Chapter

2

IT Infrastructure and Support Systems

Learning Objectives

1. Understand the types of information systems and how they process data.
2. Understand the types of information systems used to support business operations and decision makers.
3. Describe how IT supports supply chains and business processes.
4. Understand the attributes, benefits, and risks of service-based and cloud computing infrastructures.

Integrating *IT*

Chapter 2 LINK LIBRARY

Blog on cloud computing *infoworld.com/blogs/david-linthicum*
Planners Lab, for building a DSS *plannerslab.com*
Supply Chain and Logistics Institute *SCL.gatech.edu/*
Salesforce.com cloud demos *salesforce.com*
U.S. Defense Information Systems Agency *disa.mil*
Supply Chain, Europe's strategic supply chain management resource *supplychainstandard.com*

QUICK LOOK at Chapter 2, IT Infrastructure and Support Systems

This section introduces you to the business issues, challenges, and IT solutions in Chapter 2. Topics and issues mentioned in the Quick Look are explained in the chapter.

Organizations have various types of information systems that collect and process data, distribute reports, and support decision making and business processes. Starting with transactions that take place at an interface (e.g., withdrawing money from an automatic teller machine, or ATM), a **transaction processing system (TPS)** processes the data (e.g., verifies available funds, subtracts withdrawal amount) and then stores or updates the data in a database. Data are extracted from the database and organized into reports using **management information systems (MIS)**. MIS refers to basic reporting systems that convert raw data into more meaningful information used by managers and employees. Information is an organization's most important asset, second only to people.

Decision making and problem solving require data and models for analysis; they are supported by **decision support systems (DSS)**. Corporations, government agencies, the military, healthcare, medical research, major league sports, and nonprofits depend on their DSSs at all levels of the organization. Innovative DSSs create and help sustain competitive advantages. DSSs reduce waste in production operations, improve inventory management, support investment decisions, and predict demand. The **model** of a DSS consists of a set of formulas and functions, such as statistical, financial, optimization, and/or simulation models.

Figure 2.1 shows how types of ISs relate to one another and how data flows among them. In this example, data from online purchases is captured and processed by the TPS, then stored in the transactional database. Data needed for reporting purposes is extracted from the

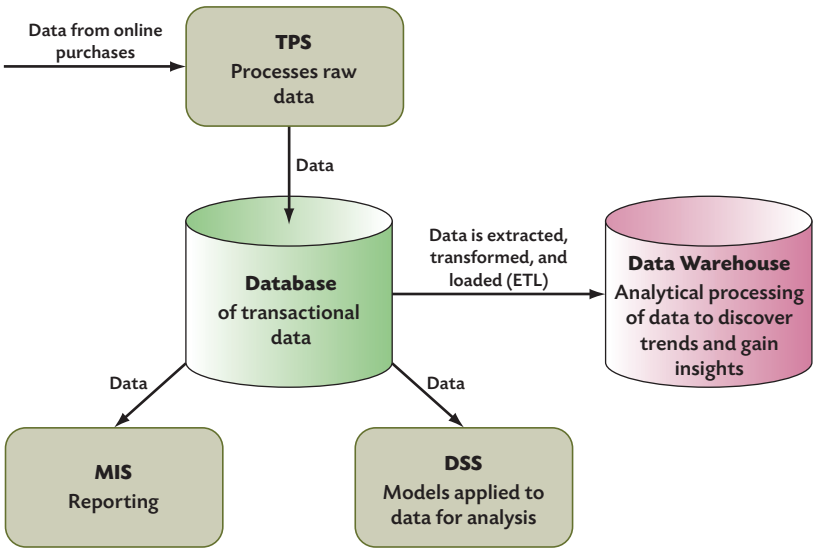

Figure 2.1 Diagram showing the relationships among information systems.

database and used by the MIS to create periodic, ad hoc, or other types of reports. Data is output to a DSS, where it is analyzed using models. In effect, data collected by the TPS is converted into information by the MIS and DSS. Customer, sales, and other critical data are selected for additional analysis, such as trend analysis or forecasting demand. That data is extracted from the database, transformed into a standard format, and then loaded into a data warehouse. Complex decision-making and problem-solving tasks cannot be done in a database because of its volatility. Those tasks need sophisticated systems, IT platforms, and data repositories, such as data warehouses.

In Chapter 2, you will learn how various types of systems and applications support managers, workers, work flows, business processes, and transactions with supply chain partners. The role of the IT department (or IT function, as it's sometimes called) is to ensure the reliability of the enterprise's IT infrastructure. **IT infrastructure** is the collection of hardware, software, processes, networks, and users. The design of the IT infrastructure determines the ability to efficiently store, protect, and manage data so that it can be made accessible, searchable, shareable, and, ultimately, actionable. In this chapter, you will learn why cost, complexity, and risk need to be considered when configuring an IT infrastructure. You will read about the growing use of software-as-a-service (SaaS) and cloud computing.

In the past, IT managers only had two options—to build or buy the technology. Now they also have the option of **cloud computing**, in which the technology is rented or leased on a regular or as-needed basis. Cloud computing gets its name from the Internet, which you usually see represented as a cloud. Examples are data storage and computing hardware that are accessed via the Internet instead of being company-owned and on-site in a data center. Cloud computing delivers IT capabilities as *services* over the Internet, allowing them to be managed and accessed via the Internet. A 2009 report from the University of California at Berkeley estimated that cloud computing services are five to seven times more cost effective than traditional data centers (Hasson, 2009). However, security risks had a dampening effect on the adoption of cloud strategies. According to a 2010 IDC survey, 88 percent of respondents said security was their biggest concern or challenge when considering cloud adoption.

Sprint Nextel's Subscriber Data Management System

In 2005, Sprint and Nextel Communications merged, forming the third-largest wireless service provider in the United States. The new company, Sprint Nextel, provided wireless and landline communications and mobile data services to 40 million customers, or subscribers. As understandably happens after a merger, the company had a fractured view of its customers because of the many different legacy (old) systems. Legacy systems stored data in multiple databases that could not share data. Because of this rigid infrastructure, their database systems had to be consolidated into another IT platform to enable an accurate, complete view of subscriber data. Until they had a single view of its subscribers, effective subscriber management was impossible.

Consolidating ISs is not simply changing over one company's TPS and MIS to match the other company's systems. And it's not achieved by moving one company's data into the databases of the other. Why? Because modifying legacy servers, databases, software applications, and reporting systems to make them compatible may not be feasible. Legacy systems are less flexible and more expensive to maintain and operate. Recognizing the limitations of their ISs and their incompatibilities, Sprint Nextel consolidated the bulk of its marketing technology into a new integrated system and IT platform. The IT department, working closely with the marketing department, built an integrated centralized database system and data warehousing platform.

360-Degree View of Subscribers

After the integration, marketing gained a single, trusted view of its subscriber data and an array of new business tools and capabilities to help pinpoint new revenue growth targets. Their new IT platform has reduced the costs associated with maintenance, upgrades, and data management. Other benefits were the ability to do advanced data analysis and creation of an IT platform for enterprise-wide applications such as customer relationship management (CRM). Centralized data means more accurate predictions—enabling more targeted marketing campaigns and better understanding of the profitability of customers.

Business Lessons

Learning is vital for managers. Marketers want to learn which advertising campaigns worked, how well, and why—and are frustrated when they cannot get the feedback to do so. For example, during and after an expensive marketing

campaign, managers would benefit from answers to the following questions:

1. **How successful was the campaign?** The success of a campaign is judged in comparison to an objective, such as increasing sales by 10 percent. A closely related question is: How effective was the campaign compared to prior campaigns?
2. **What did we learn so that we can improve our performance?** Managers not only need to earn a return on the investment (ROI); they also want to learn what works, what does not work, and why or why not. This "earn and learn" approach improves the bottom line, and furthers the career success of the management team.

For Class Discussion and Debate

1. ***Scenario for Brainstorming and Discussion:*** To compete on a global scale, organizations have increased their market share through mergers and acquisitions (M&A), both locally and internationally. Today, M&A are a common growth strategy worldwide. Integrating the merged companies' information systems and infrastructures may be much more complex, time-consuming, and expensive than senior management had expected. Studies were done in the mid-1990s to learn the impacts of the numerous mergers that occurred in the late 1980s. The evidence suggested that one of the main reasons for poor post-acquisition performance in the merger wave of the late 1980s was the failure of organizations to consider fully the complications of merging information systems and technologies (McKiernan and Merali, 1995). In 2008, researchers from Helsinki University of Technology and Copenhagen Business School reported that IS integration is among the most challenging tasks in corporate M&As (Alaranta and Henningsson, 2008).

   Imagine that two large banks merged and that they were unable to integrate their customer information systems. How might the lack of IS integration negatively impact the newly merged bank's performance? Think in terms of "waste." Waste is effort, time, or investment that has no positive effect or worse—a negative ROI. Would the merged bank know how many customers it had and which accounts each customer had? Explain your answer. How might not knowing which customers were the most profitable and which were the least profitable make it difficult for managers to improve performance?
2. ***Debate:*** Data that is inaccurate or incomplete is referred to as dirty data. The degree to which data is inaccurate or incomplete can be represented on a continuum from "dirty and cannot be trusted" to "clean and can be reasonably trusted." Of course, keeping data accurate and complete so managers can trust it is expensive. All departments want and need trusted data at all times. For example, marketing knows that their campaign costs are lower with more accurate data. However, the IT department is limited by its budget and explains that such a degree of accuracy would consume too much of its budget.

   Take the position of the marketing manager, the IT manager, or the chief financial officer (CFO) who decides the budgets for each department. For those students who assume the role of the marketing or IT managers, present valid and convincing arguments to the CFO for an increased budget to improve data quality. For those students assuming the role of the CFO, challenge any unsupported arguments, ask questions, and then decide what to do about the IT budget.

Sources: Compiled from Keefe (2010), Alaranta and Henningsson (2008), and McKiernan and Merali (1995).

2.1 Data and Software Application Concepts

Business software applications (apps) are computer programs that support a specific task or business process. Apps can support a single worker, a department or division, a functional area, or an entire enterprise. As you read in Chapter 1, there are apps specifically for the iPhone and BlackBerry. As you read throughout other chapters, you will see that apps can support relationships with customers, suppliers, and other business partners.

BUSINESS INFORMATION SYSTEMS

Multiple business apps form a system that supports a functional area—marketing, finance, human resources (HR), production, operations, accounting, and IT. Functional systems for planning and control are discussed in Chapter 9. A worker using a financial app is shown in the nearby photo.

Steve Cole/iStockphoto

Source: istockphoto.com

For instance, to support the HR function of the organization, a human resources information system (HRIS) typically consists of a suite or bundle of applications for screening job applicants, monitoring employee performance and turnover, processing payroll, documenting compliance with regulations, and tracking employee benefits. An HRIS collects data, from which reports containing information are generated. Even though the terms *data* and *information* seem to represent the same concept, their differences are important, as you will read about next.

DATA, INFORMATION, AND KNOWLEDGE

Information systems are built to achieve several goals. One key goal is to economically process data into information and knowledge.

Data, or raw data, refers to a basic description of products, customers, events, activities, and transactions that are recorded, classified, and stored. Data is the raw material from which information is produced; the quality, reliability, and integrity of the data must be maintained for the information to be useful. Examples are the number of hours an employee worked in a certain week or the number of new Toyota vehicles sold in the first quarter of 2010. A **database** consists of stored data organized for access, search, retrieval, and update.

Information is data that has been processed, organized, or put into context so that it has meaning and value to the person receiving it. For example, the quarterly sales of new Toyota vehicles from 2008 through 2010 is information because it would give some insight into how the vehicle recalls during 2009 and 2010 impacted sales.

Knowledge consists of data and/or information that has been processed, organized, and put into context to be meaningful and to convey understanding, experience, accumulated learning, and expertise as they apply to a current problem or activity. Knowing how to manage a vehicle recall to minimize negative impacts on new vehicle sales is an example of knowledge. Figure 2.2 illustrates the differences in data, information, and knowledge. Organizational knowledge—the expertise of its workers—is valuable to all employees and the bottom line.

Review Questions

1. Define *information system*.
2. What is an application program?
3. Define *data*, *information*, and knowledge.

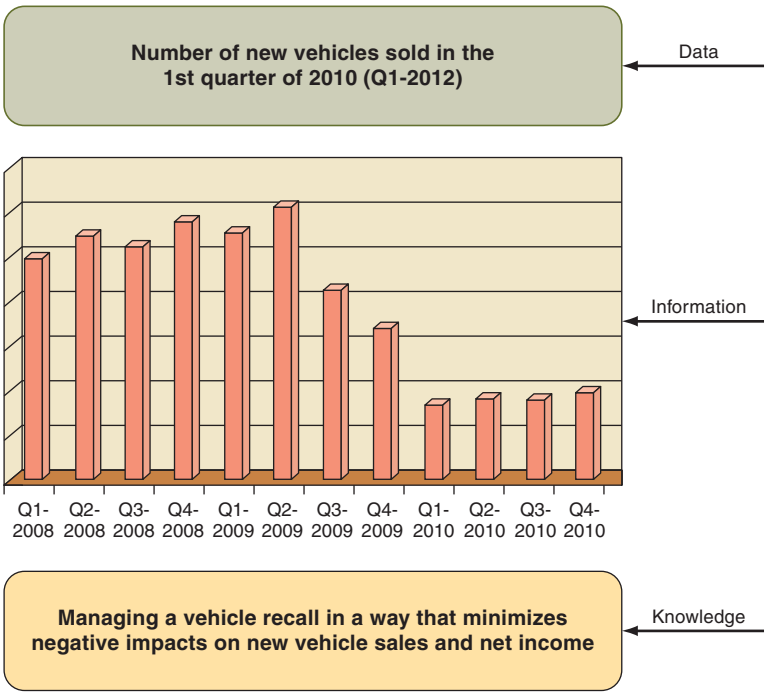

Figure 2.2 Example of data, information, and knowledge.

2.2 Types of Information Systems and Support

Information systems can be classified into two categories based on the general type of support they provide: managerial or operational support. Figure 2.3 represents this classification as management support systems and operations support systems, and it shows two examples of each.

TRANSACTION PROCESSING SYSTEMS (TPS)

Transaction processing systems are designed to process specific types of data input from ongoing transactions. TPSs can be manual, as when data is typed into a form on a screen, or automated by using scanners or sensors to capture data. Figure 2.4 illustrates input of barcode data via a handheld scanner.

Organizational data is processed by a TPS—sales orders, payroll, accounting, financial, marketing, purchasing, inventory control, and so on. Transactions are either:

- **Internal transactions:** Transactions that originate from within the organization or that occur within the organization. Examples are payroll, purchases, budget transfers, and payments (in accounting terms, they're referred to as *accounts payable*).
- **External transactions:** Transactions that originate from outside the organization, for example, from customers, suppliers, regulators, distributors, and financing institutions.

TPSs are critical systems. Transactions that do not get captured can result in lost sales, dissatisfied customers, and many other types of data errors. For example, if accounting issues a check as payment for an invoice (bill), and that transaction is not captured, the amount of cash on the financial statements is overstated and the invoice may be paid a second time. Or if services are provided but not recorded, the company loses that service revenue.

Batch vs. Online Real-Time Processing. Data captured by a TPS is processed and stored in a database; it is then available for use by other systems. Processing of transactions is done in one of two modes:

- **Batch processing:** A TPS in batch processing mode collects all transactions for a day, shift, or other time period and then processes and stores the data later. Payroll processing, which is typically done weekly or biweekly, is done in batch mode.
- **Online transaction processing (OLTP) or real-time processing:** The TPS processes each transaction as it occurs, which is what is meant by the term *real-time processing*. In order for online transaction processing (OLTP) to occur, the input device or Web site must be directly linked via a network to the TPS. Airlines need to process flight reservations in real time to verify that seats are available. E-commerce transactions also need to be processed in real time.

Batch processing costs less than real-time processing, with the obvious disadvantage that data is inaccurate because it is not updated immediately (in real time).

Data Quality. Processing improves data quality, which is important because reports and decisions are only as good as the data they are based upon. As data is collected

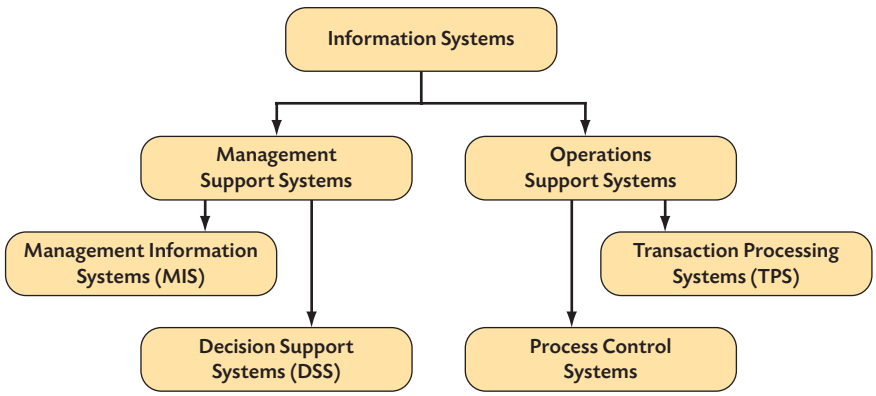

Figure 2.3 Information systems classified according to type of support.

Figure 2.4 Scanners automate the input of data into a transaction processing system (TPS). (*Jan_Neville/iStockphoto*)

or captured, it is validated to detect and correct obvious errors and omissions. For example, if a customer sets up an account with a company, such as Amazon.com, to purchase from its Web site, the TPS will validate that the address, city, and postal code are consistent and also that those data items match the address, city, and postal code of the credit card. If required fields of the online form are not completed or have obvious errors, the customer is required to make the corrections before the data is processed any further.

Data errors detected later may be difficult to correct, may expose the company to legal action, or may never be detected and corrected. You can better understand the difficulty of detecting and correcting errors by considering identity theft. Victims of identity theft face enormous challenges and frustration trying to correct data about them stored in databases.

Routine Business Transactions. Financial, accounting, and other repetitive business activities create routine business transactions. For example, employees are paid at regular intervals, customers place purchase orders and are billed, and expenses are monitored and compared to the budget. Table 2.1 presents a list of representative routine, repetitive business transactions in a manufacturing company.

TABLE 2.1 Routine Business Transactions in a Manufacturing Company

Payroll and personnel	Employee time cards
	Employee pay and deductions
	Payroll checks
	Fringe benefits
Purchasing	Purchase orders
	Deliveries
	Payments (accounts payable)
Finance and accounting	Financial statements
	Tax records
	Expense accounts
	Accounts receivable
	Accounts payable
Sales	Sales records
	Invoices and billings
	Sales returns
	Shipping
Production	Production reports
	Quality control reports
Inventory management	Material usage
	Inventory levels

MANAGEMENT INFORMATION SYSTEMS

The functional areas or departments—accounting, finance, production/operations, marketing and sales, human resource, and engineering and design—are supported by ISs designed for their particular reporting needs. General-purpose reporting systems are referred to as management information systems (MIS). Their objective is to provide reports to managers for tracking operations, monitoring, and control. The information systems department serves these departments, as shown in Figure 2.5.

Typically, a functional system provides reports about such topics as operational efficiency, effectiveness, and productivity by extracting information from databases and processing it according to the needs of the user. Types of reports are the following:

- **Periodic:** These reports are created or run according to a preset schedule, such as daily, weekly, or quarterly. Reports are easily distributed via e-mail, blogs, internal Web sites (called *intranets*), or other electronic media. Periodic reports are also easily ignored if workers don't find them worth the time to review.
- **Exception:** Exception reports are generated only when something is outside the norm, either higher or lower than expected. Sales in hardware stores prior to a hurricane may be much higher than the norm. Or sales of fresh produce may drop during a food contamination crisis. Exception reports are more likely to be read because workers know that some unusual event or deviation has occurred.
- **Ad hoc:** Ad hoc reports are unplanned reports. They are generated to a screen or in print on an *as-needed* basis. They are generated on request to provide more information about a situation, problem, or opportunity.

Reports can include tables of data and data charts, as shown in Figure 2.6. With easy-to-use multimedia technology, reports can also include video, audio, and links to other reports.

Functional information systems that support business analysts and other departmental employees can be fairly complex, depending on the type of employees supported. The following examples show the support IT provides to major functional areas.

1. Computerized analysis helps Texas collect $400 million additional taxes. Tax gaps exist between taxes owed and the amount collected in many public entities.

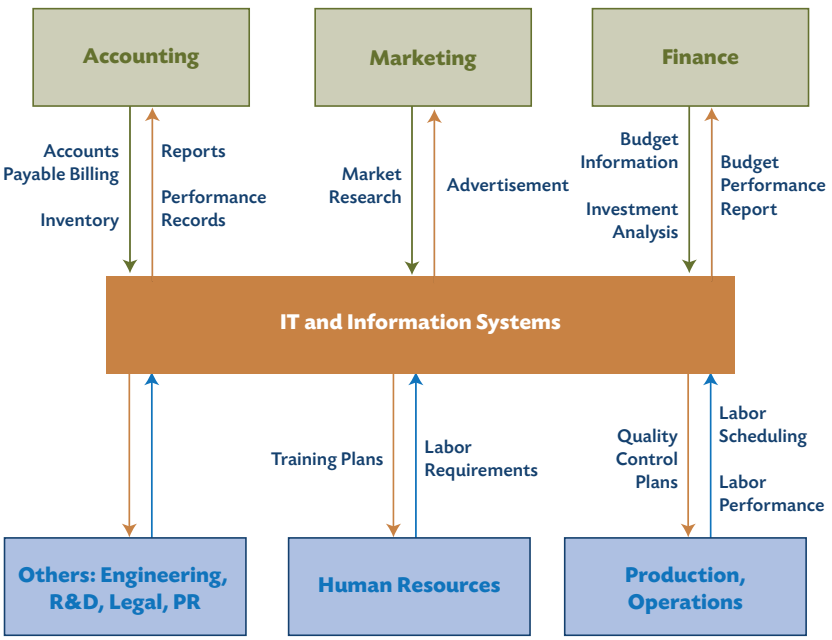

Figure 2.5 Functional information systems.

Figure 2.6 Sample report produced by an MIS. (*Damir Karan/iStockphoto*)

The state of Texas is no exception. To overcome the problems, tax collectors perform audits, which are time-consuming and expensive to conduct manually. Also, many audits are unproductive, resulting in little or no tax recovery. In order to make better decisions on whom to audit to increase the percentage of productive audits, the state of Texas uses predictive analytics.

Millions of records are stored in the state data warehouse. Using data mining software from SPSS.com, the agency can cross-match millions of records identifying promising leads. Specifically, the system helps identify thousands of businesses that were operating in the state without complying with the tax obligations. Also, it helps field auditors in adopting better audit target selections. Once the employees gained confidence in the program, they started to use it extensively, saving over $150 million a year.

2. The Dallas Mavericks: Using IT for successful play and business. The Dallas Mavericks of the National Basketball Association (NBA) expect to fill every seat at every game in their stadium and to maximize sales from concessions and souvenir items.

To track attendance, the Mavs were the first NBA team to put barcodes on tickets and then scan them. The information encoded in the barcode enabled them to find out whether group sales and community organization giveaways were filling seats or whether those marketing efforts were just wasting tickets. The team's business managers have found other uses for the attendance information as well. By using forecasting models in a DSS, they more accurately predicted attendance for particular games and demand for beverages, which reduced beverage inventories by 50 percent—reducing inventory costs.

Each of the 144 luxury suites is equipped with a PC that handles orders for merchandise, food, and beverages. Wireless access from all seats in the arena is available so that fans can place orders directly from their seats. All 840 cash registers at concessions stands, restaurants, stores, and bars use a sophisticated point-of-sale (POS) system. In the big retail store on the ground floor, salespeople using handheld computing devices ring up credit card purchases when lines get too long. During a game, managers can see which concession stands are busy and which can be closed early to cut labor costs.

IT also supports the Mavs on the court. The team has 10 assistant coaches, and each has a laptop computer and a handheld computing device. Game films can be streamed over the Web for coaches to view on the road or at home. Another system developed in-house matches game footage with precise, to-the-minute statistics provided for every play of every game by the NBA. Coaches use data from the database to analyze the effectiveness of particular plays and combinations of players in different game situations.

Since 2002, the Mavs have used handheld computers to track the performance of each referee in every one of their games. The coaches look at patterns and trends—for example, to see which referee favors a given team or which one calls more three-second violations—and alert their players. Another system logs different offensive and defensive schemes used against the Mavs. It's used by coaches to make real-time adjustments based on statistics from previous games.

3. Army trains soldiers with virtual worlds. The U.S. Army uses video games and virtual worlds to teach soldiers interpersonal skills and cultural awareness for combat environments such as Iraq and Afghanistan. The IT supports computerized exercises that can sharpen physical reflexes and shooting skills. It prepares soldiers for a war and engenders the desire to win. The new systems train for difficult communication situations abroad (Gonsalves, 2008). For example, negotiation skills are heavily dependent on culture. Soldiers learn how to think and communicate under pressure and stress. The system is a multiplayer simulation game (up to 64 players on the networked computer system over an intranet). Players direct their avatars through the realistic war zone cyberspace. Participants serve as either role players or evaluators with tasks and experiences that vary according to role. Instructors can create or modify scenarios, monitor training, and jump in to change the direction of the game at any time. The interactions practiced in the game help soldiers deal with local customs, build trust with natives in foreign war zones, and equip and train locals to aid U.S. military efforts.

An integrated trade management system with DSS components used by Western Petroleum (Western Petro) to control costs is discussed in *IT at Work 2.1*.

IT at Work 2.1

Western Petro Controls Costs with its Trade Management System

Western Petroleum Company (*WesternPetro.com/*) is one of the largest independently owned petroleum marketing companies. It buys petroleum products in bulk (e.g., 50,000 barrels) and sells them in smaller amounts (e.g., 5,000 barrels) to over 2,000 customers. Western Petro makes sure the oilfield production companies have the fuel and lubricants they need to ensure uninterrupted operations. "When our oilfield customers need fuel, they need it immediately," says Perry P. Taylor, Western Petro president. "They don't want to hear excuses about delayed deliveries. If the drilling rigs run out of fuel, they have to shut down, and that can be very expensive."

IT Strategy. The company operates on a razor-thin profit margin, so controlling purchasing costs determines profitability. Costs are controlled by using an industry-specific software platform that facilitates trading and helps schedule employees.

The IT strategy has been to automate core business processes and to outsource all noncritical functions. A key piece of the automation strategy is PetroMan, from Sisu Group (*sisugrp.com*). PetroMan is a comprehensive trading system that triggers buying and selling activities and integrates contract management, risk management, accounting, and pipeline scheduler. Using the PetroMan, the company can place bids and automatically capture a contract for refined products as well as schedule and confirm deliveries in pipelines. PetroMan also handles the resale of fuels, including electronic invoicing and a credit module that checks and tracks a customer's credit risk. This tracking is done by hedging large purchasing contracts by selling futures on the New York Mercantile (Commodities) Exchange. By hedging, the company protects itself against the risk of a large drop in oil prices. The software is plugged directly into the primary commodity exchanges, automating the process.

Accounting/financial data flows automatically from PetroMan to the company's financial application, a package called Global Financials (from Global Software). As a result, the entire process of buying and selling fuels and moving the accounting/financial information is fully automated.

Sources: Compiled from Duvall (2005), *westernpetro.com*, and *sisugrp.com/petroman.htm*

Discussion Questions: Which processes are being automated and why? Why is controlling risk important? Does PetroMan provide Western Petro with a competitive advantage? Explain. Visit *sisugrp.com/petroman.htm*. Why is PetroMan referred to as an enterprise information system?

DECISION SUPPORT SYSTEMS

Decision support systems (DSS) are interactive applications that support decision making. Configurations of a DSS range from relatively simple applications that support a single user to complex enterprise-wide systems, as at Western Petro (described in *IT at Work 2.1*). A DSS can support the analysis and solution of a specific problem, evaluate a strategic opportunity, or support ongoing operations. These systems support unstructured and semistructured decisions, such as whether to make or buy products and what new products to develop and introduce into existing markets.

Degree of Structure of Decisions. Decisions range from structured to unstructured. Structured decisions are those that have a well-defined method for solving and the data needed to reach a decision. An example of a structured decision is determining whether an applicant qualifies for an auto loan or whether to extend credit to a new customer—and the terms of those financing options. **Structured decisions** are relatively straightforward and are made on a regular basis; an IS can insure that they are done consistently.

At the other end of the continuum are **unstructured decisions** that depend on human intelligence, knowledge, and/or experience—as well as data and models to solve. Examples include deciding which new products to develop or which new markets to enter. Semistructured decisions are in the middle of the continuum. DSSs are best suited to support these types of decisions, but they are also used to support unstructured ones. To provide such support, DSSs have certain characteristics to support the decision maker and the decision-making process.

Three Defining DSS Characteristics. Three defining characteristics of DSSs are:

- An easy-to-use interactive interface
- Models that enable sensitivity analysis, *what-if* analysis, goal seeking, and risk analysis
- Data from both internal databases and external sources, added to by the decision maker, who may have insights relevant to the decision situation.

Having models is what distinguishes DSS from MIS. Some models are developed by end users through an interactive and iterative process. Decision makers can manipulate models to conduct experiments and sensitivity, w*hat-if, and goal-seeking* analyses. What-if analysis refers to changing assumptions or data in the model to see the impacts of the changes on the outcome. For example, if sales forecasts are based on a 5 percent increase in customer demand, a what-if analysis would replace the 5 percent with higher and/or lower demand estimates to determine *what* would happen to sales *if* the demands were different. With goal seeking, the decision maker has a specific outcome in mind and needs to figure out how that outcome could be achieved and whether it's feasible to achieve that desired outcome. A DSS can also estimate the risk of alternative strategies or actions.

California Pizza Kitchen (CPK) uses a DSS to support inventory decisions. CPK has 77 restaurants located in various states in the United States Maintaining the inventory of all restaurants at optimal levels was challenging. A DSS has made it easy for the managers to keep records updated and make decisions. Many CPK restaurants increased sales by 5 percent after implementing a DSS.

Building DSS Applications. **Planners Lab** is an example of software for building a DSS. The software is free to academic institutions and can be downloaded from *plannerslab.com*. Planners Lab includes:

- An easy-to-use model-building language
- An easy-to-use option for visualizing model output, such as answers to what-if and goal-seeking questions to analyze the impacts of different assumptions

These tools enable managers and analysts to build, review, and challenge the assumptions on which their decision scenarios are based. With Planners Lab, decision

makers can experiment and play with assumptions to assess multiple views of the future.

Some DSS applications may be very similar to business intelligence (BI) applications, which are discussed in Chapter 11. *IT at Work 2.2* provides an overview of BI and shows the similarity between these applications and DSS. You will read about BI and DSS is greater detail in Chapter 11.

IT at Work 2.2

Business Intelligence for Competitive Advantage

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Business intelligence (BI) combines software architectures, databases, analytical tools, applications, graphical displays, and decision-making methodologies. BI's main objective is to enable timely and even interactive access to data and to give business managers and analysts the ability to conduct appropriate analysis. By analyzing historical and current data, situations, and performances, decision makers obtain valuable insights that enable them to make more informed and better decisions.

The Architecture of BI. A BI system has four major components:

1. A data warehouse or large database with its *source data*
2. Business analytics, a collection of tools for manipulating, mining, and analyzing the data in the data warehouse
3. Business performance management (BPM) tools for monitoring and analyzing performance
4. A user interface and display, such as a dashboard

A major component in BI and in BPM is the dashboard. A dashboard is a visual presentation of critical data (e.g., results of a report or analysis) for users, including executives. It allows users to see *hot spots* at a glance, such as deviations from targets, exceptional performance, or Web analytics summaries. An example is provided in Figure 2.7, which displays a number of key performance indicators (KPI) and critical data for a software company. From the dashboard, it is easy to see, for instance, that the KPIs are all good (i.e., they are all in the green), that for all stages of the pipeline the revenues are trending upward (i.e., they are all

Figure 2.7 Sample of a performance dashboard.

green arrows pointing upward), and that the growth in revenues is outpacing the increase in marketing costs. This particular dashboard enables end users to see whether there are any differences by time period or product (the drop-downs on the upper right) and to further analyze marketing costs.

Data Mining. One major analytical tool in B1 is data mining. **Data mining** is a computerized process for conducting searches in large amounts of data and information in an attempt to discover unknown valuable relationships in the data (e.g., among variables). Data mining helps in making predictions and decision making.

BI Examples. Examples of how data mining works: Two examples of useful applications that show how data mining can support organizations follow:

BI Example 1. The National Australia Bank uses data mining to aid its predictive marketing. The tools are used to extract and analyze data stored in the bank's Oracle database. Specific applications focus on assessing how competitors' initiatives are affecting the bank's bottom line. Data mining tools are used to generate market analysis models from historical data. The bank considers BI to be crucial to maintaining an edge in the increasingly competitive financial services marketplace.

BI Example 2. The FAI Insurance Group uses data mining to reassess the relationship between historical risk from insurance policies and the pricing structure used by its underwriters. The data analysis capabilities allow FAI to better serve its customers by more accurately assessing the insurance risk associated with a customer request.

MAIN TYPES OF SUPPORT SYSTEMS

The main types of support systems are listed in Table 2.2, together with the types of employees they support. Several of these support systems and discussed in later chapters.

TABLE 2.2 Main Types of Information Support Systems

Information Systems	Workers Supported	Description
Management information system (MIS)	Middle managers	Provides routine information for planning, organizing, and controlling operations in functional areas
Decision support system (DSS)	Decision makers, managers	Combines models and data to solve semistructured problems with extensive user involvement
Business intelligence (BI)	Decision makers, managers, knowledge workers	Gathers and uses large amounts of data for analysis by business analytics and intelligent systems
CAD/CAM	Engineers, draftspeople	Allows engineers to design and test prototypes; transfers specifications to manufacturing facilities
Electronic records management system	Office workers	Automates management, archiving, and flow of electronic documents
Knowledge management system (KM)	Managers, knowledge workers	Supports the gathering, organizing, and use of an organization's knowledge
Data mining and text mining	Knowledge workers, professionals	Enables learning from historical cases, even with vague or incomplete information
Automated decision support (ADS)	Frontline employees, middle managers	Supports customer care employees and salespeople who need to make quick, real-time decisions involving small dollar amounts

Review Questions

1. Define *TPS* and provide an example.
2. What is a functional information system?
3. Explain why TPS needs to process incoming data before storing it in a database.
4. Define *MIS* and provide an example.
5. Define *DSS* and provide an example.

2.3 Supply Chain and Logistics Support

A company's supply chain can be viewed as two segments, the backstream and upstream, which are shown in Figure 2.8. Each segment can consist of multiple links, perhaps hundreds, to individual suppliers/sellers and to multiple customers. Every link an organization has to direct sources and/or direct customers needs to be managed. But not all links need to be managed to the same extent. For example, Walmart focuses its efforts on the backstream supply chain, as you will read in the next section. For a retailer, wholesalers and manufacturers are backstream; their customers are upstream. For manufacturers, their supply chain extends from raw materials through the recycling of the product.

Along with the physical flows of products and materials are the information flows and the financial flows that link companies in the supply chain. **Logistics** is the science concerned with managing material and information flows to optimize supply chain operations. Logistics has been described as having the right thing, at the right place, at the right time.

A company's competitive advantage—for example, low cost, reliability, quality, speed to market, and/or quick response—depends on how well the supply chain is aligned and managed. The importance of **supply chain management (SCM)** is understood by examining Walmart's global sourcing strategy. **Global sourcing** occurs when companies purchase goods or services from sellers located anywhere in the world.

Walmart's Global Sourcing Strategy for its Backstream Supply Chain. In March 2010, retail giant Walmart announced its new backstream SCM strategy. Because Walmart has thousands of suppliers and is constantly looking for new ones worldwide, it decided to invest in a new *global sourcing strategy*. **Sourcing** involves identifying sources (sellers) that could provide Walmart with products or services to sell in its stores and online. Its **sourcing strategy** is designed to reduce costs of goods, increase speed to market, and improve the quality of products.

Walmart's global sourcing strategy involves three things: (1) the creation of global merchandising centers (GMCs), (2) a change in leadership and structure, and (3) a strategic alliance with Li & Fung, a global sourcing organization. Li & Fung is building capacity that would enable it to act as a *buying agent* for goods valued around US$2 billion within the first year. Walmart vice chairman Eduardo Castro-Wright said: "These centres will create alignment between sourcing and merchandising and drive efficiencies across various merchandise categories. Our new strategy and structure should drive significant savings across the supply chain" ("Wal-Mart Unveils," 2010).

Walmart has been a leader in global SCM best practices for many years. Its new global sourcing strategy shows that continuing efforts and investments to drive inefficiencies out of the supply chain are vital to competitiveness. Walmart's executives recognize that maintaining their low cost and huge product variety advantages depends on how well they manage their numerous supply chains. Supply chain management is a strategic concern of almost every organization. For many, particularly those in manufacturing, distribution, and retail, SCM is critical to survival. *IT at Work 2.3* gives an example of a company managing its internal operations—also referred to as the **internal supply chain**—and upstream supply chain.

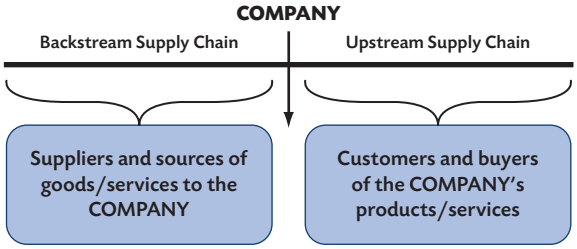

Figure 2.8 Backstream and upstream components of a supply chain.

IT at Work 2.3

Argos and VanDerLande Industries Automate U.K. Distribution Center

Argos is the largest nonfood retailer in the United Kingdom. Argos sells general merchandise and products for the home from over 700 stores throughout the United Kingdom and Ireland, online and over the telephone. It serves over 130 million customers a year through its stores and intakes 26 percent of sales through the Internet. In 2009, its sales were £4.3 billion, and it employed 33,000 people. The Argos Web site was the most visited high street retail site in the United Kingdom in 2008.

Argos partnered with VanDerLande Industries on an automated distribution center, which lowered operational costs and improved efficiency, productivity, and picking accuracy.

Background. Faced with significant growth, Argos wanted to increase product availability and reduce costs. To do so, Argos centralized its distribution of small items to ensure availability and improve picking efficiency. An example of automation is shown in Figure 2.9. Argos also wanted better control over the supply of direct imports, which make up a growing proportion of its products.

The automated distribution center includes a central warehouse for imported goods. Pallet handling is a vital part of the company's production and distribution processes. Pallet handling extends throughout the business process, from goods receiving to shipping of finished products or sorted deliveries. Therefore fast, smooth, and efficient pallet handling is essential.

All automated processes are managed by VanDerLande Industries VISION Warehouse Control System (WCS), which is integrated into Argos's warehouse management system. The automated distribution center significantly reduced Argos's operational costs by freeing up resources at the busy regional distribution centres. Managing direct imports in bulk yields greater savings and ensures continuity of supply.

Figure 2.9 Argos automated handling of its small products to improve the efficiency of its internal supply chain.

Sources: Compiled from *argos.co.uk/* (2010), *vanderlande.com*, and *supplychainstandard.com* (2008).

Discussion Questions: How does Argos's internal supply chain impact its upstream supply chain? Why did Argos (like Walmart) partner with a vendor for its warehouse management system? Watch the video *A Major Advance in Logistics* about the Argos project at *yourlogisticstv.com*. Explain why Argos's project was a major advance in logistics.

Supply Chains Create Extended Enterprises. The supply chain—by linking a company with its suppliers, vendors, and customers—creates an extended enterprise. That extended enterprise depends on IT and information systems to share data and collaborate, similar to the way various departments within the company do. Supply chains can be grossly inefficient unless the companies in the supply chain can share data, collaborate, and respond to changes in demand efficiently and quickly.

ITs used for planning, organizing, coordinating, and controlling supply chain activities include the following:

- Enterprise resource planning (ERP) software: ERP helps manage both the internal and the external relationships with the business partners.
- Supply chain management software: SCM software helps in decision making related both to internal segments and to their relationships with external segments. Both ERP and SCM are covered in detail in Chapter 11.
- **Radio frequency identification** (RFID): RFID is a technology that uses electronic tags (chips) instead of barcodes to identify objects or items. This technology is similar to the 2D tags discussed in Chapter 1. RFID tags can be attached to or embedded

in packages, physical objects, animals, or humans. RFID readers scan and input identifying information from the tags via radio waves.

Radio Frequency Identification (RFID) Systems. RFID systems are essential to any supply chain, but their ability to track and monitor also provides additional benefits. For example, in 2010, Gerry Weber International, a Germany-based manufacturer of women's fashions, began applying RFID tags to the 25 million garments it produces annually. The company rolled out RFID technology at 150 of its company-owned retail stores in Germany and abroad. The RFID system is designed to improve the efficiency of its incoming goods and inventory processes and also to function as an electronic article surveillance (EAS) system to deter theft. The RFID tags are embedded into the garment-care labels. The company is the first in Germany to sew RFID-enabled care labels into apparel, as well as the first to rely solely on RFID for EAS (*gerryweber-ag.de*, 2010; Wessel, 2009).

At a presentation at *RFID Journal LIVE! Europe 2009*, Ralph Tröger, an IT project manager at Gerry Weber, said his company learned from the logistics processes testing that it can gain "real value" from RFID, particularly by using the technology for picking and outbound shipping processes. It also learned that some RFID hardware was too large for retail distribution centers and that handheld readers required improved battery life and needed to be lighter.

Gerry Weber had significant time savings in the incoming goods receiving process because employees no longer had to manually count items or scan their barcodes to find out if an order was complete. Clerks simply scanned the barcode on the delivery note and scanned the RFID tags in garments to match up delivery receipts with actual items shipped. In addition, employees saved significant time by no longer having to attach and detach EAS security tags and take inventory. When a tagged item is purchased, a clerk reads the barcode on the price tag. The RFID system then reads the EPC number encoded to the garment's RFID tag and removes it from the database.

Sewing RFID tags into all garments it produces provides opportunities for suppliers and partners. The firm is encouraging all companies with which it does business to take advantage of its tagging in order to improve their processes and services by implementing RFID read points in the supply chain or at other points. Gerry Weber's performance improvements represent major benefits of RFID—efficient tracking of the items in real time, automated inventory tracking, and aligning companies in the supply chain.

RFID implementation has been slow due to costs, privacy, and security concerns, especially when it involves consumers. On the other hand, an increasing number of companies use the technology internally, frequently in combination with other IT systems, as is done by Nokia. Security guards at Nokia carry a mobile phone handset with an attached RFID tag. RFID tags are also installed at various points around the facility. At the start of a shift, guards use the phone to read their RFID-enabled name badges. Then security guards do their rounds, operating the handsets to read the various tags as they pass by them. Details of the phone number and RFID tag just read are transmitted over the cell phone network. Supervisors are thus given accurate information as to when a particular guard started and finished a shift, whether the guard patrolled all of the required locations, and where the guard was at a particular point in time. In addition, supervisors can use the text and phone function to ask guards to recheck an area, vary their route, and the like.

For RFID implementation at Airbus Industries, see the Business Case at the end of this chapter.

Review Questions

1. Describe how IT can support the supply chain of a retailer.
2. What is meant by an extended enterprise?
3. What is an internal supply chain?
4. What is RFID? What are its major benefits?

2.4 IT Infrastructures, Cloud Computing, and Services

When employees log into the company network or e-mail accounts, or access data or documents to perform their jobs, the speed of the response and the reliability of the hardware are critical factors. Delays due to heavy network traffic or system crashes waste time and are frustrating. Of course, everyone wants fast response, quick processing, and rapid access to information or files from various ISs and databases. It is the company's IT infrastructure that determines the workload that ISs, apps, and mobile computing devices can handle and their speed. IT infrastructure is the collection of hardware, software, processes, networks, and users.

The design of the IT infrastructure allows (or limits) the ability to store, protect, and manage data so that it can be made accessible, searchable, shareable, and actionable. To improve performance or lower up-front costs, companies are turning to cloud computing options. The cloud—which is the term used to refer to the Internet—has greatly expanded the options for enterprise IT infrastructures. The general name for Internet-based infrastructures is *cloud computing*. The evolution to cloud computing is represented in Figure 2.10. Organizations may use any or all three types of infrastructures, depending on their needs. As you will read in *IT at Work 2.4,* the U.S. Department of Defense (DoD) has implemented a private cloud to service many military agencies at reduced cost but has not adopted cloud computing because of the sensitive nature of its data.

First we discuss IT infrastructures and then virtualization and cloud computing.

IT INFRASTRUCTURE

What an organization's IT infrastructure can support is determined by five major components: (1) hardware, (2) software, (3) networks and communication facilities, including the Internet and intranets, (4) databases and data workers, and (5) information management personnel. When making decisions about how to acquire hardware, software, or any of these five components, the following four characteristics of an IT infrastructure need to be considered.

- **Dependable.** Dependability means that the infrastructure meets availability, reliability, and scalability requirements of the company's information systems (TPS, MIS, DSS, etc) and applications. Applications inherit their dependability from the IT infrastructure. That is, the dependability of applications is limited by (is only as good as) the dependability of the IT architecture.
- **Manageable.** IT infrastructure determines the complexity of managing hardware and software required to deliver dependable applications. A wireless infrastructure is necessary for interactivity and mobile computing applications.
- **Adaptable.** When additional application capacity is needed, organizations are able to scale up the infrastructure as needed.
- **Affordable.** In today's IT reality, dependability, manageability, and adaptability are not as significant as affordability. For example, older infrastructures may need expensive redundancy, or backup systems, to ensure these characteristics.

With this understanding of IT infrastructure, we can intelligently examine the reasons enterprises are investing in new IT architectures, particularly those that are cloud-based.

Figure 2.10 Evolution to cloud computing.

VIRTUALIZATION

Cloud computing evolved from virtualization—an approach that enabled more flexible IT infrastructures and lower IT costs. **Virtualization** is a concept that has several meanings in IT and therefore several definitions. The major type of virtualization is hardware virtualization, which remains popular and widely used. Virtualization is often a key part of an enterprise's disaster recovery plan. In general, virtualization separates business applications and data from hardware resources. This separation allows companies to pool hardware resources—rather than to dedicate servers to applications—and assign those resources to applications as needed. The major types of virtualization are the following:

- *Storage virtualization* is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console.
- *Network virtualization* combines the available resources in a network by splitting the network load into manageable parts, each of which can be assigned (or reassigned) to a particular server on the network.
- *Hardware virtualization* is the use of software to emulate hardware or a total computer environment other than the one the software is actually running in. It allows a piece of hardware to run multiple operating system images at once. This kind of software is sometimes known as a virtual machine.

Virtualization increases the flexibility of IT assets, allowing companies to consolidate IT infrastructure, reduce maintenance and administration costs, and prepare for strategic IT initiatives. Virtualization is not primarily about cost cutting, which is a tactical reason. More importantly, for strategic reasons, virtualization is used because it enables flexible sourcing and cloud computing.

THE MOVE TO ENTERPRISE CLOUDS

A majority of large organizations have hundreds or thousands of licenses for software, such as Microsoft Office or Oracle database management software, that are critical for building and running their databases and apps that support business processes. Managing software programs and their licenses—including deploying, provisioning, and updating them—is time-consuming and expensive. Productivity suffers when IT professionals cannot quickly access the tools they need at the right time. Putting software on a server with no management or usage tracking capabilities around them can cost even more. The latest trend, cloud computing, can overcome several problems and issues. The reduced complexity, lower costs, and improved scalability afforded by enterprise clouds are growing in appeal to many organizations. By offering computer power over the Internet, vendors can free their customers from having to pay for their own hardware, facilities, maintenance, and management.

The cloud idea is to store applications and information in the vendors' data centers rather than on local company-owned servers. This cloud concept refers to sources of stored data *outside a customer's internal network.* However, large companies or government agencies with multiple locations can set up their own clouds, called **private clouds**, on servers that they own if data confidentiality is a key requirement, as with military and defense agencies. See *IT at Work 2.4*.

The move toward cloud computing, particularly cloud hosting by a vendor, is increasing with the introduction of new apps. For example, the vendor Rackspace (*rackspace.com/*) launched Cloud Pro in April 2010. Cloud Pro leverages the iPad's touch-screen interface to enable its customers to manage their servers. Using the iPad, network administrators (admins) can turn on backups for a server; create new servers from backups; manage backup scheduling; and reboot, rename, resize, and delete servers. The app was made available at no additional charge through iPad-maker Apple's iTunes store. This arrangement is of enormous benefit to start-up companies. The iPad tablet and Rackspace Cloud servers lower the entry barriers for Web

start-ups because they no longer have to make large investments in hardware to get their businesses going.

CLOUD COMPUTING

One definition for cloud computing is that it is Internet-based computing in which shared resources (such as hard drives for storage) and software apps are provided to computers and other devices on-demand, like a public utility (see Figure 2.11 for a model of cloud computing). That is, it's similar to electricity—a utility that companies have available to them on-demand and pay for based on usage. Companies don't generate their own electricity but obtain it from a "vendor," which in this case is an electric company. Major cloud vendors or providers are Google, Amazon, Microsoft, and Cisco. For example, Google Apps provides common business applications online that are accessed from a Web browser, while the software and data are stored on the servers.

Why Use the Cloud? Optimizing IT infrastructure became especially important during tough economic times when cost cutting became a priority. During challenging times, making the most of IT assets becomes imperative for competitive advantage and, ultimately, survival. The cloud typically offers a steep drop in IT costs because applications are hosted by vendors and provided on demand, rather than via physical installations or seat licenses. This rental arrangement with vendors is a key characteristic of cloud computing.

Cloud computing is often used to describe services such as Google's online word-processing application and Salesforce.com's customer service software, which are accessed online through a Web browser instead of stored on a computer. Another option is to pay to use Amazon.com's computing infrastructure—in effect, renting it—rather than buy more servers. *IT at Work 2.4* describes the value of cloud computing for national defense and military purposes.

The concept is catching on in the business world. *The New York Times* uses Amazon.com's cloud service to upload images of archived newspapers and convert them into a more readable format. Nasdaq OMX Group Inc. uses Amazon.com's service to provide historical trading information. Both companies pay only for the computing resources or services they use.

Figure 2.11 Cloud computing.
(*Alex Slobodkin/iStockphoto*)

IT at Work 2.4

U.S. Defense Department Provides Private Cloud Services

When John Garing, who runs the U.S. Department of Defense's IT infrastructure, met with representatives of Microsoft Corp. and Amazon.com to learn about cloud computing, he recognized its potential to change how government IT worked. Those vendors, together with Google and Salesforce.com Inc., were promoting cloud computing as a way to boost efficiency and cut costs.

Garing copied the vendors' approach, but only internally for agencies, by developing his own cloud that is shared by various government agencies. Going beyond that level of cloud computing would not be an option for defense agencies because they cannot give up control of sensitive information to vendors.

Government agencies can significantly reduce costs and energy consumption by using their cloud structure. The U.S. government spent about $68.1 billion in 2008 on IT, with one-third spent on IT infrastructure. The percent spent on cloud services is increasing. And to build up business with government clients, Google opened a 30-employee office in 2008 near Washington, D.C. Agencies use its products to allow people to search government Web sites.

Cloud computing is relatively new, and the military is still finding its way with this new approach. The U.S. Navy has drafted guidelines for ordering cloud services, but standards and policies for cloud computing have not yet been established. Eventually, agencies will depend on the Office of Management and Budget and the National Institute of Standards and Technology (NIST) for guidance.

DISA Becomes an Internal-Cloud Vendor to Other DoD Agencies. Garing, whose Defense Information Systems Agency (DISA) provides the internal network and computer processing for the military, took his inspiration from the corporate world when he developed his cloud for the department. Military agencies can contract with DISA to rent storage space and to use its computers for processing information. In a development test, a user in Falls Church, Virginia, logged onto the network, set up a Web site in seven minutes, and paid for it with a credit card. According to Garing: "That has fundamentally changed the way we do business. You virtually don't have to buy another computer in the DoD because you can use our servers."

The DISA Web site explains the cloud services that it provides on its Web site:

> DISA provides world class computing services that allow DoD to better execute its missions. From our 13 computing centers, we deliver hosting and information processing services that enable sharing of information through an assured, accessible, net-centric storage and processing environment.
>
> Our services combine the people, the processes, and the methodologies to ensure DoD systems are always ready and available. We support more than 3 million users of more than 2,800 applications utilizing more than 3.7 petabytes of storage. Computing Services is the DoD's #1 provider of personnel, payroll, logistics, accounting, and medical records processing.

Sources: Compiled from Harrison (2009), DISA (2010), and *disa.mil/services/*.

Discussion Questions: Describe the cloud computing services provided by DISA. Why did DISA develop its own cloud rather than use a vendor's cloud? Why did Garing claim that agencies would not have to buy another computer in the DoD? What efficiencies does this provide government agencies?

What Services Are Available in the Cloud? Cloud computing makes it more affordable for companies to use *services* that in the past would have been packaged as software and required buying, installing, and maintaining on any number of individual machines. A major type of service available via the cloud is called software-as-a-service.

Software-as-a-service (SaaS) is an increasingly popular IT model in which software is available to users as needed. Other terms for SaaS are *on-demand computing*, *utility computing*, and *hosted services*. The idea is basically the same: Instead of buying and installing expensive packaged enterprise applications, users can access software apps over a network, with an Internet browser being the only absolute necessity. Usually there is no hardware or software to buy since the apps are used over the Internet and paid for through a fixed subscription fee or per an actual usage fee. The SaaS model was developed to overcome the common challenge to an enterprise of efficiently meeting fluctuating demands on IT resources.

Cloud services are expanding. For instance, the use of cloud computing to lower accounting costs is becoming widespread, particularly with smaller companies,

because there is practically limitless room for growth of the service. For example, a popular leading cloud software and services provider is *salesforce.com*. To emphasize its approach, its telephone number is 1-800-No-Software. Two clouds offered by Salesforce.com are:

- **Sales Cloud.** Sales Cloud is used by almost 80,000 companies. Sales representatives (reps) have almost everything they need to do their jobs in one place. They spend less time on administrative work and have more time to spend with customers and closing deals. For sales managers, the Sales Cloud gives real-time visibility into their team's activities.
- **Service Cloud.** Service Cloud is a platform supporting customer service activities that range from call (contact) centers to social Web sites. Tools provided by the Service Cloud include knowledge-as-a-service, giving agents and customers the ability to find answers online, 24/7; Twitter integration for real-time service conversations; and analytics that provide dashboards and real-time reports to monitor performance.

Issues in Moving Workloads from the Enterprise to the Cloud. With Amazon's EC2, Google's AppEngine, and Microsoft's Azure, cloud computing looks a lot less like a futuristic concept and more like a real IT architecture. But there are still plenty of critics and doubters of the cloud. Variable (on-demand as needed) computing capacity like Amazon's EC2 has its niche, but legacy (older) enterprise apps aren't leaving the data center, and you can't send critical business data to the cloud. However, the services offered by Amazon, Google, and Microsoft offer economies of scale, as you read in *IT at Work 2.4*.

But putting part of the IT workload into the cloud requires different management approaches and different IT skills. These include strategy questions, such as deciding which workloads should be exported to the cloud, which set of standards to follow for cloud computing, and how to resolve issues of privacy and security as things move out to the cloud. Two big questions are: How will departments or business units get new IT resources? Should they help themselves, or should IT remain a gatekeeper?

There are different vendor management skills. Staffs experienced in managing outsourcing projects will find parallels to managing work in the cloud, like defining and policing **service-level agreements (SLAs)** with vendors. There's a big difference, however, because cloud computing runs on a shared infrastructure, so the arrangement is less customized to a specific company's requirements. A comparison to help understand the challenges is that outsourcing is like renting an apartment while the cloud is like getting a room at a hotel.

With cloud computing, it may be more difficult to get to the root of performance problems, like the unplanned outages that occurred with Google's Gmail and Workday's human resources apps. The trade-off is cost versus control.

Demand for faster and more powerful computers is increasing, and increases in the number and variety of applications is driving the need for more capable IT architectures.

Review Questions

1. Define *information infrastructure*.
2. Describe virtualization.
3. Describe cloud computing.
4. What are the benefits of cloud computing?
5. Describe software-as-a-service and its benefits. Why is it referred to as utility computing?

Key Terms

ad hoc report *37*
batch processing *35*
business intelligence (*BT*) *41*
business software application *33*
cloud computing *32*
data *34*
data mining *42*
database *34*
decision support system (DSS) *31*
exception report *37*
global sourcing *43*
information *34*
IT infrastructure *32*
knowledge *34*
logistics *43*
management information system (MIS) *31*
model *31*
online transaction processing (OLTP) *35*
periodic report *37*
Planners Lab *40*
private cloud *47*
radio frequency identification (RFID) *44*
software-as-a service (SaaS) *49*
sourcing strategy *43*
structured decision *40*
supply chain management (SCM) *43*
transaction processing system (TPS) *31*
unstructured decision *40*
utility computing *00*
virtualization *47*

Chapter Highlights and Insights

(Numbers refer to Learning Objectives)

1 Organizations have various types of information systems that collect and process data, distribute reports, and support decision making and other business processes.

1 Multiple business apps form an information system that supports a functional area—marketing, finance, human resources (HR), production, operations, accounting, and IT.

2 Information systems can be classified into two categories based on the type of support they provide: managerial and operational support.

2 Transaction processing systems (TPS) cover the core repetitive organizational transactions such as purchasing, billing, and payroll.

2 The data collected in a TPS is used to build other support systems, especially MIS and DSS.

2 Processing improves data quality, which is important because reports and decisions are only as good as the data they are based upon.

2 The functional areas or departments—accounting, finance, production/operations, marketing and sales, human resource, and engineering and design—are supported by ISs designed for their particular information and reporting needs.

2 Decision support systems (DSS) support unstructured and semistructured decisions, such as whether to make or buy products and what new products to develop and introduce into existing markets.

3 A company's competitive advantage—for example, low cost, reliability, quality, speed to market, and/or quick response—depends on how well the supply chain is aligned and managed.

3 The supply chain—by linking a company with its suppliers, vendors, and customers—creates an extended enterprise.

3 Three of the major IT-supported managerial activities are (1) improving supply chain operations, (2) integrating departmental systems with ERP, and (3) introducing a variety of customer relationship management (CRM) activities. IT is a major enabler of all of these.

4 IT infrastructure refers to the shared information resources (such as corporate networks and databases) and their linkages, operation, maintenance, and management.

4 IT supports individual business processes in all functional areas (with MIS applications). It also supports activities along the supply chain such as procurement, relationship with suppliers, supply chain management, customer relationship management, and order fulfillment.

4 The design of the IT infrastructure allows and limits the ability to store, protect, and manage data so that it can be made accessible, searchable, shareable, and, actionable.

4 Virtualization increases the flexibility of IT assets, allowing companies to consolidate IT infrastructure, reduce maintenance and administration costs, and prepare for strategic IT initiatives.

4 Cloud computing is Internet-based computing in which shared resources (such as hard drives for storage) and software apps are provided to computers and other devices on-demand, like a public utility.

4 The major emerging technologies include cloud computing and software-as-a-service (SaaS).

Questions for Discussion

1. Explain the relationship between information systems and data stores.
2. Describe how raw data transform into information and information transforms into knowledge.

3. What critical functions do TPSs perform?
4. Explain how MIS supports the needs of middle-level managers.
5. Why are periodic reports often ignored? What types of reports are more valuable to managers?
6. Discuss the differences between structured and unstructured decisions. List an example of each type of decision that you've made within the past week.
7. Explain why a company's competitive advantage—such as low cost, reliability, quality, speed to market, and/or quick response—depends on how well the supply chain is aligned and managed.
8. How do the information systems that support supply chains create an extended enterprise?
9. RFID is considered superior to barcodes. Explain why.
10. Discuss the benefits of cloud computing.

Exercises and Projects

1. Classify each of the following systems as one (or more) of the IT support systems and design a business performance management for each:
   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
   e. A robotic system that paints cars in a factory
2. Visit *teradatastudentnetwork.com* (ask your instructor for the password) and find the Webcase on "BI Approaches in Healthcare, Financial Services, Retail, and Government" (2006). Explain the IT support. What challenges are common across the industries?
3. Visit *plannerslab.com*. Click onto YouTube in the Community. Watch the most recent Planners Lab video on YouTube. Explain how Planners Lab supports semi-structured and unstructured decisions. How does it support what-if analysis?

Group Assignments and Projects

1. Observe a checkout counter in a supermarket 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, and outputs.
   b. What kind of a system is the scanner (TPS, DSS, BI, ES, etc.)? Why did you classify it as you did?
   c. Having the information electronically in the system may provide opportunities for additional managerial uses of that information. Identify such uses.
   d. Checkout systems are now being replaced by self-service checkout kiosks and scanners. Compare the two.
2. Visit Planners Lab. Register to create an account, then download free trial software. Click on Models and Materials.
   a. Read the Tutorial Westlake *Lawn and Garden, University of Nebraska, Omaha.*
   b. Under "Example Models," select *Westlake Lawn and Garden, University of Nebraska, Omaha.* Load the Westlake model into Planners Lab.
   c. What are the most valuable decision support features of Planners Lab?
   d. How does Planners Lab support Westlake decision making?

Internet Exercises

1. Visit Rackspace at *rackspace.com/* and review the company's CloudPro products. Describe what CloudPro does. Explain how Rackspace CloudPro leverages the iPad's interface. What are the benefits of the iPad Cloud app?
2. Visit the Supply Chain and Logistics Institute at *SCL.gatech.edu/*. Describe two recent trends or issues of current interest.
3. Visit Teradata University Network (TUN). Search for and read an article or white paper on decision support systems (DSS). List four valuable *take-aways* (those are specific lessons learned) from the article.
4. Visit *oracle.com.* Describe the types of virtualization services offered by Oracle.
5. Visit *infoworld.com/blogs/david-linthicum*. Describe the key issues discussed in this blog.

BUSINESS CASE

Airbus Improves Productivity with RFID

Because it is in constant competition with Boeing, the European aircraft manufacturer Airbus is looking for every opportunity to increase productivity, reduce costs, and make its production process more efficient. One of its latest efforts is to use RFID technology in both manufacturing and maintenance of its airplanes. The basic idea is to use RFID to track parts and tools, which are scattered over a large area. Airbus had major delays in completing its A380, the two-decker, 525-seat airplane scheduled for completion in 2007 and 2008.

Airbus hopes that RFID will become "as everyday as barcoding." The company experimented with the technology for three years before signing a multimillion-dollar deal with vendors to implement the technology. It also created a value cabin visibility and RFID unit to implement the biggest private sector RFID deal ever.

Airbus has implemented process-improvement projects involving RFID to track parts inside warehouses, as they move from one region to another, and as they are built into aircraft, as well as to track how and where tools are used for manufacturing and maintenance. The new RFID software infrastructure lets Airbus employees and systems exchange information collected by RFID readers. The infrastructure also integrates RFID data with business systems such as Airbus' core ERP system.

The software also manages data from barcodes, which remain an important part of Airbus' supply chain. RFID tags can hold more information and require a line-of-sight reader, but they typically cost more than $1 per tag. So Airbus uses them only on rolling cages, pallets, cases, and high-cost parts.

Airbus expects RFID to augment ongoing supply chain process improvements, saving money by reducing time spent searching for parts, reducing inventory, and improving productivity.

Airbus is assessing a few pilot projects in which suppliers tag parts before shipping them, and the new software makes it possible to extend parts tracking from the supplier side to Airbus. Boeing, which has its own extensive RFID tests, said its first 787 Dreamliner would be delivered in the third quarter of 2009, instead of the first, due to supplier delays, unanticipated rework, and longer testing. Airlines that ordered the plane are pressing for compensation for the delays.

To close its RFID deal, Airbus had to navigate a still highly fragmented RFID industry. There have been hundreds of vendors, each telling a different story, with different architectures and different payoffs. To sort it out, Airbus assigned a 25-person team of IT, business, and process analysts for about two years to develop a company-side RFID approach. Airbus is employing RFID across two main categories: nonflyable and flyable.

- Nonflyable consists of ground-based processes, such as supply chain, transportation, logistics, manufacturing, and assembly-related applications.
- Flyable refers to all in-service processes, including operational, maintenance, and payload-tracking applications.

Sources: Compiled from Hayes-Weier (2008) and *RFID Journal* (2007).

Questions

1. What are the drivers of the RFID project?
2. What information technologies are cited here and are related to the implementation?
3. What categories of people will be supported by the RFID?
4. What managerial levels and tasks will be supported by the RFID?
5. What are the performance management implications? (Relate to the book's model.)

NONPROFIT CASE

Royal Shakespeare Company Leverages Patron Data to Improve Performance

The United Kingdom's nearly 100-year-old Royal Shakespeare Company (RSC) is one of the most respected theatrical companies in the world. The company is dedicated to keeping the spirit of William Shakespeare alive, and it also stages other classics and modern works. Over the past decade, the RSC staged 171 new productions, delivered 19,000 performances, sold 11 million tickets, and traveled from its home in Stratford-upon-Avon (Shakespeare's birthplace) to 150 towns and cities around the world. In fiscal year 2006, the RSC had 700 employees and total income of approximately US$60 million (£32 million).

Customer Loyalty

Theater companies, like other businesses, rely on customer loyalty for long-term success. The RSC teamed with Accenture Ltd. to conduct research into the characteristics of high-performance businesses. Accenture (*accenture.com*) is a global management consulting, technology services, and outsourcing company.

Despite its excellent reputation, securing its financial future in the 21st century depended on reaching a broader

and more diverse audience as well as increasing repeat visits by current loyal patrons (customers). The RSC relied on *audience analytics* to develop superior marketing capabilities to acquire new customers, retain existing customers, and cross-sell (sell more) to all customers.

Learning from Sales Data

The RSC filtered through seven years of sales data for a marketing campaign that increased regular visitors by 70 percent. Performing statistical analysis to forecast and discover correlations in sales and customer data had a huge payoff. By examining more than 2 million transaction records, the RSC learned about its best customers—income, occupation, and family status—which improved its ability to target marketing more precisely. This intelligence enabled the RSC to substantially increase membership and fund-raising revenues.

According to Mary Butlin, the RSC's Head of Market Planning: "Our direct mail strategy for the last London season only took about 45 minutes to plan. The audiences to target were so clear cut, and we could even tell from Accenture's analysis exactly when to communicate with different groups to maximize response. As well as the campaign planning being much faster and more fact based, it is easier to predict likely response even in London, which is notoriously difficult."

Earning from Sales Data

By analyzing its transaction data with advanced analytics, the RSC achieved the following improvements:

- The number of the RSC's Stratford ticket buyers increased by more than 50 percent.
- The number of audience members in the Stratford segment defined as "regulars," who make the greatest overall contribution to the RSC, increased by more than 70 percent, from 40,000 to 68,000.
- The number of audience members in the Stratford family show segment increased by more than 20 percent.

Sources: Compiled from Accenture (2008), *rsc.org.uk/*, and *en.wikipedia.org/wiki/Royal_Shakespeare_Company*

Questions

1. Why is customer loyalty critical to nonprofit organizations?
2. Explain the importance of data quality to the success of the RSC's marketing campaigns.
3. Discuss the benefits of more accurate forecasting to theater and other artistic companies.
4. What is audience analytics?
5. What can be learned from audience analytics to improve earnings?

ANALYSIS USING SPREADSHEETS

Managing Gasoline Costs

Notes: For this analysis, go to the Student Web Site to download the Excel file to help with this analysis.

The price of gasoline remains high, and demand for energy is increasing. Individuals, corporations, and government are involved in solving this issue. It is very likely that you are, too. What can you do? This assignment may help you learn how to reduce your carbon footprint on the environment.

To Do

1. Using the spreadsheet that you download, calculate and compare the costs of driving a hybrid automobile and non-hybrid SUV from your location to a location 600 miles away.
2. How can you find the cheapest gas prices in your starting and destination locations? *Automotive.com* provides a free application (a widget), a real-time, continually updated tool that monitors gas prices.
3. You have just been promoted to fleet manager in a food company that uses 250 cars of different sizes. Prepare a report to top management on how to save on gas if the price is at $4, $5, $6, and $7 per gallon. A spreadsheet will help support your report (use the *what-if* option in Excel).

Resources on the Book's Web Site

More resources and study tools are located on the Student Web Site and on WileyPLUS. You'll find additional chapter materials and useful Web links. In addition, self-quizzes that provide individualized feedback are available for each chapter.

Cases for Chapter 2 are available at wiley.com/college/turban:

2.1 Mary Kay's IT Systems

2.2 Predictive Analysis Can Help You Avoid Traffic Jams

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