, managers, many other professionals, and their staffs—build their own systems.

Decision support expanded in two directions. First, executive information systems (EISs) were designed to support senior executives. These were later expanded to support all levels of managers around the organization. The second direction was the support of people working in groups. Group support systems (GSSs) initially supported people working in a special decision-making situation or meeting, in a single location. As network computing developed, GSSs became able to support decision makers working in different locations. The various commercial software products that support people working in groups is called groupware. Groupware is designed for use with all types of networks because it supports employees in different locations.

**Box 2.1: Glaxo Wellcome saves lives with DSS**

Glaxo Wellcome of the United Kingdom is one of the largest pharmaceutical companies in the world. In 1996 the company found that a combination of two of its existing drugs, Epirir and Retrovir, was effective in treating some cases of AIDS. Almost overnight, doctors worldwide began writing prescriptions en masse. Such a tidal wave of demand depleted the inventories of the two drugs in the pharmacies. Glaxo needed to produce and ship Epirir and Retrovir quickly, but the demand, which is used to determine production, scheduling of shipments, and inventory levels was too difficult to forecast.

To solve the problem, Glaxo developed a special corporatewide DSS. The system worked with a vast amount of internal and external data stored in a data warehouse. Using these data and certain DSS models, market analysts at Glaxo were able to track and size the sources of demand, generating summary reports and projections in minutes. The projected demand was fed into the DSS models to figure appropriate production plans, delivery schedules, and inventory levels along the supply chain.

As a result, Glaxo streamlined its distribution process so that wholesalers and retailers around the world seldom ran out of the drugs. An added benefit was that operational costs were reduced. Finally, the system provided Glaxo’s employees with a tool that allowed them quickly and easily to access information from different sources. Finally, the network allowed for efficient internal and external collaboration and communication. The DSS was so successful that it is now used on a regular basis to manage the logistics and production of all Glaxo’s drugs.

**Questions**

1. Why was a DSS needed in this case?
2. Identify the different decisions supported by the DSS.
Intelligent Systems

By the mid-1980s, managerial applications of so-called artificial intelligence began, creating intelligent systems that seem able to replicate the thought processes of humans. Of special interest are expert systems (ESs), which are advisory systems that provide the stored knowledge of experts to nonexperts, so that the latter can solve difficult problems. For example, expert systems are frequently used to capture the knowledge of bank loan officers and enable a less experienced employee make a complex loan decision.

Later, by the beginning of the 1990s, a new breed of intelligent systems emerged, systems with learning capabilities. This capability enables computers to incorporate new information or feedback and update their knowledge. This type of artificial intelligence excels at processing vague or incomplete information, recognizing subtle patterns in data, and making predictions or recognizing patterns or profiles in situations where the logic or rules are not known. For example, IT’s About Business Box 2.2 describes one use of an intelligent system called an artificial neural network (ANN) to detect bombs in luggage. (Chapter 12 will provide more information on intelligent systems.)

IT's About Business

Box 2.2: Detecting bombs in airline passengers' luggage faa.gov

The U.S. Federal Aviation Administration (FAA) is making continuous efforts to improve safety and prevent terrorists from sneaking bombs aboard airplanes. Since it is practically impossible to open and search every piece of luggage, the FAA uses computer technologies in an attempt to find different types of explosives. One approach is to bombard each piece of luggage with gamma rays that are collected by a sensor and then interpreted. The FAA is using statistical analysis and expert systems to conduct the interpretation.

However, these technologies cannot detect all types of explosives. Since 1993, artificial neural networks have been added to improve detection effectiveness. The ANN is exposed to a set of historical cases (a training set); that is, it is shown pictures obtained by gamma rays. It is also told whether each specific piece of luggage contains an explosive or not. Once trained, the system is used to predict the existence of explosives in new cases. It can detect an explosive even if the explosive device is somewhat different from those used for training. The objective is not only to detect explosives successfully, but also to minimize false alarms caused by the fact that many things (including clothing) contain nitrogen, a major component of bombs.

Question

1. It is said that two heads are better than one. Can the addition of ANN be considered an extra head? Why?
Integrating Support (and Other) Systems

Within an organization, information can flow among the various computer systems. For example, an MIS might extract information from a TPS, and an EIS might receive information from both a TPS and an MIS. However, providing a computerized solution to a business problem may require integrating two or more of the information systems described in this section. For example, a decision support system combined with an expert system can be built to support a marketing promotion program.

As we enter the twenty-first century, various computerized systems are being integrated to increase their functionalities. One popular form of integrated system is enterprise resources planning (ERP). ERP plans and manages all of an organization’s resources and their use, including contacts with business partners. An example of ERP software is SAP R/3, which can integrate more than 70 departmental TPS, MIS, and DSS components. (Details are provided in Chapter 8.)

The evolution of computer-based information systems just described is shown in Figure 2.2.

1. Distinguish between the terms information infrastructure and information architecture.
2. Describe a TPS and its major functions.
3. Define MIS and list three of its major characteristics.
4. Briefly define DSS, groupware, and expert systems.

To better understand how IT supports organizations and their activities, it is useful to see how companies are organized and what roles managers and other employees play in them. First, it is important to understand that organizations can be classified by various characteristics. One characteristic is whether they are intended to make a profit. Nike, Microsoft, and Budget Car Rental, for example, are organized as profit-making businesses. Not-for-profit organizations like the United Way, the U.S. Army, and
most churches, on the other hand, contribute (in a broad sense) to the public good. Organizations also can be classified by whether they manufacture **goods** (computers, cars, tools, food, and so forth) or produce **services** (insurance companies, universities, banks, and hospitals). The nature of organizations determines their activities, the information support they need, and the type of information systems provided.

Other important factors are the size of an organization and its location. Two extreme types can be distinguished:

1. Companies that are located in **one place**, from which they conduct all their operations. These are usually small- to medium-sized companies.
2. Companies that are located in several places, sometimes in several countries. We refer to these as **global** or **multinational organizations**. They are usually medium-sized to large organizations.

Size and number of locations are the major determinants of an organization’s structure.

**Organizational Structure**

As shown in the opening case, organizations typically have a centralized headquarters and divisions at different locations. These **divisions** can be independent subsidiaries or integral parts of one corporation. Depending on the organization and its size, a division may be further divided into units (such as plants), each of which is in a different location. Alternatively, each division may represent a plant or another organizational entity (for example, a warehouse). A plant is usually composed of departments and other operating units.

Departmental structure is most widely used in business organizations. It is also referred to as a **functional structure**. As discussed in Chapter 1, a **functional department** specializes in the delivery of a certain function, such as manufacturing or marketing. Most organizations have at minimum, the following departments:

- Accounting
- Finance
- Marketing and Sales
- Production or Operations Management (POM)
- Human Resources Management
- Information Systems

Note that these functions correspond to the departments in most business schools.

In addition, other, smaller units in organizations provide specialized services such as legal, engineering, or purchasing.

**The hierarchical structure.** The most widely used organizational structure is a **hierarchical** one. A typical hierarchical structure is shown in Figure 2.3.

**Project management and matrix organization.** In some cases, organizations have found the hierarchical structure to be inflexible or nonresponsive. To increase flexibility it is customary to add teams, temporary or permanent, to this structure. Some of these teams are cross-functional, and they are responsible for an entire business process. An example would be a team assembled to work on a new and urgent business problem.

When cross-functional teams are temporary, and their members return to their regular functional departments when the team’s task is completed, the structure is
called project management. When the teams are a permanent collection of people from different departments assigned to work on a series of special projects, the structure is called a matrix organization. As shown in Figure 2.4, a cross-functional organizational structure in effect creates teams with representatives from each relevant business function. Matrix organization tends to work well in high-tech industries and with firms that develop many new products.

Regardless of its format, organizational structure is a major driver of information systems arrangements in organizations.

Mapping Information Systems to Organizational Structure

One way to classify information systems is by the part of the organizational structure they support. Although some organizations are reengineering themselves into cross-functional teams, the vast majority still have a traditional hierarchical structure. Therefore, the most common arrangement of information systems is one that follows the hierarchical structure. This arrangement provides a match between the needs of organizational entities and the support provided by IT.

Information technology provides support in three major areas: communication, collaboration, and data processing and access (including knowledge sharing). Specific types of support are usually given by an application program (or, more simply, an application). An application is a system developed for a specific purpose, such as facilitating a production schedule, expediting a financial forecast, or executing the weekly
payroll. It is usually a software program built on existing infrastructure, although some applications require specialized hardware.

Thus, we can categorize information systems by their breadth. Systems and applications can be built for headquarters, for divisions, for departments, for specific teams (e.g., quality-assurance teams), and even for individuals. Other systems are: enterprisewide, interorganizational, and global (international). Such systems can either stand alone or be interconnected. Brief descriptions of some of these systems follow.

**Departmental information systems.** Frequently, *departmental information systems* are named to reflect the department they support, such as accounting information systems or human resources information systems. In practice, each functional information system is composed of several specific application programs. For instance, in managing human resources, the HR department might use one application program for recruiting and another for monitoring employee turnover. The collection of the various application programs in the human resources area would be called the human resources information system. Some of the applications might be completely independent of each other, whereas others might be integrated.

**Plant information systems.** Whereas a departmental information system is usually related to a functional area, the collection of all departmental applications combined with the applications of other business units comprises the *plant information system*. The plant information system provides the necessary communication and collaboration among the departmental entities of the plant as well as access to data for all authorized people.

**Divisional information systems.** The *divisional information system* connects all of a plant’s systems with information systems of other business units in the same division. It permits communication and collaboration among the plants and other units in the division, including access to headquarters and the business environment.
Enterprisewide information systems. In a similar manner, an enterprisewide information system connects all divisions and other units of an organization. Burlington’s system described at the beginning of the chapter is an enterprisewide system.

Interorganizational information systems. Some information systems connect two or more organizations. For example, a worldwide airline reservation system is composed of several information systems belonging to different airlines, of which American Airlines’ SABRE system is one of the largest. Such interorganizational information systems (IOSs), connecting two or more organizations, are common among business partners. These systems may provide for communication at the plant, divisional, or enterprisewide level, depending on the needs of the organizations involved. A special instance of an IOS is an international or multinational corporation whose computing facilities are located in two or more countries. Such an IOS is called a global information system (GIS). Interorganizational information systems play a major role in e-commerce, as well as in supply chain management support.

Before you go on...

1. Describe the hierarchical structure of organizations.
2. List and briefly describe the major types of information systems that correspond to the hierarchical structure.
3. Define interorganizational and global information systems.

2.3 IT SUPPORT AT DIFFERENT ORGANIZATIONAL LEVELS

Individuals in organizations are supported by different types of information systems, depending on the roles and the tasks they perform:

- **Strategic decisions** are usually made by top management; these are relatively long-term planning decisions that deal with the organization’s objectives as a whole and the allocation of resources to achieve these objectives. Top management may rely on executive information systems for some of their decision making and forecasting.

- **Tactical or managerial decisions** are made by middle managers, who prepare short-term plans, procedures, and policies with which to begin implementing the organization’s long-term strategies. MISs provide the primary support at this level, along with some types of DSS.

- **Operational decisions** are made by line managers and operators. These are the day-to-day decisions that aim to keep the organization’s operations moving smoothly. TPSs typically capture the operational information relevant for decision making at this level.

The relationships between information systems and the people they support in organizations are shown in Figure 2.5. Organized as a triangle, the figure also illustrates the number of employees involved at the various levels of decision making. Top managers are few, and they sit at the top of the triangle.

As you can see in the figure, an additional level of employees is introduced between top managers and middle managers. These are professional people who act as advisors to both top and middle management. Many of these professionals can be...
thought of as **knowledge workers**—people who create information and knowledge and integrate it into the business. Knowledge workers are engineers, financial and marketing analysts, production planners, lawyers, and accountants, to mention just a few. They are responsible for finding or developing new knowledge for the organization and integrating it with existing knowledge. Therefore, they must keep abreast of all developments and events related to their profession. They also act as advisors and consultants to the members of the organization. Finally, they act as change agents by introducing new procedures, technologies, or processes. In many developed countries, 60 to 80 percent of all workers are knowledge workers.

Knowledge workers can be supported by a large variety of information systems. These range from Internet search engines that help them find information, to expert systems that support information interpretation, to computer-aided design, and even to hyperlinks that help them increase their productivity and the quality of their work. Within most organizations, knowledge workers are the major users of the Internet. They need to learn what is new, to communicate regularly with corporate managers and colleagues, and frequently to collaborate with knowledge workers in other organizations.

One way that IT can integrate the expertise of knowledge workers into an organization and assist in improving worker performance is through the use of intelligent systems. These systems contain the knowledge of super-experts and can disseminate that knowledge to all employees who need it. An example of how expert systems can be used is shown in IT’s About Business Box 2.3.

However, knowledge workers do not have an exclusive right to an organization’s knowledge. Knowledge should be accumulated by all employees in organizations. IT can facilitate not only the creation of knowledge by all workers but also its preservation and use. The reserve of accumulated knowledge in organizations is called an organizational **knowledge base**. Besides that developed from within, the knowledge base may also contain knowledge generated by people outside the organization, such as that provided by consultants. This outside knowledge is known as **best global practices** or **benchmarks**. The process of acquiring, maintaining, and disseminating organizational knowledge is called **knowledge management**. It is supported by several types of information systems, as will be shown in Chapters 11 and 12.
Another class of employees who need IT support is **clerical workers**, who support managers at all levels. Among clerical workers, those who use, manipulate, or disseminate information are referred to as **data workers**. These include bookkeepers, assistants who work with word processors, electronic file clerks, and insurance claim processors. Clerical employees are supported by office automation and groupware, including document management, workflow, e-mail, and other personal productivity software.

The IT support provided to managers and other employees, by the type of information system, is summarized in Table 2.3.

---

**Box 2.3: An expert system increases productivity at Ford Motor**

On production lines at Ford Motor Company, manufacturing processes are achieving major productivity increases through the adoption of a computer-integrated manufacturing (CIM) strategy. CIM provides access to the information flowing from robots and other machines and allows all of the resources of the plant to be combined into a unified network.

Cadiz Electronica of Spain, a subsidiary of Ford Motor Company, employs about 480 people on two production lines. The first one produces electronic engine control modules. The second builds the antilock brake system modules. This subsidiary has installed an information system called the System for Diagnosis and Repair (SEDYR). This expert system detects and diagnoses printed circuit malfunctions by analyzing the CIM system information flow and assisting repair operations online during the production process. Each component is automatically diagnosed, in real time, while it is still on a manufacturing line. The system also provides access to the manufacturing-process history located on a database.

It maintains a real-time connection with the main CIM computer, informing it about failures in processing. The failed boards are eventually separated from the boards that pass the functional tests and sent to the repair zone.

Besides being able to visualize the boards and identify failed components, the expert system also links a graphical representation of the problem with appropriate comments and provides tips for the treatment of the failures. This ability has drastically lowered the time needed to repair a board. Another benefit provided by this approach of manufacturing supervision is the ability to use the system as a realistic and cost-effective simulation-training tool.

**Questions**

1. How is productivity increased by use of the expert system at Cadiz Electronics?
2. Why is a real-time connection necessary?

---

Another class of employees who need IT support is **clerical workers**, who support managers at all levels. Among clerical workers, those who use, manipulate, or disseminate information are referred to as **data workers**. These include bookkeepers, assistants who work with word processors, electronic file clerks, and insurance claim processors. Clerical employees are supported by office automation and groupware, including document management, workflow, e-mail, and other personal productivity software.

The IT support provided to managers and other employees, by the type of information system, is summarized in Table 2.3.

---

**Table 2.3 Main Types of IT Support Systems**

<table>
<thead>
<tr>
<th>System</th>
<th>Employees Supported</th>
<th>Detailed Discussion in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office automation</td>
<td>Office workers</td>
<td>Chapters 7, 8</td>
</tr>
<tr>
<td>Communication</td>
<td>All employees</td>
<td>Chapters 6, 8</td>
</tr>
<tr>
<td>Group support</td>
<td>People working in groups</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>Decision support</td>
<td>Decision makers, managers</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>Executive information</td>
<td>Executives, top managers</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>Intelligent systems</td>
<td>Knowledge workers</td>
<td>Chapters 8, 12</td>
</tr>
<tr>
<td>TPS</td>
<td>Line managers and employees</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>MIS</td>
<td>Middle management</td>
<td>Chapter 8</td>
</tr>
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A modern organization possesses a considerable amount of information resources. As described in Chapter 1, the major categories of information resources are: hardware (all types of computers, servers, and other devices), software (development tools, languages, and applications), databases, networks (local, wide, the Internet and intranets, and supporting devices), procedures, and physical buildings. These resources are scattered throughout the organization; some of them change frequently. Therefore, it may be rather difficult to manage IT resources.

Information systems have enormous strategic value, and firms rely on them heavily. In some cases, when one information system is not working, even for a short time, an organization cannot function. Furthermore, the acquisition, operation, and maintenance of these systems may cost a considerable amount of money. Therefore, it is essential to manage information systems properly. The planning, organizing, implementing, operating, and controlling of the infrastructures and other information resources must be done with great skill.

The responsibility for the management of information resources is divided between a usually centralized information systems department (ISD) and the end users, who are scattered throughout the organization. This division of responsibility raises some important interrelated questions: Which resources are managed by whom? What is the role of the ISD? Who runs the ISD and to whom should the department report? What are the relationships between the ISD and end users? Brief answers to these questions are provided below.

**Which Resources Are Managed by Whom?**

Generally speaking, the information systems department is responsible for corporate-level and shared resources, and the end users are responsible for departmental resources. Regardless of who is managing what, there are several activities that must be done. These range from planning and purchasing of both hardware and software to application development and maintenance. Frequently, the ISD and the end users will divide such activities. For example, the ISD may acquire or build systems, and the end users will operate and maintain them.

Because of interdependencies of information resources, it is important that the ISD and the end users work closely together and cooperate, regardless of who is doing what.

**What Is the Role of the Information Systems Department?**

The role, structure, and place of the ISD in the organization’s hierarchy vary considerably, as does the department’s leadership in the organization. These characteristics of the ISD depend upon the amount and importance of information resources to be managed, the extent to which IT is outsourced by the organization, and the role that
end users play. Here, we provide only some major observations about the role of the 

The role of the ISD has been changing from purely technical to more managerial and strategic. Table 2.4 shows the ISD’s changing functions in recent years. As a result of its changing role, the position of the ISD within the organization tends to be elevated from a unit reporting to a functional department, to a unit reporting to a senior vice president of administration or to the CEO. The role of the director of the ISD is changing from a technical manager to a senior executive, sometimes referred to as the chief information officer (CIO). The internal structure of the ISD is changing to reflect its new role—perhaps emphasizing vendor relations over software programming as outsourcing becomes more strategically efficient than internal development of systems. The ISD must frequently work closely with external organizations such as vendors, business partners, research institutions, universities, and consultants.

The key issues in information systems management change over time. Changing issues reflect progress made in achieving organizational IT goals and objectives as well as new opportunities made possible by new technologies. Recent important IT issues are the need to improve productivity, develop strategic applications, cut costs, enhance customer relationships, improve supply chains, and manage data. All of these issues are covered in many places throughout this book.

**Who Runs the ISD and to Whom Does the Department Report?**

The centralized ISD is run by a director who may have a title such as MIS director, manager of computing services, manager of information technology, or chief information officer (CIO). The latter title indicates the importance of the IS area in any organization that uses it. The title “chief” is usually reserved for the top managers in an organization, such as the chief financial officer (CFO), chief operating officer (COO), or chief executive officer (CEO). You can find CIOs in organizations that are heavily dependent on IT, such as banks or airlines.
A position related to the CIO is that of chief knowledge officer (CKO)—the director assigned to capture and make effective use of knowledge for an organization. The same person may assume the roles of the CIO and CKO, especially in smaller companies. The major challenges facing CIOs are summarized in Manager’s Checklist 2.1.

Information technology has become a strategic resource for many organizations. Coordinating this resource requires strong IT leadership and genuine cooperation between the ISD and end users within the organization. Therefore, the positive professional relationships among the CIO and other members of the top management group are crucial for effective, successful utilization of IT, especially in organizations that greatly depend on IT.

In many large organizations, the chief information officer (or whatever other title the top information executive holds) generally is a member of the corporate executive committee, which has responsibility for strategic business planning and response. The executive committee is the most important committee in any organization. Its members include the chief executive officer and the senior vice presidents. The executive committee provides the top-level oversight for the organization’s information resources. It guides the IS steering committee, which is usually chaired by the CIO.

Manager’s Checklist 2.1

Major Questions and Challenges for the Chief Information Officer

- Do I understand the complexity inherent in doing business in a competitive, global environment?
- Am I managing the accelerating pace of technological change?
- Do I understand that IT may reshape organizations that could become technology driven?
- Do I realize that IT often is the primary enabler of business solutions?
- How well do I know the business sector in which the organization is involved?
- Do I understand the organizational structure and operating procedures?
- Am I using business, not technology, terms when communicating with corporate management?
- Am I gaining acceptance as a member of the business management team?
- Am I establishing the credibility of the IS department?
- Am I increasing the technological maturity of the company?
- Am I creating a vision of the future of IT and selling it to upper management?
- Am I implementing IT architecture that will support the vision?
- Am I maintaining sufficient technology competency?
- Do I understand networking on a global basis?
- Am I able to facilitate change within the department and the organization?
- Am I managing IT safety and security?
- Am I providing education to other executives?
- Do I understand industry standards?
- Is our organization setting industry standards?
- Am I balancing priorities?
What Are the Relationships Between the ISD and End Users?

The ISD and the end-user units must be close partners. Some mechanisms that provide the required cooperation are:

- A **steering committee** that represents all end users and the ISD. This committee sets IT policies, provides for priorities, and coordinates IS projects.
- **Joint ISD/end-user project teams** for planning, budgeting, application developments, and maintenance.
- ISD representation on the **top corporate executive committee**.
- **Service agreements** that define computing responsibilities and provide a framework for services rendered by the ISD to end users.
- **Technical and administrative support** (including training) for end users.
- A **conflict resolution unit** established by the ISD to handle end-user complaints quickly and resolve conflicts as soon as possible.
- An **information center** that acts as a help center to end users regarding purchase, operations, and maintenance of hardware and software.

Before you go on . . .

1. List the major information resources in an organization. Which of these are managed by the ISD?
2. Describe the role of the ISD in an organization.
3. List five major challenges of the CIO.

2.5 IT People and Careers

People rarely begin a career in information systems management at the CIO level. Rather, there are a number of career paths that can lead to that position. Most require a fair amount of technical training and experience. Some place a greater emphasis on business and strategic knowledge, while others emphasize almost purely technical knowledge, similar to an engineering position. The various career paths are described below.

**Programmer**

Programmers are IS professionals who modify existing computer programs or write new computer programs to satisfy user requirements. Programmers typically can specialize in one or more programming languages, and be trained in universities or technical schools. On large development projects, programmers often work in teams. Although knowledge of business processes is a plus, a programmer’s focus is primarily technical. This is a common entry-level IS position.

**Systems Analyst/Developer**

Systems analysts are information systems professionals who specialize in analyzing and designing information systems. They usually have some programming skills that
are augmented by greater knowledge of business processes. In addition, analysts use a variety of specialized analysis and design tools. This job also places a premium on communication skills, as systems analysts must spend a great deal of time with users to determine how best to meet their needs.

**Telecommunications/Network Specialist**

*Telecommunications/network specialists* have a greater technical orientation. At higher levels, these specialists often hold electrical engineering degrees, although some network specialists may have technical training only in their particular area. Given the mission-critical nature of networks and telecommunications in most organizations, this career path is both demanding and in demand.

**Systems Operations Specialist**

*Systems operations specialists* keep systems up and running, and may have subspecializations with particular types of computing hardware (e.g., mainframes) and their related software, as well as some aspects of the telecommunications and networks involved. There are entry-level positions where training may be provided by the organization or contracted out to a training company. As with other areas, ongoing training is always necessary to keep pace with advances in technology.

**Business Analyst**

A *business analyst* has IT experience and an in-depth knowledge of the organization’s business processes. He or she is often heavily involved with the development of new information systems and acts as a “translator” between IS developers and users. This role enables a clearer understanding of business problems and appropriate IT solutions, and ensures that the strategic goals and the user requirements are understood and appropriately addressed by the technical IT people.

**Database Administrator**

Data are an extremely valuable organizational asset for both day-to-day operations and strategic objectives. Organizational data reside in databases that must be designed and managed for maximum efficiency and effectiveness. *Database administrators* typically have considerable experience and training in one or more types of database software and hardware. Like many other IT positions, this position requires strong communication skills as well as technical training so that the databases can be as useful as possible to users.

**Webmaster/E-Commerce Specialist**

This new area encompasses programming skills as well as strong knowledge of an organization’s processes. With the advent of the Internet and e-commerce there has been a high demand for people who have professional command of the languages and packages used for Web site development. For many organizations, the Web site is designed to transact business, and this requires some very advanced programming skills to link what a client sees to many other areas within the company, particularly databases and other IT-supported parts of the supply chain.

This chapter illustrates that information systems vary in breadth and specialization. They can be suitable for supporting different numbers of users, from the stand-
alone personal computer through the group system, to the enterprisewide system. They can be designed to support users at different levels in the organization, from the transaction processing systems used by operational managers and lower-level employees, to executive information systems used by top management teams. Because of their strategic importance, information resources, technologies, and systems require professional management. Also, the relationships between the ISD and those who rely on it for support—from the operational to the strategic—must receive high priority. Finally, we see that a career in information systems management can begin in different ways and follow different technical and managerial directions.

**Before you go on . . .**

1. List the major career paths in IT.
2. Which career path is most appealing to you at this point? Why?

**WHATS IN IT FOR ME?**

**FOR THE ACCOUNTING MAJOR**
The accounting department in organizations regularly interfaces with the ISD. Many of the transactions handled in a TPS—such as billing customers, preparing payrolls, and purchasing and paying for materials—are data that the accounting department needs to record and track.

**FOR THE FINANCE MAJOR**
Enterprisewide information systems have moved from focusing primarily on manufacturing to integrating finance and other functional areas. These are important changes. The interfaces between IT and finance are getting stronger, and reliance of finance on IT is rapidly increasing. Finance departments, for example, often use a specialized DSS for forecasting and portfolio management. An understanding of the fundamentals of information systems is, therefore, a must for finance people.

**FOR THE MARKETING MAJOR**
It is said that marketing without IT is not modern marketing. Marketing now uses such IT-related concepts as customer databases, marketing decision making, and sales automation. To better understand such basic concepts, marketers need to understand how information systems are structured, what they support, and how they are managed.

**FOR THE PRODUCTION/OPERATIONS MANAGEMENT MAJOR**
Organizations are competing on price, quality, time (speed), and customer service—all of which are concerns of productions and operations management, and all of which are enhanced and supported by IT. Purchasing, inventory, quality control, logistics, and other aspects of operations each receive considerable integrated IT support in modern manufacturing firms, each often a complex system of its own.
Discuss major information systems concepts such as architecture and infrastructure.

An information architecture is the “blueprint” that provides the conceptual foundation for building the information infrastructure and specific applications. It maps the information requirements as they relate to information resources. The information infrastructure refers to the physical shared information resources (such as corporate database) and their linkages, operation, maintenance, and management. The major categories include: (a) the transaction processing system (TPS), which covers the core repetitive organizational transactions such as purchasing, billing, or payroll; (b) management information systems (MISs) that support managers in the major functional areas; (c) the general support systems, including office automation, decision support, group support, and executive support; (d) intelligent systems such as expert systems and artificial neural networks; and (e) the integrated systems that link the entire organization, such as enterprise resource planning (ERP) systems.

Describe the hierarchical structure of organizations and the corresponding information systems.

Most organizations are structured vertically in what is known as hierarchical structure, from headquarters down to departments and operating units. Information systems follow this structure closely. For example, an organization typically would have divisional information systems, plant information systems, and departmental information systems.

Describe the support provided to different types of employees in an organization.

Information systems are also categorized by the support they provide to certain individuals in organizations, particularly to managers at different levels, to knowledge workers, and to data workers (clerical, office employees). Knowledge workers are those who find, develop, integrate, and maintain organizational knowledge. They are usually the experts in the functional areas.

Describe how information resources are managed.

Information resources are extremely important to an organization, and they must be properly managed by both the ISD and end users. In general, the ISD manages shared enterprise information resources such as networks, while end users are responsible for departmental information resources, such as PCs. The role of the ISD is becoming more managerial, and its importance is rapidly increasing. Steering committees, service agreements, and conflict-resolution units are some of the mechanisms used to facilitate the cooperation between the ISD and end users.

Describe IT careers and personnel.

There are a number of IS management career paths that begin with positions such as programmer, systems analyst/developer, database administrator, Webmaster, or network specialist. Most require a fair amount of technical training and experience. Some place a greater emphasis on business and strategic knowledge, while others emphasize almost purely technical knowledge.

For the Human Resources Management Major

As we begin the twenty-first century, the “new” human resources department is taking full advantage of IT, especially intranets, to disseminate throughout the organization relevant information such as job opportunities, benefits information, and educational materials. Critical IT knowledge for the HRM professional includes what kind of systems are available, what their capabilities are, and how they are utilized in HRM.

Summary

1. Discuss major information systems concepts such as architecture and infrastructure.
   - An information architecture is the “blueprint” that provides the conceptual foundation for building the information infrastructure and specific applications. It maps the information requirements as they relate to information resources. The information infrastructure refers to the physical shared information resources (such as corporate database) and their linkages, operation, maintenance, and management. The major categories include: (a) the transaction processing system (TPS), which covers the core repetitive organizational transactions such as purchasing, billing, or payroll; (b) management information systems (MISs) that support managers in the major functional areas; (c) the general support systems, including office automation, decision support, group support, and executive support; (d) intelligent systems such as expert systems and artificial neural networks; and (e) the integrated systems that link the entire organization, such as enterprise resource planning (ERP) systems.

2. Describe the hierarchical structure of organizations and the corresponding information systems.
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3. Describe the support provided to different types of employees in an organization.
   - Information systems are also categorized by the support they provide to certain individuals in organizations, particularly to managers at different levels, to knowledge workers, and to data workers (clerical, office employees). Knowledge workers are those who find, develop, integrate, and maintain organizational knowledge. They are usually the experts in the functional areas.

4. Describe how information resources are managed.
   - Information resources are extremely important to an organization, and they must be properly managed by both the ISD and end users. In general, the ISD manages shared enterprise information resources such as networks, while end users are responsible for departmental information resources, such as PCs. The role of the ISD is becoming more managerial, and its importance is rapidly increasing. Steering committees, service agreements, and conflict-resolution units are some of the mechanisms used to facilitate the cooperation between the ISD and end users.

5. Describe IT careers and personnel.
   - There are a number of IS management career paths that begin with positions such as programmer, systems analyst/developer, database administrator, Webmaster, or network specialist. Most require a fair amount of technical training and experience. Some place a greater emphasis on business and strategic knowledge, while others emphasize almost purely technical knowledge.
INTERACTIVE LEARNING SESSION

Go to the Web site (or CD) and access Chapter 2, Information Technologies in the Modern Organization and read the case presented. You will be presented with a business problem which will require you to query a database for certain information. You will be able to construct SQL statements obtain the needed information. As you construct your SQL statements, you will see what information results and decide if it meets your requirements. You may need change your SQL statements as necessary to obtain further (or different) information.

DISCUSSION QUESTIONS

1. Discuss the logic of building information systems in accordance with the organizational structure.
2. Discuss the characteristics and roles of knowledge workers.
3. Discuss the relationship between TPS, MIS, and DSS.
4. Describe how the importance of issues in IS management can change over time.
5. Discuss how one might decide among career paths in information systems management.

PROBLEM-SOLVING ACTIVITIES

1. Classify each of the following systems as one (or more) of these types: TPS, DSS, EIS, GSS, ES, CAD/CAM.
   a. A student registration system in a university
   b. A system that advises farmers about which fertilizers to use
   c. A hospital patient admission system
   d. A system that provides a marketing manager with demand reports regarding the sales volume of specific products
2. Prepare a list of what you think, based on your reading and experience, are key IT issues.
   a. Present these issues to IT managers in an organization to which you have access. (You may want to develop a questionnaire.) Have the managers vote on the importance of these items in their organization. (Instruct them that they can also add items, if appropriate.)
   b. Report the results. Try to explain the differences between this and the published studies.
3. Review the following systems in this chapter, and classify each system according to the triangle in Figure 2.5.
   - Burlington Coat Factory Warehouse
   - Glaxo Wellcome
   - Detecting bombs
   - Ford Motors, Inc.
   - Hershey Foods

INTERNET ACTIVITIES

1. Surf the Internet for information about airport security via bomb-detecting devices. Examine the available products, and comment on the IT techniques used.
2. Visit the site of American Airlines (AA.com). Find out how the Internet is being used for advertising, auctions, etc.
3. Enter the site of Hershey (hersheyfoods.com). Examine the information about the company and its products and markets. Explain how an intranet helps such a company compete in the global market.
TEAM ACTIVITIES AND ROLE PLAYING

1. Observe a supermarket checkout counter that uses a scanner. Find some material that describes how the scanned code is translated into the price that the customers pay.
   a. Identify the following components of the system: inputs, processes, outputs, feedback.
   b. What kind of a system is this (TPS, DSS, EIS, MIS, etc.)? Why?
   c. Having the information about a product filed electronically in the system may provide opportunities for additional managerial uses. Identify such uses.
   d. Research and report on how such systems will be operating in the future. Describe them.

REAL-WORLD CASE  hershey.com

Hershey Foods enhances group work with an Intranet

The Business Problem  Hershey bars and kisses can be found on the shelves of convenience stores and supermarkets in about a hundred countries, competing with both local brands and brands from other countries. But the transportation cost and the low labor cost in many foreign countries are factors that reduce the competitiveness of Hershey in overseas markets.

The IT Solution  Hershey’s use of a corporate intranet is helping compensate for the disadvantages imposed by transportation and labor costs. Recognizing the importance of group work, internal communication, and collaboration, the company set up a Director of Corporate Communications position. The director initiated a Web site as early as 1994 and also created a comprehensive corporate intranet in 1996. Since then, Hershey has developed the following intranet applications: Most corporate internal communications are now paperless, training materials are delivered to the desktops of employees, and the intranet includes e-mail and software to support the work of groups (such as video teleconferencing). In addition to training, the HRM department uses the intranet extensively to manage its fringe benefits, broadcast available job openings to all employees; and publish an electronic newsletter about corporate people and events.

The Results  Hershey now runs one of the most efficient food-processing businesses in the world. By 1999, more than 4,000 key employees were on the intranet. Corporate information such as annual reports, press releases, information on quality, and internal newsletters are published electronically, saving paper and delivery cost. All departments have their own home pages. This enables improved communications and collaboration within and among departments.

John Long, Director of Corporate Communications, said that to him the corporate intranet is much more exciting than the Internet since there is a greater opportunity to defray costs and measure the system’s worth. All in all, Hershey’s intranet helps the company produce high-quality products at a low cost, easing its competitiveness problem and enabling it to capitalize on new markets worldwide.

Questions

1. How does the intranet-based system support the human resources management function at Hershey?
2. How is collaborative (group or team) work hindered by having group members in different locations and/or time zones?
3. Who is communicating with whom at Hershey? That is, what kinds of groups or teams might be assembled for what kinds of projects or problems?
4. What is it about the Internet that makes intranets popular as a basis for groupware? (Hint: How many people do you know who are comfortable using a common Internet browser and other functionalities of the Internet, like search engines? What about the perceived reliability of the Internet?)
Congratulations! You have been hired as an IS intern by Extreme Descent Snowboards—a relatively new company that manufactures and sells custom-crafted snowboards. As an IS intern, you will find an assignment waiting for you at the end of each chapter. Each assignment will relate directly to the concepts and material that you read in the chapter. You will then apply yourself and these concepts just as if you were working on a real assignment for the company.

Extreme Descent Snowboards’ electronic commerce Web site and corporate Intranet can be found at www.wiley.com/college/turban. You will need Internet access, a login ID, and a password to enter this site. Your instructor will provide this information.

Once you have a login ID and password, you should become acquainted with the Extreme Descent Snowboard organization. Jacob March, the vice president of information systems at Extreme Descent Snowboards, will be your mentor and supervisor during your internship. He suggests that you do the following:

- Visit the Extreme Descent Snowboard electronic commerce Web site. Become familiar with the company’s history and its products.
- Visit the company’s corporate intranet. Become familiar with the company’s organizational structure and services available on the corporate intranet.

Even though you may not become an IS professional, your IS internship will provide you with valuable insight concerning the role and use of information technology throughout the functional areas of an organization. Hopefully, you will gain an appreciation for the interdisciplinary nature of the nature of the information systems field and how the various functional areas within an organization are related and depend on each other. This will make you a more enlightened, effective, and valuable manager, regardless of your chosen field.