Chapter

10

Enterprise Information Systems

Learning Objectives

❶ Understand how enterprise systems support cross-functional and multinational operations.

❷ Understand why companies need enterprise resource planning (ERP) systems.

❸ Describe supply chain management (SCM) networks and solutions.

❹ Understand collaborative planning, forecasting, and replenishment (CPFR).

❺ Describe customer relationship management (CRM) systems.

❻ Discuss benefits of knowledge management systems.

Integrating *IT*

ACC   **FIN**   **MKT**   **OM**   **HRM**   **IS**

CHAPTER 10 LINK LIBRARY

Comparison of top 10 ERP vendors   *top10erp.org/*
ERP Vendor Shootout   *erpshootout.com/*
Oracle   *oracle.com*
SAP   *sap.com*
SSA Global   *ssaglobal.com/solutions/erp/ln.aspx*
Microsoft Dynamics   *microsoft.com/dynamics/en/us/default.aspx*
Teradata   *Teradata.com*

QUICK LOOK at Chapter 10, Enterprise Information Systems

This section introduces you to the business issues, challenges, and IT solutions in Chapter 10. Topics and issues mentioned in the Quick Look are explained in the chapter.

Companies have many of the database and software applications that they had invested in over the past several decades. These older information systems (IS), called **legacy systems,** have been built with various outdated technologies. As business strategies and technologies changed over the years, the legacy systems were modified repeatedly and patched to the point where they just cannot be modified anymore. Typically, legacy systems are inflexible and expensive to maintain for two reasons:

1. They cannot be updated or cannot be updated without significant effort.
2. They cannot interface (connect to) and exchange data with newer information technologies (IT) or cannot be interfaced without significant effort.

Regardless of their limitations and age, a company's legacy systems may be **mission-critical.** That means that if one of these systems crashes or stops working, one or more business operations may grind to a halt. Think about the chaos you'd be caught in if you were at an airport when your airline's reservation system crashed. Passengers could not make connections and their luggage could not be checked in. You can imagine—or might have experienced—other aggravating consequences.

New IT may also be mission-critical. Our dependency on newer IT infrastructures was made obvious on August 6, 2009, when a hack attack took down the microblogging site Twitter. In some companies and in some countries, Twitter has turned into a critical infrastructure. Over 45 million Twitter users worldwide were left speechless—so to speak— by the attack, including companies that relied on Twitter for marketing and consumer outreach.

Given the situation that organizations of all types find themselves in with their legacy systems, when they need to upgrade mission-critical ISs or implement global systems, they turn to enterprise information system software. **Enterprise information systems,** or simply **enterprise systems,** are integrated ISs that support core business processes and functions. Business processes and functions include marketing, accounting, finance, information security, human resources (HR), compliance, production, purchasing, and logistics. Integration is achieved by linking databases and data warehouses so they can share data from:

• Internal functions: Functions that take place within the company, which are referred to collectively as the **internal supply chain**
• External partners: Business or supply chain partners, such as customers or suppliers, which are referred to as the **external supply chain**

As you read in greater detail in this chapter, key enterprise systems are:

• ERP: Enterprise resource planning
• SCM: Supply chain management
• CPFR: Collaborative planning, forecasting, and replenishment
• CRM: Customer relationship management
• KM: Knowledge management

The key benefit of enterprise systems is data integration. Integration enables the sharing or exchange of data. For example, ERP is integrated with SCM to improve supply chain performance, and KM is integrated with CRM to identify profitable and unprofitable customers. Improvements in business processes are highly dependent on data accuracy, completeness, context, and access to it—which all of the ISs discussed in this chapter help achieve.

Enterprise systems are a top issue in IT management and corporate strategy because of their potential to increase both the *top line* (growth in net revenues) and the *bottom line* (growth in net income). **Corporate strategy** is the collection of activities and actions a company chooses to invest in and perform as well as those it chooses not to invest in or perform.

The greatest challenges when implementing enterprise systems are not the technical ones. Rather, the biggest challenges are process and change management. Companies that have inconsistent or outdated business processes along their supply chains tend to have poor-quality data. To improve data quality, companies reengineer those processes and consolidate them into an integrated enterprise system.
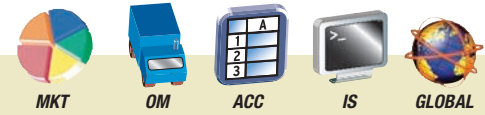
ERP Gives Under Armour an Edge on Nike

MKT   OM   ACC   IS   GLOBAL

Entering a market dominated by Nike, adidas, and Reebok is tough. Competing successfully with them on a global playing field is even tougher. That's what former University of Maryland football player and entrepreneur Kevin Plank did with Under Armour Inc. (*underarmour.com/*) in 1996. Under Armour is the originator of performance apparel that's made of fabric to keep athletes cool, dry, and light throughout their games and workouts. The company develops, markets, and distributes branded apparel, footwear, and accessories. The brand's synthetic fabrics are engineered in many different designs and styles for wear in any climate. Their products are sold worldwide and worn by athletes at all levels and ages, from youth to professional. The Under Armour global headquarters is in Baltimore, Maryland, with European headquarters in Amsterdam and remote offices in Denver, Toronto, Hong Kong, and Guangzhou, China.

Figure 10.1 Under Armour is the originator of performance apparel and succeeds in a fiercely competitive industry. (© *Under Armour, Inc. 2010.*)

Business and IT Challenges

Under Armour was facing several business challenges due to its extensive product line, global distribution, and ambitious growth strategy, as well as the fierce competition in the athletic apparel and gear industry. The company's key technology and business challenges and needs were:

- ISs did not provide sufficient agility to outpace competitors and enable the company to reinvent itself every six months—a goal important to top management.

- ISs with multicurrency and multicompany processing capabilities were needed to support international expansion.

- Software applications could not support growth of the product lines or the company's expansion into several other countries.

The company had sharp spikes in orders during seasonal product shifts and promotional pushes. To improve its brand and channel management, the company needed to replace its time-consuming manual allocation processes with dependable **available-to-promise (ATP)** capabilities. ATP is a business function that provides data about resource availability and delivery dates to keep customers informed of their orders' status. ATP also supports order fulfillment in order to manage demand and match it to production plans. The software takes a lot of work out of the order fulfillment process—and less effort means lower cost and fewer errors.

ERP Solution

After identifying its challenges, management reviewed various software vendors' products to identify the one that best met the company's needs. The company selected an ERP solution from SAP (*sap.com*) that would give it the ability to accelerate time-to-market of new products, to improve customer service, and to take advantage of growth opportunities. Under Armour implemented the *SAP Apparel and Footwear Solution for Consumer Products* module to the ERP. Together with the *SAP NetWeaver Exchange Infrastructure* component, Under Armour had the capabilities to achieve its ambitious expansion plans.

The ERP solution had broad executive support and guidance. Within eight months, a 20-person project team from operations and IT together with ERP consulting company Metamor managed the implementation. To improve management and operational visibility, the company also deployed Web-based SAP NetWeaver Business Intelligence software through which reports can be accessed on demand or be delivered on schedule.

Growth in the Top and Bottom Lines of the Business

With the SAP ERP, products module, and exchange infrastructure, Under Armour increased both its top line—*growth*

in sales—and bottom line—*growth in net income*. With automated ATP processes, the data is reliable and inventory management is efficient and lower cost. Multiple currencies and companies are supported. Managers have a clear view of timely data to drive better decisions and business performance.

On July 28, 2009, Under Armour announced positive financial results for the second quarter (Q2) of 2009—a time when most companies' sales were being hurt by the recession. Consolidated net revenues for Q2 increased 5.1 percent to $164.6 million, and net income increased 4.7 percent. The apparel division's net revenues increased 16.5 percent while direct-to-consumer net revenues grew an impressive 36.6 percent during Q2. CEO Kevin Plank stated about Q2, "Our results this quarter demonstrate our continued ability to successfully manage our business."

Given the capabilities provided by the ERP, the company is able to close its books faster than ever, to bring new operations onboard quickly, and to make more knowledgeable decisions with greatly improved operational visibility. With bottom-line growth every year since 1996 and net revenues over $810 million in 2009, Under Armour is one of the best-performing and fastest-growing public companies.

With clear objectives for the ERP, SAP software, and the assistance of an experienced consulting firm, Under Armour improved sales revenues and profits in a highly competitive industry during a recession. The Under Armour case illustrates the operational and strategic benefit of enterprise systems to ensure quick response to market changes and customer needs. Doing so is not a simple task, as you read in this chapter.

Sources: Compiled from *Business Wire* (2009), SAP (*sap.com*), and Under Armour (*underarmour.com,* 2010).

For Class Discussion and Debate

1. *Scenario for Brainstorming and Discussion:* Many factors contributed to Under Armour's success in the fiercely competitive sports apparel industry.

a. Identify all of the factors, reasons, and conditions that contributed to Under Armour's success.

b. Discuss the importance of each factor, reason, and condition. Decide which are the top three success factors and explain why.

2. *Debate:* Based on your answers to 1(a) and (b), debate how and to what extent a company wanting to enter that market today—given today's economic and market conditions—could succeed for the same reasons and due to the same factors.

10.1 Enterprise Systems

Enterprise information systems, or **enterprise systems** for short, are systems that help managers and companies improve their performance by enabling them to seamlessly share data among departments and with external business partners. Enterprise systems allow workers to access and analyze real-time information and transaction processes across the entire organization. These systems integrate the functional systems that you read about in Chapter 9, such as accounting, finance, marketing, and operations. Another advantage of enterprise systems is that processes become more automated or totally automated, which increases efficiency. For example, by automating finance processes, a company can do things such as accept online orders and do business-to-business (B2B) transactions electronically instead of via e-mail or offline methods such as telephone or fax.

Prior to selecting and implementing an ERP or other enterprise system, it's essential that a company identify the problems to be solved, the goals to be achieved, and the type of support the IS is to provide. For example. Under Armour's management wanted real-time or near-real-time data and sufficient agility to respond quickly to operational and market conditions. **Agility** is the ability to thrive and prosper in an environment of constant and unpredictable change. Agility is a result of streamlining processes on the shop floor to speed up order fulfillment, which in turn maximizes capacity for increased productivity.

TYPES OF ENTERPRISE SYSTEMS AND THEIR FUNCTIONS

Several examples of enterprise systems are listed and described in Table 10.1. Companies implement most or all of these systems, not just one.

TABLE 10.1	Descriptions of Enterprise Systems	
Name	**Abbreviation**	**Description**
Enterprise resource planning	ERP	ERP is the software infrastructure that links an enterprise's internal applications and supports its external business processes
		ERP systems are commercial software packages that integrate business processes, including supply chains, manufacturing, finance, human resources, budgeting, sales, and customer service.
Supply chain management	SCM	SCM software refers to software that supports the steps in the supply chain—manufacturing, inventory control, scheduling, and transportation.
		SCM improves decision making, forecasting, optimization, and analysis.
Collaborative planning, forecasting, and replenishment	CPFR	CPFR is a set of data-driven business processes designed to improve the ability to predict and coordinate with supply chain partners.
		With CPFR, suppliers and retailers collaborate in planning and demand forecasting in order to ensure that members of the supply chain will have the right amount of raw materials and finished goods when they need them.
Customer relationship management	CRM	CRM creates a total view of customers to maximize share-of-wallet and profitability. Also, it is a business strategy to segment and manage customers to optimize their long-term value.
Knowledge management	KM	KM helps organizations identify, select, organize, disseminate, and share information and expertise.

REASONS COMPANIES MIGRATE TO ENTERPRISE SYSTEMS

The reasons companies migrate to enterprise systems stem from limitations with their existing legacy systems. Here are several reasons for the migration from legacy systems to enterprise systems:

• **High maintenance costs.** Maintaining and upgrading legacy systems are some of the most difficult challenges facing CIOs (chief information officers) and IT departments.

• **Business value deterioration.** Technological change weakens the business value of legacy systems that have been implemented over many years and at huge cost.

• **Inflexibility.** Monolithic legacy architectures are inflexible. That is, these huge systems cannot be easily redesigned to share data with newer systems, unlike modern architectures.

• **Integration obstacles.** Legacy systems execute business processes that are hardwired by rigid, predefined process flows. Their hardwiring makes integration with other systems such as CRM and Internet-based applications difficult and sometimes impossible.

• **Lack of staff.** IT departments find it increasingly difficult to hire staff who are qualified to work on applications written in languages no longer used in modern technologies.

IMPLEMENTATION CHALLENGES AND BEST PRACTICES

Implementing an enterprise system is challenging because it requires extensive changes in processes, people, and existing systems. Three required changes are:

1. Redesign of business processes. Processes need to be simplified and redesigned so that they can be automated, either totally or partially. Tasks that are no longer necessary are removed from the processes.

2. Changes in how people perform their jobs. Jobs and how they are performed will change to accommodate the new processes. Enterprise systems require retraining of end users, whose productivity will slow initially as they adjust to a new way of doing their jobs.

3. Integration of many types of information systems. Integrating information systems is necessary so that data can flow seamlessly among departments and business partners. Automated data flows are essential to productivity improvements.

A best practice is to examine the inefficiencies in existing processes to find ways to improve on or significantly simplify the process. For example, manual document-intensive processes (such as order entry and billing) create major headaches for workers. These processes require users to manually review documents for approval, enter data from those documents into a back-office system, and then make decisions. Automated order entry systems track customer orders from the time of initial order placement through the completion of those orders; they also perform backorder processing, analysis, invoicing, and billing.

Because of their complexity, enterprise systems are leased or licensed from vendors and customized with support from IT personnel who are familiar with their company's business processes. The trend toward *ERP as a service* continues to increase. In fact, the term ERP commonly refers to commercially available software systems. For examples of monthly costs and a comparison of 10 ERP vendors' products, visit *top10erp.org/*. To simplify and reduce the cost of the ERP software selection process (the selection process itself is complex and critical), an annual event called the ERP Vendor Shootout (*erpshootout.com/*) is held and geared toward ERP selection teams and decision makers for companies with manufacturing, distribution, or project-oriented requirements.

ENTERPRISE SYSTEMS INSIGHTS

Here are three other insights related to enterprise systems to better understand the current state of enterprise systems and their potential:

1. One of the IT department's most important roles is to provide and support applications that enable workers to access, use, and understand the data. These applications need to be tightly aligned with well-defined and well-designed business processes—a standard that few enterprises are able to achieve.

2. Customer loyalty helps drive profits, but only for customers who are profitable to the company. Many companies don't know how to recognize or encourage the kind of customer loyalty that's worth having. Using data about buying behaviors (e.g., amount spent per month, purchase of high-margin products, return activity, and demands for customer service) helps a company identify its loyal customers and which ones are profitable.

3. Companies all over the world are spending billions of dollars on the design and implementation of enterprise systems. Huge investments are made in ERP systems from vendors such as Oracle, Peoplesoft (acquired by Oracle), JD Edwards (also acquired by Oracle), SAP, Microsoft, and BAAN to create an integrated global supply chain. Interorganizational ISs play a major role in improving communication and integration among firms in a global supply chain.

Next you read about ERP systems, which despite the name are not limited to planning functions. Although most types of companies now have an ERP system, ERP evolved from the manufacturing industry.

Review Questions

1. Explain the purpose of an enterprise system.
2. Describe five types of enterprise systems.
3. What are two challenges of legacy systems?
4. Explain the three types of changes needed when an enterprise system is implemented.

10.2 Enterprise Resource Planning (ERP) Systems

What is an **ERP (enterprise resource planning) system?** From a technology perspective, ERP is the software infrastructure that links an enterprise's internal applications and supports its external business processes, as you read in the opening case on Under Armour. ERP applications are modular, and the modules are integrated with each other to expand capabilities.

TABLE 10.2	Characteristics of ERP Applications

- Bring silos of information together to enable managers to really understand what is going on
- Provide the information access, integrated business processes, and modern technology platform necessary to become and remain competitive
- Support all, or a great majority, of a company's business functions and processes
- Expand a company's reach beyond its internal networks to its suppliers, customers, and partners

An ERP helps managers run the business from front to back. Departments can easily stay informed of what's going on in other departments that impact their operations or performance. Being informed of potential problems and having the ability to work around them improves the company's business performance and customer relations. For example, an ERP enables a manufacturer to share a common database of parts, products, production capacities, schedules, backorders, and trouble spots. Responding quickly and correctly to materials shortages, a spike in customer demand, or other contingency is crucial because small initial problems are usually amplified down the line or over time. Table 10.2 lists the characteristics of ERP suites and applications.

**ERP: A STRATEGIC WEAPON FOR FOOD MANUFACTURERS**

Food manufacturing is a highly competitive and regulated environment. Major challenges facing food manufacturers are margin pressures, food safety and regulations, and constantly changing consumer tastes. An integrated business software system is essential for controlling costs, managing inventory, and meeting government regulations. Another challenge is knowing how to evaluate a new enterprise-wide software system.

Figure 10.2 shows the subsystems that need to share data and support the operations of most manufacturers.

Food Safety and Agri-Food Regulations. In a survey conducted by *Food Engineering* magazine, the top concern of the agri-food industry was food safety, in large part because worldwide distribution systems have increased the risk and range of contaminated food entering the food supply. In 2009, the *New York Times* reported that a single hamburger could contain beef products from several slaughterhouses on several continents (Moss, 2009). An estimated 76 million people in the United States get sick every year with foodborne illness and 5,000 die, according to the U.S. Centers for Disease Control and Prevention (CDC).

The threats and potential costs associated with food safety are high and rising. Contaminated spinach, peanut butter, beef, imported seafood, pet food, and many other food products, in addition to life-threatening and ethical issues, result in litigation, bad publicity, and recall costs that damage or destroy companies' reputations.

The European Food Safety Authority (*efsa.europa.eu/*) applies a "from the farm to the fork" integrated approach based on transparency, risk analysis and prevention,
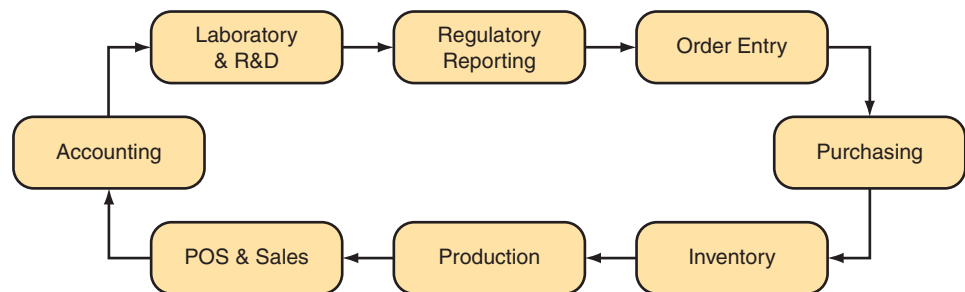
Figure 10.2 An ERP system integrates all function ISs of a food manufacturer around a single set of data.

and consumer protection. The U.S. Congress responded to terrorism by passing the Public Health Security and Bioterrorism Preparedness and Response Act (Bioterrorism Act) in 2002. In 2009, Congress passed a food safety law creating new traceability requirements for the food supply chain and giving greater facility inspection power to the Food and Drug Administration (FDA).

Using IT to Deal with Complexity. All of these challenges have one thing in common: They add complexity, and that adds costs. The challenge for today's food manufacturer is how to meet the regulatory requirements, ensure a safe food supply, constantly improve business processes, and make a profit. The answer has been investments in IT.

The first software purchased is an accounting package to handle the financial aspects of running a business. As the company grows, companies invest in IT to manage inventory, process sales and purchase orders, and control production. This progression of IT investments addresses the needs of individual departments or functions. As a result, companies have separate ISs for accounting, sales and purchasing, and inventory management—with the same data being held in multiple systems. This leads to duplicate data entry and differing versions of the truth.

Integrated ERP System. A well-designed ERP system can help integrate all aspects of an organization around a single set of data. Key benefits of an integrated ERP system to a food manufacturer are improved operational performance, a framework to meet regulatory mandates and reporting requirements, and cost control. Many food manufacturers are replacing multiple software applications with a single integrated ERP system to manage their complex businesses to maximize productivity and profitability. Specifically, the ERP gives manufacturers a single point of control for data, thereby:

- Eliminating the need to enter data in multiple systems
- Reducing common data entry errors and costs
- Allowing for the posting of transactional data in real time for instant access to up-to-date information
- Being able to respond quickly to food recalls
- Meeting requirements of the Bioterrorism Act or other regulations for accurate recordkeeping in order to support the discovery of and quick response to food chain supply threats

Like many other companies, food manufacturers are being squeezed at both ends. Increased pressure for food safety and regulation add costs to the food processing supply chain. Higher energy bills and distribution further reduce profit margins. These pressures are leading to investments in enterprise systems to integrate data silos.

FROM STAND-ALONE DATA SILOS TO AN INTEGRATED ENTERPRISE SYSTEM

When companies need to replace their disparate (stand-alone) or labor-intensive legacy systems, they often invest in enterprise systems. Doing so requires migrating databases and applications from legacy to enterprise systems. Not surprisingly, database vendors such as Oracle and IBM are also enterprise system vendors. These vendors provide tools that help automate both the database migration and the application migration, which occur separately.

Implementing an enterprise system may be a competitive necessity for companies with data management problems. The greater the number of applications and databases, the greater the complexity of data management because of the numerous interfaces needed to exchange data. As you see in the left-side diagram of Figure 10.3, disparate functional systems—HR, finance, operations—involve numerous interfaces. These interfaces increase maintenance efforts and costs as well as the risk of dirty
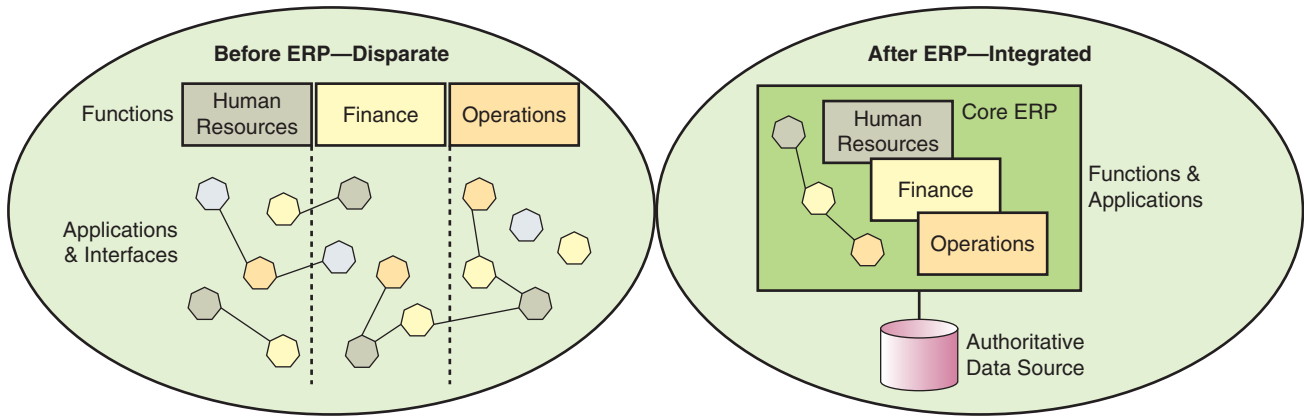
Figure 10.3 Comparison of disparate systems within an enterprise to an integrated ERP system.
(Courtesy of U.S. Army Business Transformation Knowledge Center (2009), *army.mil/armyBTKC/*.)

data. An ERP integrates functions, including a suite of IT modules that can be purchased as needed by the company.

Enterprise Application Integration Layer. In Figure 10.4, you see how an ERP fits into an enterprise's IT infrastructure. The core ERP functions are integrated with other systems or modules that are bolted-on, including SCM, PLM, CRM, and BI. In the example shown in Figure 10.4, the ERP interfaces with legacy applications through an **enterprise application integration (EAI)** layer and with external business partners through a B2B gateway (explained in next section). EAI is middleware that connects and acts as a go-between for applications and their business processes. Benefits of EAI are listed in Table 10.3.

B2B Gateway Layer. Business-to-business integration (B2Bi) is vital to ensure the efficient, accurate, and timely flow of data across internal ISs and external business partners. (See left side of Figure 10.4.) Companies that implement B2Bi are realizing enormous competitive advantage through faster time to market, reduced cycle times, and increased customer service. Through integration of business and technical processes, companies are able to strengthen relationships with partners and customers, achieve seamless integration inside and outside the enterprise, gain real-time views of customer accounts, increase operational efficiencies, and reduce costs.
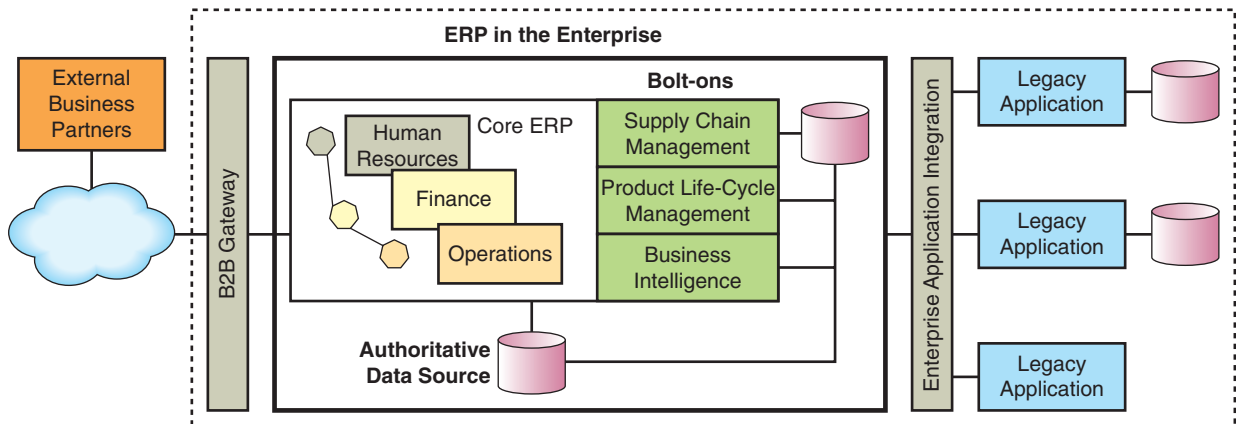
Figure 10.4 How ERP interfaces with other enterprise systems.
(Courtesy of U.S. Army Business Transformation Knowledge Center (2009), *army.mil/armyBTKC/*.)

TABLE 10.3	Benefits of the Enterprise Application Integration (EAI) Middleware Layer

- Reduced IS development and maintenance costs
- Enhanced IS performance and reliability
- Extended life cycle of legacy systems
- Reduced time-to-market of new IS features or applications

Companies need to be able to safely and securely participate in B2Bi and to securely exchange data over the Internet. **B2B gateways** provide these services. They consist of a suite of software products that support internal and external integration and business processes. B2B gateways provide a backbone for the secure exchange of data, files, and documents—intracompany and with external parties. As such, they increase real-time visibility into business activity and performance.

JUSTIFYING AN ERP

Why are ERP systems worth their cost? Because decisions are only as good as the timeliness and completeness of the data on which they're based. The more complete the data, the less the uncertainty and risk involved in the decision process. An ERP provides the integration and automation that makes timely and complete data possible. So it's not surprising that establishing a reliable pipeline of data from internal functions and external business partners is a priority for businesses in every industry and of all sizes.

ACQUIRING AN ERP

Typically, ERP systems are acquired by purchasing or leasing packaged software. The purchased or leased ERP software is customized to meet the company's need by adding modules. ERP systems include modules for manufacturing, order entry, accounts receivable and payable, general ledger, purchasing, warehousing, transportation, and HR. ERPs are not built in-house or built using proprietary software because the costs and time to do so would be staggering. You read more about IS acquisition in Chapter 11.

The current major ERP vendors are the following. Note that acquisitions continue to consolidate the industry.

- Oracle, *oracle.com,* which acquired PeopleSoft and JD Edwards
- SAP, *sap.com*
- SSA Global, *ssaglobal.com/,* which acquired BAAN
- Microsoft Dynamics, *microsoft.com/dynamics/en/us/default.aspx*

Vendors charge license fees based on the number of users and annual revenues, as shown in Table 10.4. Table 10.4 lists the types of ERP vendors, whose systems range from Tier 1 to Tier 5. Tier 1 ERP systems are able to support the largest global corporations—those with annual revenues over $200 million with 500 or more employees. Tier 5 systems support the smallest companies with less than $5 million in annual revenues and fewer than 10 employees. Tier 1 vendors are SAP, Microsoft, and Oracle.

TABLE 10.4	Types of ERP Vendors Based on the Size of the Company They Can Support		
Tier	Annual Revenues	Number of Employees	License Fees
1	Over $200 million	500 and over	> $300,000
2	$50 million to $200 million	100–499	> $150,000
3	$10 million to $50 million	50–99	> $50,000
4	$5 million to $10 million	10–49	> $5,000
5	Less than $5 million	1–9	> $100

IT at Work 10.1

ERP Enables Agility, a Competitive Asset for Manufacturers

OM   GLOBAL   MKT

The first step toward becoming an agile manufacturer is developing the means to monitor the marketplace— for example, changes in customer demand or competitors' actions—and to respond to it quickly. ERP software brings all areas of the manufacturing operation into a single, real-time database where the actions of one department do not happen in isolation, but rather are known throughout other departments. As a result, all departments are aware of what's going on within the company and capable of responding quickly to customer demands. Manufacturers that have invested in ERP to become agile are able to leverage their insights into new products and services for their current customers and prospective ones—and to counteract competitors' attempts to steal away their customers.

While agile manufacturing is not widespread, early adopters are reaping the benefits. An example is Humanetics (*humanetics.com*), a Texas-based precision metal works company with four geographically dispersed plants. Humanetics' ERP system serves the following functions:

- Supports estimating and quoting processes
- Supports parts' manufacturing, shipping, invoicing, and payment collection
- Prepares financial statements
- Manages the day-to-day international movement of parts, quality control, and on-time delivery

In a global economy, windows of opportunity open quickly and can close just as fast. The more agile and aware the manufacturer, the greater the rewards from being the first responder to customer needs.

Sources: Compiled from Alexander (2009) and *humanetics.com*.

Discussion Questions: What competitive advantages does agility provide to a manufacturing company? Are those competitive advantages sustainable? Why or why not?

These revenues and license fees for the five tiers are only general figures, and vendors may use their own cut-off points. In addition to the license fees, there are implementation, training, and maintenance costs. The conventional wisdom is that you buy a software license, and then you buy maintenance and support separately, which usually costs 20 percent of the original license cost annually. For a $1,000 software license, maintenance and support cost an additional $200 per year.

Lesser known ERP vendors tend to be less expensive and to provide more specialized (customized) features than traditional ERP options. For example, complex design-to-order low-volume manufacturers are not going to want a package that supports high-volume, make-to-stock manufacturing. Rather, they need a solution that handles their customized type of business very well rather than one that tries to be everything to everyone.

As the Under Armour opening case and the Humanetics case in *IT at Work 10.1* illustrate, improved agility can create a competitive advantage. ERP provides the infrastructure needed for the agility for quick correction and response, which can be exploited to improve profitability, market share, or customer service.

UNDERSTANDING ERP SUCCESS AND FAILURE FACTORS

Managers and other decision makers tend to think that if an enterprise system works for the best companies, it will work for them, too. But that's not true. In fact, as you read in Table 10.5, several of the best companies have suffered devastating consequences that led to multimillion-dollar losses, bankruptcy, or lawsuits. Most often, the ERP eventually is fixed and remains in use, which gives the false impression that the ERP was successful from the start.

The success of ERP depends on organizational and technological factors that occur prior to, during, and after the implementation. Knowing what to do and what not to do are important. Both the successes and failures teach valuable lessons, too, as you read in this section.

Be aware that reading vendor white papers and viewing Webcasts or demos may give you a biased view of the benefits of their software. You need to conduct your own research to learn the full story of an enterprise system implementation. Problems may be skipped over or ignored. While blogs and YouTube posts may be good sources of objective data, many vendors have blogs and YouTube videos that are designed to appear to be neutral, when in fact they're not.

| TABLE 10.5	ERP Failures
Company and Industry	**Description of ERP Failure**
Hershey Food, manufacturer of chocolates, confectionaries, and beverages	Hershey's spent three years implementing a $115 million ERP system with SAP, Siebel, inventory, and Manugistics. The ERP was to replace all legacy systems and to integrate inventory, production, order processing, payroll, accounting, and finance. Hershey's devastating mistake was trying to implement all systems in all departments at the same time and at its busiest time of the year.
	Hershey suffered heavy losses in profits and sales, which led to an 8 percent drop in its stock price, and filed a lawsuit against the vendors.
Nike, athletic shoe and apparel manufacturer	Nike implemented i2's (*i2.com*) demand and supply planner software, which it wanted up and running before introducing an SAP ERP to handle all supply chain and sales order processes.
	The i2 system created duplicate orders, deleted customer orders, and deleted manufacturing requests to Asian factories. Adding to the problems, the ERP was not designed to handle Nike's large number of products. Many legacy systems had been left in use that lacked the ability to communicate with the supply chain software, causing huge delays and system crashes. The $400 million upgrade to Nike's supply chain and ERP systems caused $100 million in lost sales, a drop of 20 percent in stock price, and class-action lawsuits. Nike blamed the failure on underestimating the needed resources for the i2 system and rolling out the SAP prematurely.
FoxMeyer, bankrupted; formerly the fourth largest pharmaceuticals distributor	FoxMeyer's ERP could not process the transactions needed to supply its customers with their orders. FoxMeyer had been processing 425,000 invoice lines per day on its legacy software. Its ERP was limited to 10,000 invoice lines per day. This decreased order processing capability, quickly put the company into bankruptcy protection, and ultimately shut down the business.
Waste Management, garbage-disposal giant	As of mid-2009, Waste Management was embroiled in a $100 million legal battle with SAP over an 18-month installation of its ERP software. In the lawsuit filed in March 2008, Waste Management claimed that SAP executives participated in a fraudulent sales scheme and demo that resulted in the massive failure. SAP countersued, alleging that Waste Management violated its contract agreement.

Cases of ERP Failure. ERP implementations are complex, so it's not surprising to learn that there have been horror stories of ERP projects gone wrong. Dell canceled an ERP system after spending two years and $200 million on its implementation. Hershey Food Corp. brought widely publicized lawsuits against ERP software vendors because of their failed implementations. Table 10.5 presents Hershey's and other cases of ERP failures. In cases of extreme failure, companies have sued their vendors or consulting firms because their ERP software failure made it impossible to ship product or, at the extreme, led to a shutdown of the entire business.

ERP Success Factors. What factors increase the likelihood of ERP success and minimize the risk of problems? Many managers assume that success or failure depends on the software and, furthermore, that a failure is the fault of the software that's purchased or licensed. In reality, 95 percent of a project's success or failure is in the hands of the company implementing the software, not the software vendor.

The results of a 2008 survey to identify what ERP experts had found to be most important to successful ERP projects are shown in Figure 10.5. These ERP experts were given a list of five factors and asked to select only one of them as *most important*. The sixth alternative was *all five factors*. The results (which sum to 100 percent) are:

1. Strong program management: 6 percent
2. Executive support and buy-in: 19 percent
3. Organizational change management and training :13 percent
4. Realistic expectations: 8 percent
5. Focus on business processes: 5 percent
6. Interaction of all five factors: 49 percent

Survey responses to the question:
What is most important to successful ERP projects?
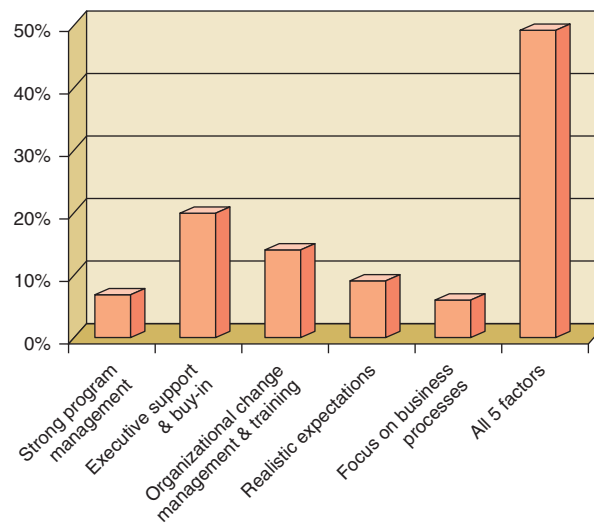
Figure 10.5 Experts identify what's most important to the success of an ERP.

That is, 49 percent of the ERP experts have found that success depended on all five factors. Stated another way, nearly half of the experts indicated that the failure of any one of these five factors would or could cause the ERP to fail.

The following recommendations explain why ERP success depends on several key factors being done right.

1. Focus on business processes and requirements. Too often, companies get caught up in technical capabilities or platforms on which the ERP runs. But compared to business processes, none of this really matters. What matters is how managers want business operations to run and what the key business requirements are. Once management and IT have defined them, they can more effectively choose the software that fits their unique business needs.

2. Focus on achieving a measurable ROI. Developing a business case to get approval from upper management or the board of directors is essential, but not sufficient. Establish key performance measures, set baselines and targets for those measures, and then track performance after going live. The performance results are proof of how well the ERP meets the expectations that had been listed in the business case.

3. Use a strong project management approach and secure commitment of resources. An ERP project depends on how it is managed. Responsibility for the management of the ERP implementation project cannot be transferred to vendors or consulting firms. Because of the business disruption and cost involved, ERP projects require the full-time attention and support of high-profile champions from the key functions for a long period of time, from six to twelve months on average. It's also known that ERP projects cannot be managed by people who *can be spared*. They must be managed by people who are *indispensable* personnel. Without powerful champions and the necessary budget (discussed next), expect the ERP to fail.

4. Ensure strong and continuing commitment from senior executives. Any project without support from top management will fail. No matter how well run a project is, there will be problems, such as conflicting business needs or business disruptions, that can only be resolved by someone with the power and authority to cut through the politics and personal agendas.

5. Take sufficient time to plan and prepare up front. An ERP vendor's goal is to close the deal as fast as possible. The company needs to make sure it correctly defines its needs and what it can afford to achieve in order to intelligently evaluate and select the best vendor. Do not be rushed into a decision. Too often, companies jump right

into a project without validating the vendor's understanding of business requirements or its project plan. The principle of "measure twice, cut once" applies to vendor selection. The more time the company spends ensuring that these things are done right at the start, the lower the risk of failure and the less time spent fixing problems later. Filing a lawsuit against a vendor (see Table 10.5) is not a fix. Lawsuits are both expensive and risky, and they add nothing to the company's performance.

6. Provide thorough training and change management. Another key principle to understand is that when you design an ERP, you redesign the organization. ERP systems involve dramatic change for workers. An ERP loses value if people do not understand how to use it effectively. Investing in training, change management, and job design are crucial to the outcome of any large-scale IT project.

Why Companies Don't Invest in ERP. One of the IT department's most important roles is to provide and support applications that ensure that workers can access, use, and understand the data they need to perform their jobs effectively. An ERP would seem to be the perfect solution. Despite their potential benefits, not all companies invest in ERP, typically because they are unable to meet or overcome the following requirements:

• Applications must be tightly aligned with well-defined and well-designed business processes, which is a standard that few enterprises are able to achieve.
• Selecting the appropriate ERP is time-consuming, complex, and expensive.
• Business processes must be modified to fit the software.
• Initial costs to purchase or lease and set up the ERP may be extremely high.
• The complexity of the applications might make it too difficult for employees to use the ERP correctly for maximum efficiency and ROI.

In addition, justifying an ERP becomes more difficult during an economic downturn.

Review Questions

1. Define *ERP* and describe its objectives.
2. Briefly describe the challenges of legacy systems that motivate the migration to ERP.
3. Describe how ERP enables agility.
4. List and briefly describe three ERP implementation success factors.
5. Describe two barriers to ERP implementation.

10.3 Supply Chain Management (SCM) Systems

The journey that a product travels, as shown in Figure 10.6, starting with raw material suppliers, then to manufacturers or assemblers, then forward to distributors and retail sales shelves, and ultimately to customers, is its **supply chain.** The supply chain is like a pipeline composed of multiple companies that perform any of the following functions:

• Procurement of materials
• Transformation of materials into intermediate or finished products
• Distribution of finished products to retailers or customers
• Recycling or disposal in a landfill

Supply chains vary significantly depending on the type, complexity, and perishability of the product. For example, in a simplified sense, the food supply chain begins with the livestock or farm, moves to the manufacturer (processor), then through the distribution centers and wholesalers to the retailer and final customer. In *IT at Work 10.2*, you read how track and trace technologies are being used to improve food safety and reduce costs.
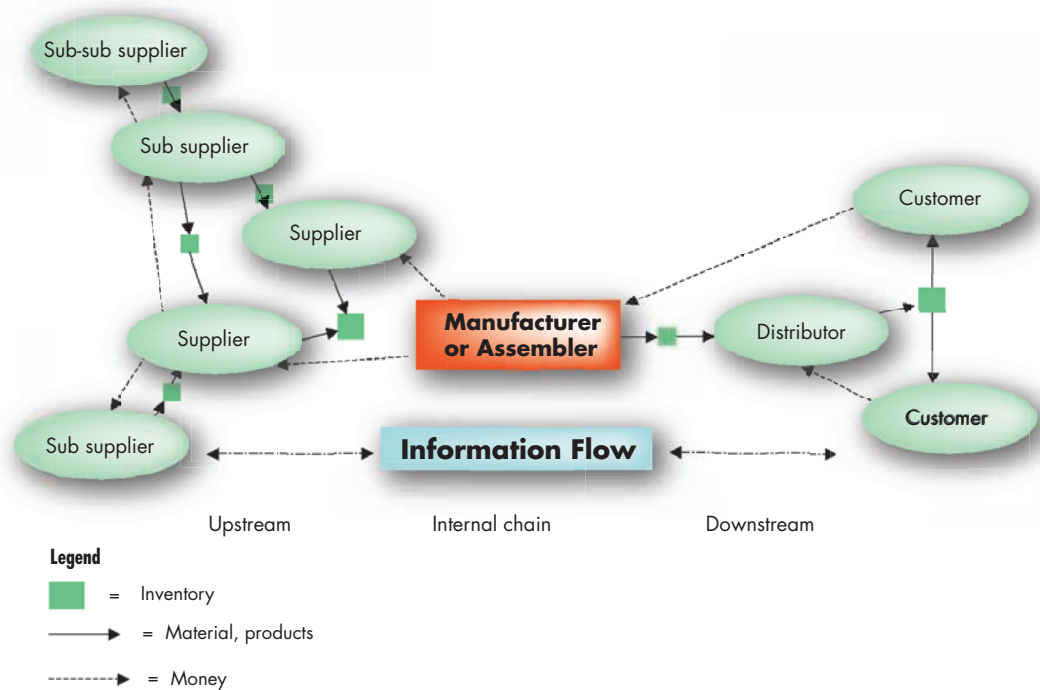
Figure 10.6 Structure of a typical supply chain.

IT at Work 10.2

Track and Trace Technologies Lead to Safer Food and Lower Costs

IS   OM   GLOBAL   GOV

Beef patties, pet food, peanut butter, lettuce, and spinach are a few of the recent high-profile food recalls due to contamination. Consumers worldwide are worried about the safety and source of their food. One solution is to implement track and trace technologies that follow food products throughout their supply chain, primarily through the use of barcodes and radio frequency identification (RFID). Barcoding and RFID enable the tracking of food through the food supply chain from "farm to fork." Without the capability to identify the scope of the contamination and contain it, the food recall is much more extensive than necessary as a safety precaution. For example, when *E.coli*-tainted spinach was discovered in 2007, using the barcode on a bag of bad spinach, investigators traced its origin to California's Salinas Valley. But then they had to do an intense and expensive search for the specific grower in that valley. And during that search time, all spinach was being pulled from grocery stores, distribution plants, and processing plants and destroyed. A growers' organization estimates the recall cost the spinach industry $74 million. It would have been much faster to track the contaminated leaves to the grower if spinach bags and containers had carried RFID tags with complete histories of the contents' origins.

With detailed information, companies can streamline the distribution chain and lower spoilage and contamination rates. Reducing the rates of spoilage and contamination is important for reasons related to safety and costs.

Consumer product and retail industries lose about $40 billion annually, or 3.5 percent of their sales, due to supply chain inefficiencies.

In the Canadian Province of Manitoba, a full traceability network was developed connecting more than 16 supply chain partners, including beef and pork producers, animal feed ingredient producers, feed manufacturers, farmers, processing plants, truckers, and a retail grocery chain. Using Global Traceability Network (GTNet) software from TraceTracker, an IBM partner, the Manitoba project shows it is possible to securely and accurately collect and process data about a piece of meat from a variety of sources and share that information at any step in the process.

Track and trace technologies are also being used at Germany's METRO Future Store (*future-store.org/*), where butchers not only cut meat but also apply RFID smart labels. Each package is identified with an RFID tag and recorded when it is placed into the refrigerated display case. All cases are equipped with RFID readers and antennas to scan the label of each product as it goes in, as it sits on the shelf, and as it goes back out with a consumer. Real-time data helps the store maintain fresh products, control the storage environment, and manage inventory levels.

Sources: Compiled from METRO Future Store (*future-store.org,* 2009), *CDC.gov*, IBM (*ibm.com*), and Weier (2007).

Discussion Questions: Where does the food supply chain start and end? What costs are reduced during a food recall if the food has RFID tags? How has barcoding and RFID improved the food supply chain? How has the Bioterrorism Act affected food SCM?

MANAGING THE FLOW OF
MATERIALS, DATA, AND
MONEY

Supply chains involve the flow of materials, data, and money. Descriptions of these three main flows are:

1. Material or product flow: This is the movement of materials and goods from a supplier to its consumer. For example, chipmaker Intel supplies computer chips to its customer Dell. Dell supplies its computers to end users. Products that are returned make up what is called the **reverse supply chain** because goods are moving in the reverse direction. For any location on the supply chain, the immediate previous source is **one-back** and the immediate subsequent recipient is **one-up.** For example, in the food chain, each immediate previous supplier of food is a one-back and the immediate subsequent recipient (customer) of the food product is the one-up. For a manufacturer, raw material suppliers are one-back in the supply chain while retailers are one-up in that chain.

2. Information flow: This is the movement of detailed data among members of the supply chain, for example, order information, customer information, order fulfillment, delivery status, and proof-of-delivery confirmation. Most information flows are done electronically, although paper invoices or receipts are still common for noncommercial customers.

3. Financial flow: This is the transfer of payments and financial arrangements; for example, billing payment schedules, credit terms, and payment via **electronic funds transfer** (**EFT**). EFT provides for electronic payments and collections. It is safe, secure, efficient, and less expensive than paper check payments and collections.

Supply chain links are managed. Think of the chain in terms of its links because the entire chain is not managed as a single unit. A company can only manage the links it actually touches. That is, a company will manage only partners who are one-back and one-up because that's the extent of what a company can manage.

ORDER FULFILLMENT
AND LOGISTICS

Order fulfillment is the set of complex processes involved in providing customers with what they have ordered on time and all related customer services. Order fulfillment depends on the type of product/service and purchase method (online, in-store, catalog, etc). For example, a customer who has ordered a new appliance via the *Sears.com* Web site needs to receive it as scheduled, with assembly and operating instructions as well as warranty and return information. The customer can receive a paper manual with the product or download the instructions from the Sears Web site. In addition, if the customer is not happy with a product, an exchange or return can be arranged via the Web site.

Order fulfillment is a part of **back-end** (or **back-office**) **operations,** which are activities that support the fulfillment of orders, such as accounting, inventory management, and shipping. It also is closely related to **front-office operations,** or *customer-facing activities,* which are activities, such as sales and advertising, that are visible to customers. The key aspects of order fulfillment are the delivery of materials or products at the right time, to the right place, and at the right cost.

Logistics is defined by the Council of Logistics Management as "the process of planning, implementing, and controlling the efficient and effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements" (*Logisticsworld.com*). Note that this definition includes inbound, outbound, internal, and external movements and the return of materials and goods. It also includes *order fulfillment.* The distinction between logistics and order fulfillment is not always clear, and the terms are sometimes used interchangeably because logistics is a large part of order fulfillment.

STEPS IN THE ORDER
FULFILLMENT PROCESS

The order fulfillment process consists of the flows of orders, payments, information, materials, and parts, all of which need to be coordinated with various departments and external partners. The order fulfillment process starts when an order is received

and includes the following nine activities that are supported by software or may be automated:

Step 1. Make sure the customer will pay. Depending on the payment method and prior arrangements with the customer, verify that the customer can and will pay and the payment terms. This activity is done by the finance department for B2B sales or an external company, such as PayPal or a credit card issuer such as Visa for B2C sales. Any holdup in payment may cause a shipment to be delayed, resulting in a loss of goodwill or a customer. In B2C, the customers usually prepay by credit card, but the buyer may be using a stolen card, so verification is crucial.

Step 2. Check in-stock availability and reorder as necessary. As soon as an order is received, the stock (inventory) is checked to determine the availability of the product or materials. If there's not enough stock, the ordering system places an order, typically automatically using EDI (electronic data interchange). To perform these operations, the ordering system needs to be connected to the inventory system to verify availability and to suppliers' ordering systems. Several scenarios are possible that may involve the material management department and production department as well as outside suppliers and warehouse facilities. Most often buyers can check availability by themselves using the Web.

Step 3. Arrange shipments. When the product is available, shipment to the customer is arranged (otherwise, go to Step 5). Products can be digital or physical. If the item is physical and it's readily available, packaging and shipment arrangements are made. Both the packaging/shipping department and internal shippers or outside transporters may be involved. Digital items are usually available because their "inventory" is not depleted. However, a digital product, such as software, may be under revision and thus unavailable for delivery at certain times. In either case, information needs to flow among several partners.

Step 4. Insurance. Sometimes the contents of a shipment need to be insured. Both the finance department and an insurance company could be involved, and, again, information needs to flow not only inside the company but also to and from the customer and insurance agent.

Step 5. Replenishment. Customized (build-to-order) orders will always trigger a need for some manufacturing or assembly operation. Similarly, if standard items are out of stock, they need to be produced or procured. Production can be done in-house or by contractors.

Step 6. In-house production. In-house production needs to be planned, and actual production needs to be scheduled. Production planning involves people, materials, components, machines, financial resources, and possibly suppliers and subcontractors. In the case of assembly and/or manufacturing, several plant services may be needed, including collaboration with business partners. Production facilities may be in a different country than the company's headquarters or retailers. This may further complicate the flow of information.

Step 7. Use suppliers. A manufacturer may opt to buy products or subassemblies from suppliers. Similarly, if the seller is a retailer, such as in the case of *Amazon.com* or *Walmart.com,* the retailer must purchase products from its manufacturers. In this case, appropriate receiving and quality assurance of incoming materials and products must take place.

Once production (Step 6) or purchasing from suppliers (Step 7) is completed, shipments to the customers (Step 3) are arranged.

Step 8. Contacts with customers. Sales representatives need to keep in close contact with customers, especially in B2B, starting with notification of orders received and ending with notification of a shipment or a change in delivery date. These contacts are usually done via e-mail and are frequently generated automatically.

Step 9. Returns. In some cases, customers want to exchange or return items. The movement of returns from customers back to vendors is *reverse logistics*. Overall,

Digital Supply Chain Map
Goods Movement Visibility
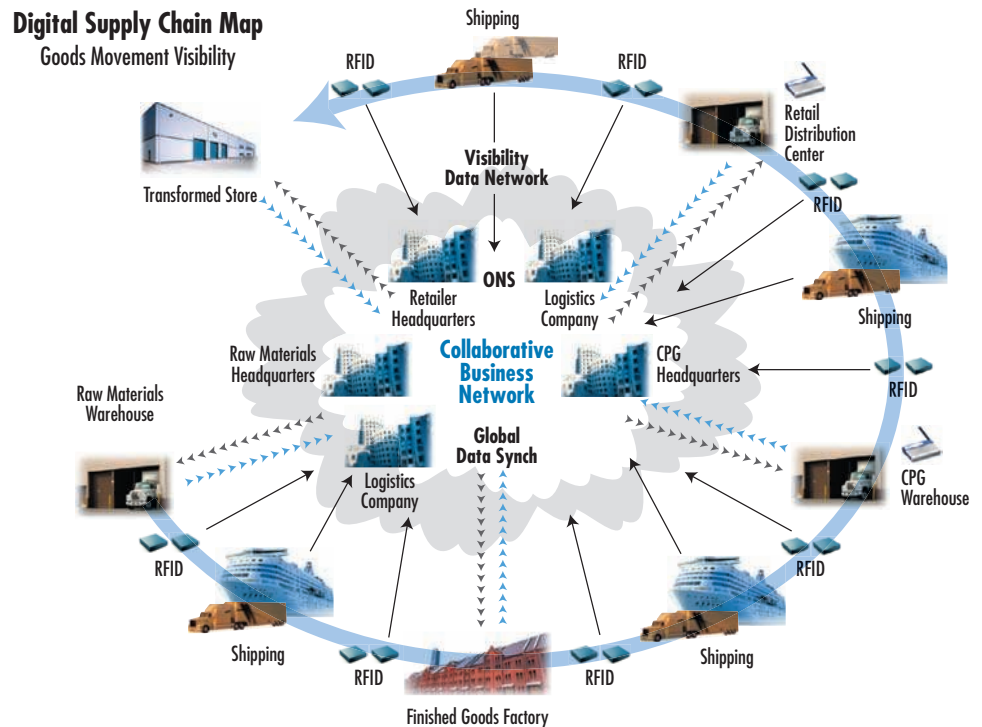
Figure 10.7 Managing a supply chains with RFID.

between $50 and $100 billion in U. S. goods are returned each year. Such returns can be a major problem, especially when they occur in large volumes.

We now take a more in-depth look at supply chain management concepts.

SUPPLY CHAIN MANAGEMENT CONCEPTS

Supply chain management (SCM) is the efficient management of the flows of material, data, and money in the supply chain, as shown in Figure 10.7. **SCM software** refers to software that supports the steps in the supply chain—manufacturing, inventory control, scheduling, and transportation. SCM software concentrates on improving decision making, forecasting, optimization, and analysis. SCM software is configured to achieve the following business goals:

• To reduce uncertainty and variability in order to improve the accuracy of forecasting

• To increase control over the processes in order to achieve optimal inventory levels, cycle time, and customer service

The benefits of SCM have long been recognized in business, government, and the military. In today's competitive business environment, efficient, effective supply chains are critical to survival and fully dependent on SCM software, which depends on up-to-date and accurate data. If the network goes down or data is outdated, those managing the supply chain are mostly working blind.

The use of RFID in the supply chain provides a major opportunity to reduce costs and increase operating efficiencies. Figure 10.8 illustrates how RFID can improve the efficiency of a supply chain by improving data quality.

MANAGING ON-DEMAND ACTIVITIES

The current business environment contains the elements of an *on-demand enterprise* with *real-time* operations. To review those concepts:

• **On-demand enterprise.** The concept of an on-demand enterprise is based on the premise that manufacturing or service fulfillment operations will start only after an order is received. We also refer to this approach as *build-to-order*. Enterprises have added this approach to their traditional **produce-to-stock** manufacturing. As the term indicates, *produce-to-stock* is the manufacture of products to stockpile inventory so the company is ready to respond to future demand. An obvious example of produce-to-stock is automobile dealerships, which have huge inventories of vehicles on their lot.
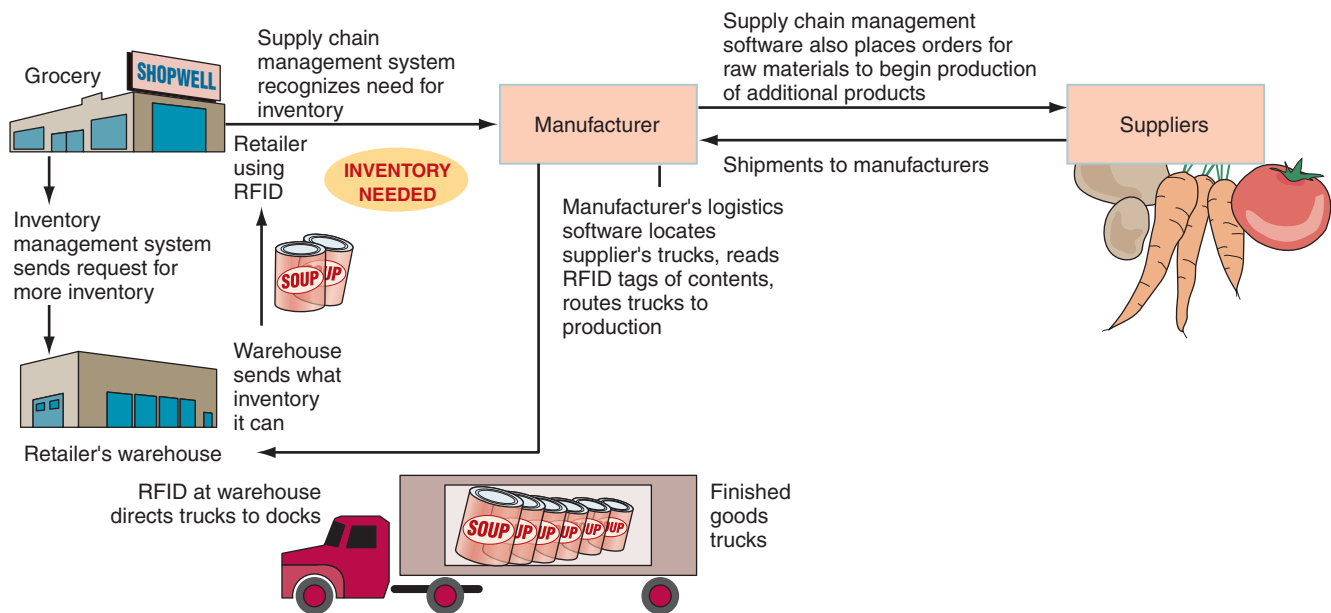
Figure 10.8 How RFID tags provide the data needed to manage the supply chain.

• **On-demand and real-time processes.** An on-demand process in the fulfillment cycle is one that is primed to respond to real-time conditions. There will be no back-orders, safety stock, lag time, or excess inventory. This principle is not fully achievable, but it is the direction that high-tech companies are headed in. Laptop and netbook manufacturers build-to-order as much as possible to reduce inventory, holding, and obsolescence costs. Inventory holding costs can greatly add to the cost of a product and narrow the profit margin.

These on-demand concepts have revolutionized the design and management of supply chains. To achieve on-demand and real-time processes, companies must reengineer their supply chain and add SCM to their ERP capabilities.

The market for SCM software applications and services reached $6.68 billion in 2008, a 4 percent increase over 2007, according to AMR Research (*amrresearch.com*). Leading SCM software vendors SAP and Oracle both posted significant percentage gains in 2008, with SAP up nearly 12 percent and Oracle growing by nearly 9 percent. In 2009, growth declined because of the bad economy. In a recession, companies do not make major investments in supply chain software unless it is mission-critical.

Review Questions

1. Define a *supply chain*.
2. List four functions performed in a supply chain.
3. List and describe the three main flows being managed in a supply chain.
4. Describe SCM.
5. What is order fulfillment?
6. Define *logistics*.

10.4 Collaborative Planning, Forecasting, and Replenishment (CPFR) Systems

There is a lot of uncertainty in product demand. The most common solution to supply chain uncertainties is to build inventories, or *safety stock,* as insurance. High levels of safety stock increase the costs of holding inventory. High inventories at multiple points in the supply chain can result in the bullwhip effect, described below. Low inventory levels increase the risk of stockouts (insufficient supply) and lost revenues when demand is high or delivery is slow. In either event, the total cost—including the cost of holding inventories, the cost of lost sales opportunities, and bad reputation—can

be very high. Thus, companies strive to optimize and control inventories. A leader in inventory management for several decades has been Procter & Gamble (P&G).

In the late 1980s, P&G convinced Walmart to implement its continuous replenishment software. One of its first collaborations was with Walmart. For example, P&G continuously replenished Pampers baby diapers at Walmart stores. Continuous replenishment is a supply chain relationship in which a vendor continuously monitors the inventory of a retailer or distributor and automatically replenishes its inventory when levels hit the reorder point. In this vendor-managed inventory (VMI) situation, a vendor manages the inventory of its customers, eliminating the need for customers to send purchase orders. The advantage to the vendor is having more advanced notice of product demand. The advantage to the retailer or distributor is minimizing inventory costs. Having the correct item in stock when the end customer needs it benefits all partners.

BULLWHIP EFFECT IN THE SUPPLY CHAIN

P&G logistics executives examined the order patterns for one of their best-selling products, Pampers diapers. At retail stores, Pampers sales were fluctuating, but the variability was not excessive. However, as they examined orders of distributors, the executives were surprised by the higher degree of variability. When they looked at P&G's orders of materials—the manufacturing level—to its suppliers such as 3M, they discovered that the swings (variability) in the size of orders were even greater. Figure 10.9 shows how the swings, which look like bullwhips, intensify from retailers to distributors to manufacturers.

At first glance, the variability did not make sense. While the consumers, in this case *babies*, consumed diapers at a steady rate, the demand order variability in the supply chain gets amplified at the manufacturer. This phenomenon is called the **bullwhip effect,** which occurs when companies significantly cut or add inventories. Economists call it a *bullwhip* because even small increases in demand can cause a big increase in the need for parts and materials further down the supply chain.

The bullwhip has broad implications today, as companies rush to fill orders while also restocking warehouse shelves. It touches everyone from retailers to the industrial companies that supply the grease, bolts, and coal needed to churn out more products. The manner in which companies, large and small, respond to market shifts determines which ones emerge first from the slump and start growing again.

A big question as the economy starts to recover is how well suppliers are positioned to ramp up production. Bottlenecks may occur as spot shortages cause unexpected price hikes and hamper companies' ability to meet demand. That's why heavy-equipment manufacturer Caterpillar took the unusual step late in 2009 of visiting with key suppliers to ensure that they had the resources to quickly increase output. In extreme cases, Caterpillar is helping suppliers get financing.

Example. Caterpillar said that even if demand for its equipment was flat in 2010–2011, it would still need to boost production in its factories by 10 percent to 15 percent, just to restock dealer inventories and meet ongoing customer demand. Mechanical Devices Co. was already feeling the crack of the whip. The small factory in Bloomington, Illinois, supplies Caterpillar with metal parts. It struggled through 2009, shedding about 100 of its 275 workers and scrounging for other clients to keep its machines running.
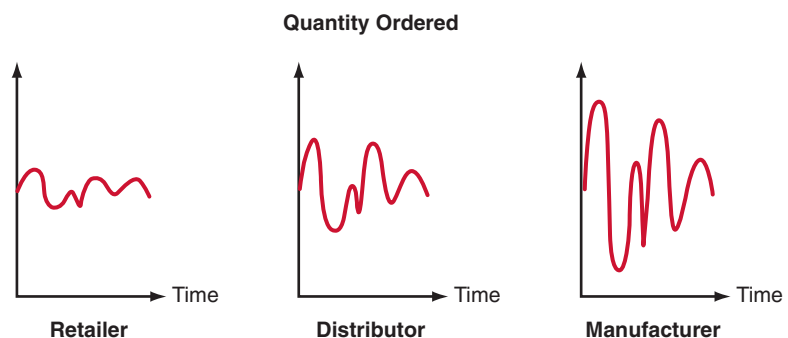

Figure 10.9 Bullwhip effect.

One reason Caterpillar is so attuned to the inventory cycle is its history. The company went through a massive growth spurt in the past decade, fueled by the twin forces of a commodity boom and a housing boom. Sales of the company's iconic yellow machines grew to $51 billion in 2008 from $20 billion in 2002.

How the Effect Works. SCM systems generate demand forecasts for a planning period, such as a quarter, month, or week. Participating sales representatives generate the sales forecasts. Based on these forecasts, the SCM systems stage, source, and schedule production and distribution facilities to meet your forecasted demand. Unfortunately, the sales force often changes the order quantities for a product before the close of the planning period. These deviations from the forecast are significant enough to cause a mismatch between what a company planned for production and what is actually needed to meet the amended orders. The deviations from the planned number of sales orders ripple through the supply chain, causing the bullwhip effect.

Amended sales orders exaggerate deviations as the information travels up the supply chain. If I am a component supplier one step up the chain, I will order raw material to build additional components and procure some material for safety stock. Next, my supplier will add its own safety stock to my amended order. These changes will continue up the supply chain, magnifying the original small deviation from planned orders. These oscillations cause all the firms in the supply chain to revamp their sourcing, manufacturing, and distribution plans. They now scramble to get additional raw material, add production lines, and restock distribution lines to meet the amended sales order quantities.

As a result of these oscillations from the bullwhip effect, firms across the supply chain are saddled with excess inventory, procurement cost overruns, additional warehousing and shipping costs, and, most importantly, quality problems. The upstream firms have the option of taking the loss resulting from amended orders or passing on the costs by reducing other product attributes. Component quality is the biggest casualty of rush orders. Distributors or retailers often return products manufactured to meet the amended demand signals, thus placing additional burden on the supply chain.

IMPROVING B2B EC

The most promising source of performance improvement in B2B e-commerce is collaboration in the supply chain. Supply chain collaboration can increase profit margins by as much as 3 percent for supply chain partners, which is a significant improvement. For the collaboration effort to succeed, business partners must *trust* each other and each other's information systems. Many supply chain problems have been solved through *sharing information* along the supply chain. Such information sharing is frequently referred to as the **collaborative supply chain.** It may take several different formats, as described next.

COLLABORATIVE PLANNING, FORECASTING, AND REPLENISHMENT

The concepts of continuous replenishment, VMI, and collaboration evolved into the more comprehensive model known as **collaborative planning, forecasting, and replenishment (CPFR).** CPFR is a set of data-driven business processes designed to improve the ability to predict and coordinate with supply chain partners. With CPFR, suppliers and retailers collaborate in planning and demand forecasting in order to ensure that members of the supply chain will have the right amount of raw materials and finished goods when they need them. CPFR streamlines product flow from manufacturing plants all the way to customers' homes.

The Voluntary Interindustry Commerce Solutions (VICS) Association (*vics.org*) describes the structure of CPFR activities and guidelines for implementing them. Since 1986, VICS Association has worked to improve the efficiency and effectiveness of supply chains. CPFR comprises four main collaboration activities:

- **Strategy and planning:** Setting the ground rules for the collaborative relationship and specifying the product mix
- **Demand and supply management:** Forecasting consumer demand and order and shipment requirements over the planning horizon
- **Execution:** Performing activities, such as placing orders, shipping and delivery, receiving, stocking, tracking sales transactions, and making payments

• **Analysis:** Monitoring outcomes of planning and execution, assessing results and key performance metrics, sharing insights with partners, and adjusting plans to improve results

Large manufacturers of consumer goods, such as Warner-Lambert (WL), have superb supply chains resulting from their use of CPFR. As part of a pilot project, WL shared strategic plans, performance data, and market insights with Walmart. The company realized that it could benefit from Walmart's market knowledge, just as Walmart could benefit from WL's product knowledge (see Figure 10.10). See *IT at Work 10.3* for details.

IT at Work 10.3

Warner-Lambert Collaborates with Retailers

OM

In 2000, Warner-Lambert (WL) was acquired by Pfizer (*pfizer.com*), creating the world's fastest-growing pharmaceutical company. One of its major products is Listerine mouthwash. The materials for making Listerine come mainly from eucalyptus trees in Australia and are shipped to the WL manufacturing plant in New Jersey. Like all manufacturers, WL wanted answers to the one burning question that drives many decisions: "What are we going to sell this week or month?" Its key concern is accurately *forecasting overall demand* to determine how much Listerine to produce. Once demand is determined, WL calculates how much raw material is needed and when. A wrong forecast results in excess raw material or finished product inventories, or in shortages. Inventories are expensive to keep; shortages may result in loss of business to competitors.

WL forecasts demand with the help of JDA Demand Management System (*jda.com/*). Used with other SCM software, the system analyzes manufacturing, distribution, and sales data against expected demand and business climate information. Its goal is to help WL decide when and how much Listerine and other

products to produce. For example, the model can anticipate the impact of seasonal promotion or a production line being down. WL's supply chain excellence stems from the CPFR program.

WL's demand management system analyzes manufacturing, distribution, and sales data against expected demand and business climate information to help WL decide how much product to make and distribute. Because WL can smooth seasonality in forecasts, it has dramatically cut manufacturing and raw materials inventory costs. Data transfer between companies is done using **electronic data interchange (EDI).** EDI is a communication standard that enables the electronic transfer of routine documents, such as purchase orders, between business partners. It formats these documents according to agreed-upon standards.

Sources: Compiled from *JDA.com* and *VICS.org.*

Discussion Questions: What other supply chain management solutions are offered by JDA? For what industries, besides retailing, would such collaboration be beneficial?
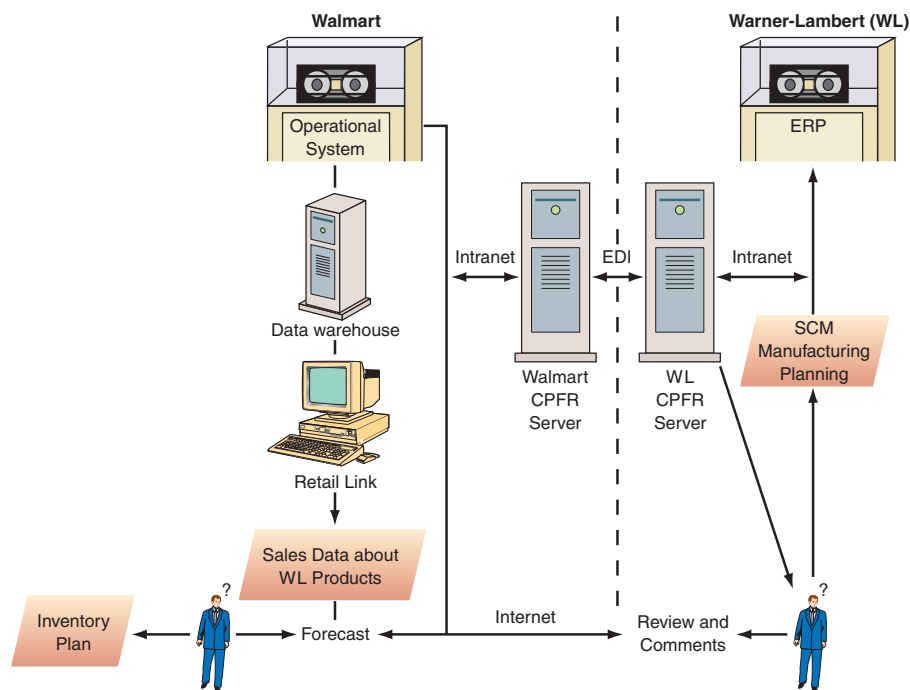

Figure 10.10 Model of CPFR.

1. How does demand uncertainty affect inventory? Give an example.
2. Describe a collaborative supply chain.
3. Define *CPFR* and describe how it works.
4. Describe how vendor-managed inventory works.

10.5 Customer Relationship Management (CRM) Systems

Every company depends on customers for revenues and growth. Marketing managers run campaigns, promotions, commercials, and advertisements to attract new customers, or to increase sales to existing customers, or to do both. Attracting new customers is expensive; for example, it costs banks roughly $100 to acquire a new customer. Newly acquired customers are unprofitable until they have purchased enough products or services to exceed the cost to acquire and service them. Therefore, retaining customers that generate revenues in excess of the costs (e.g., customer service, returns, promotional items, and the like) is critical—and the underlying reason for **customer relationship management (**CRM). **CRM** refers to the methodologies and software tools to leverage customer information in order to achieve the following:

- Build greater customer loyalty and therefore greater profitability per customer
- Deter customer attrition (loss of a customer)
- Acquire new customers who are most likely to become profitable
- Up-sell (sell more profitable products/services) or cross-sell (sell additional products/services) to unprofitable customers to move them to a profit position
- Reduce inefficiencies that waste advertising dollars

The purpose of frequent-purchase programs offered by airlines, supermarkets, credit card issuers, retailers, casinos, and other companies is to track customers for CRM purposes and build customer loyalty to improve financial performance.

According to management guru Peter Drucker, "Those companies who know their customers, understand their needs, and communicate intelligently with them will always have a competitive advantage over those that don't." For most types of companies, marketing effectiveness depends on how well they know their customers; specifically, knowing what their customers want, how best to contact them, and what types of offers they are likely to respond to positively. According to the *loyalty effect*, a 5 percent reduction in customer attrition can improve profits by as much as 20 percent. Customer-centric business strategies strive to provide products and services that customers want to buy. One of the best examples is the Apple iPhone and iPod—devices that customers were willing to camp out on sidewalks to buy to guarantee getting one on the day of their release. In contrast, companies with product-centric strategies need to create demand for their products, which is more expensive and may fail.

CRM EXAMPLE: TRAVELOCITY

CRM is best understood by looking at a familiar company's CRM strategy. Consider *Travelocity.com,* the online travel agency. Travelocity implemented CRM software from Teradata (*teradata.com*) in 2001 to better understand, serve, and communicate with its 40 million customers. Its CRM software has enabled Travelocity to:

- Analyze clickstream data and discover how customers use the Web site. This information is leveraged to better personalize messages in realtime (that is, while customers are using the site).
- Test the value of specific messages and offers on various customer segments.
- Identify customers who have booked a flight, but not a hotel or car rental, and then make them a compelling offer. Adjusting offers or taking action based on customer behavior is referred to as *event-based marketing*.

Building CRM capabilities takes time and requires a data warehouse for the analytics. Travelocity started with the building blocks to learn about its customers and the best ways to deliver targeted market campaigns to them. In addition, Travelocity can respond quickly to offers from its suppliers. For example, at 8 A.M. a major airline offered travel agencies a special fare from Los Angeles to San Juan, Puerto Rico. Travelocity quickly scanned its customers' browsing behavior, pulled the e-mail addresses of 30,000 people in the Los Angeles area who had browsed but not bought tickets to the Caribbean, and then generated an e-mail message to them. The response rate was incredible: 25 percent of the recipients who had been e-mailed booked flights. This was an effective campaign measured by the response rate, or take rate, as well as a highly efficient one as measured by the ROI from the profit on sales of those extra tickets.

CRM IS MULTICHANNEL

CRM is implemented across multiple sales channels.

Dell Computer uses direct mail, e-mail, media advertising, and the Internet in combination with personal contacts by sales representatives and special intranet Web sites for large Dell accounts to stay connected with its customers.

Barnes & Noble's (*BN.com*) multichannel strategy allows customers to browse and buy products at any of its stores or online. The "Readers Advantage" loyalty program offers customers additional discounts and benefits.

1-800-FLOWERS.com uses e-mail, Web sites, telephone, retail stores, and catalogs to deploy its multichannel marketing strategies. The company's customer-centric focus has enabled it to achieve up to 35 percent growth for several years.

CRM IS AN ENTERPRISEWIDE INITIATIVE

CRM is an enterprise-wide effort to acquire and retain profitable customers. CRM focuses on building long-term and sustainable customer relationships for the purpose of increasing the company's profitability. A common misconception about CRM is that it's about providing services and perks to delight or keep customers happy. As the Travelocity example shows, CRM is a data-driven, fact-based business strategy to select and manage customers to optimize sales and profit.

Key components of CRM are shown in Figure 10.11 and described below:

- Customers
- Call center
- Marketing department
- Sales department
- Customer support

CRM is basically a simple idea: *Treat different customers differently* according to their current or potential value to the company. CRM involves much more than just sales and marketing because a firm must be able to change how its products are configured or its services are delivered based on the needs of individual customers or customer segments. Smart companies encourage the active participation of customers in the development of products, services, and solutions.

E-CRM

There's one key advancement created by Web 2.0 that organizations must force themselves to recognize: "Your customers have technology, too, and if you don't deliver a customer experience that's of value to them, they will let the community know."

CRM has been practiced manually by corporations for generations. However, since the mid-1990s, various types of information technologies have enhanced CRM. CRM technology is an evolutionary response to changes in the business environment, making use of new IT devices and tools. The term **e-CRM (electronic CRM)** was
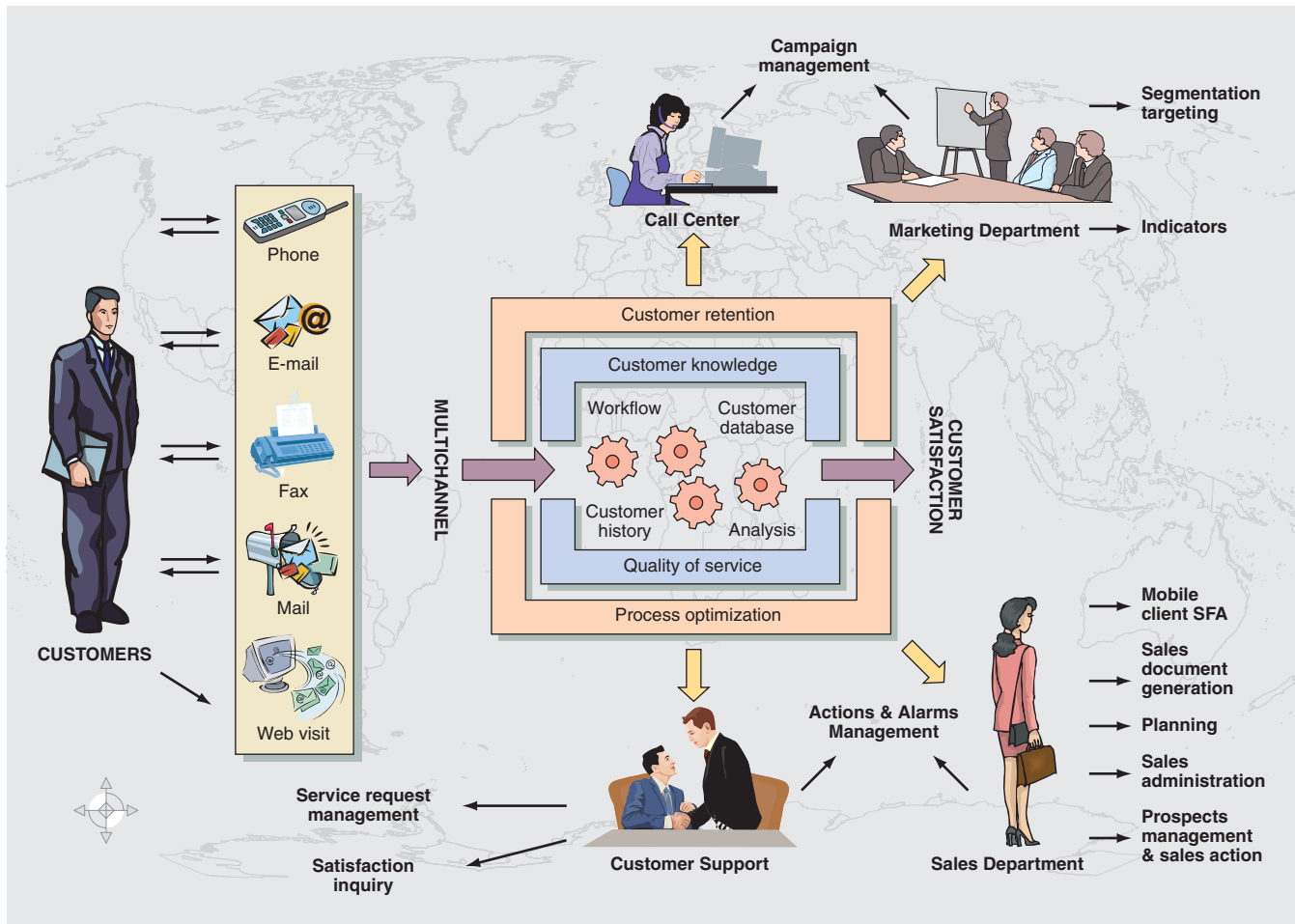
Figure 10.11 CRM.

coined in the mid-1990s, when businesses started using Web browsers, the Internet, and other electronic touchpoints (e-mail, POS terminals, call centers, and direct sales) to manage customer relationships. E-CRM covers a broad range of topics, tools, and methods, ranging from the proper design of digital products and services to pricing to loyalty programs.

Through Internet technologies, data generated about customers can be easily fed into marketing, sales, and customer service applications for analysis. Electronic CRM also includes online applications that lead to segmentation and personalization. The success of these efforts can be measured and modified in real time, further elevating customer expectations. In a world connected by the Internet, e-CRM has become a requirement for survival, not just a competitive advantage. In this section we will discuss several issues related to e-CRM and its implementation.

Loyalty programs are programs that recognize customers who repeatedly use the services (products) offered by a company. A well-known example is the airlines' *frequent-flyers* program. Casinos use their players' clubs to reward their frequent players. Many supermarkets use some kind of program to reward frequent shoppers, as do many other companies. These programs include some kind of database (or data warehouse) to manage the accounting of the points collected and the rewards. Analytical tools such as data mining are then used to explore the data and learn about customer behavior.

A loyalty program is offered by *1-800-FLOWERS.com,* as shown in *IT at Work 10.4.*

IT at Work 10.4

1-800-FLOWERS.com Uses Data Mining for CRM

1-800-FLOWERS.com is an Internet pioneer. It had an Internet presence in 1992 and full-fledged e-store capabilities in 1995. Online sales are a major marketing channel in addition to telephone and fax orders. Competition is very strong in this industry. The company's success was based on operational efficiency, convenience (24/7 accessibility), and reliability. However, all major competitors provide the same features today. To maintain its competitive advantage, the company transformed itself into a customer-intimate organization, caring for more than 15 million customers.

The company decided to cultivate brand loyalty through customer relationships based on intimate knowledge of customers. How is this accomplished? SAS software spans the entire decision-support process for managing customer relationships. Collecting data at all customer contact points, the company turns this data into knowledge for understanding and anticipating customer behavior, meeting customer needs, building more profitable customer relationships, and gaining a holistic view of a customer's lifetime value. Using SAS Enterprise Miner, *1-800-FLOWERS.com* sifts through data (such as historical purchases) to discover trends, explain outcomes, and predict results so that the company can increase response rates and identify profitable customers. The rationale for the customer-intimate effort is to build loyalty. In addition to selling and campaign management, the ultimate goal is to make sure that when a customer wants to buy, he or she continues to buy from *1-800-FLOWERS.com* and cannot be captured by a competitor's marketing. To build that kind of loyalty, it is necessary to know your customers and build a solid relationship with each one of them.

The company's objective is not just to get customers to buy more. It is about making sure that when they decide to purchase a gift online or by phone, they do not think of going to the competition. Loyalty is earned through the quality of the relationship offered. The difficulty is that not every customer wants the same relationship. Some want you to be more involved with them than others; some will give you different levels of permission on how to contact them. The data mining software helps the company identify the many different types of customers and how each would like to be treated. The net result is that customer retention has increased by over 15 percent.

Sources: Compiled from Reda (2006) and *1-800-flowers.com.*

Discussion Questions: Why is being number one in operation efficiency not enough to keep *1-800-FLOWERS.com* at the top of its industry? What is the role of data mining? How is the one-to-one relationship achieved in such systems?

CRM SUCCESSES AND FAILURES

As with many IT innovations, initially there were numerous CRM failures, which have been reported in the media. Some of the major issues relating to CRM failures are the following:

• Difficulty in measuring and valuing intangible benefits. There are only a few tangible benefits to CRM.

• Failure to identify and focus on specific business problems that the CRM can solve.

• Lack of active senior management (non-IT) sponsorship.

• Poor user acceptance. This can occur for a variety of reasons, such as unclear benefits—that is, CRM is a tool for management, but it may not help a rep sell more effectively—and usability problems.

• An attempt to automate a poorly defined business process in the CRM implementation.

Example of a Failure. Citizen National Bank's experience is an example of a failure, changing the CRM vendors, and then a success. The lessons learned, at a cost of $500,000, were

• Be absolutely clear about how the CRM application will add value to the sales process.

• Determine if and why sales people are avoiding CRM.

• Provide incentives for the sales team to adopt CRM.

• Find ways to simplify the use of the CRM application.

• Adjust the CRM system as business needs change.

IT at Work 10.5

How Companies Use e-CRM

MKT **SVR** **OM**

Almost all large companies have a formal CRM program. Here are a few examples of how companies have implemented CRM:

- Continental Airlines monitors telephone calls to its data center, using intelligent software from Witness Systems (*witness.com*) to analyze recorded conversations. The analysis tells Continental Airlines what customers really want. It also helps the company craft marketing plans and business strategy. Results serve customers better and resolve problems immediately, saving the company $1 million annually.

- Micrel Inc., a leading manufacturer of integrated circuit solutions for enterprise, consumer, industrial, mobile, telecommunications, automotive, and computer markets, has become known for being "fast on its feet" in responding to customer needs. To improve response time and relevancy of information delivered to customers online, the company uses a sophisticated self-service search and navigation engine that directs customers to the right information at the right time to help them reach buying decisions. As a result, Web site traffic grew by 300 percent, retention rate for new site visitors increased by 25 percent, the company saved $40,000 a year, and customer satisfaction increased significantly.

- The Kassel region in Germany uses a CRM-based social networking platform to attract businesses, tourists, and potential residents. The site won the Most Innovative CRM Deployment Award at the *CRM Expo*, Europe's largest CRM show.

- Boots the Chemists, a U.K. retailer of over 1,400 health and beauty stores, uses e-CRM analytics to learn about customers in its e-loyalty programs. The retailer uses data mining to acquire insights into customer behavior. Customer service agents can analyze, predict, and maximize the value of each customer relationship.

- Harrah's Entertainment Inc. treats its customers differently: The more a customer spends in a casino, the more rewards the customer gets. The company assigns a value to each customer as determined by the results of data mining.

- FedEx's CRM system enables the company to provide superb service to millions of customers using 56 call centers. Each of its 4,000 call center employees has instant access to a customer's profile. The profile tells the employee how valuable the customer is and the details of the current transaction. The more an agent knows about the customer, the better the service provided. Customers use one phone number regardless of where the company is or the destination of the package. The CRM reduced calls for help, increased customer satisfaction, and enabled better advertising and marketing strategy.

Discussion Questions: What are the common elements of CRM in these examples? CRM systems provide managerial benefits. What are they? Why is data mining becoming so important in CRM?

Justifying e-CRM. One of the biggest problems in CRM implementation is the difficulty of defining and measuring success. Additionally, many companies say that when it comes to determining value, intangible benefits are more significant than tangible cost savings. Yet companies often fail to establish quantitative or even qualitative measures in order to judge these intangible benefits.

A formal business plan must be in place before the e-CRM project begins—one that quantifies the expected costs, tangible financial benefits, and intangible strategic benefits, as well as the risks. The plan should include an assessment of the following:

- **Tangible net benefits.** The plan must include a clear and precise cost-benefit analysis that lists all of the planned project costs and tangible benefits. This portion of the plan should also contain a strategy for assessing key financial metrics, such as ROI, NPV, or other justification methods.

- **Intangible benefits.** The plan should detail the expected intangible benefits, and it should list the measured successes and shortfalls. Often, an improvement in customer satisfaction is the primary goal of the e-CRM solution, but in many cases this key value is not measured.

- **Risk assessment.** The risk assessment is a list of all of the potential pitfalls related to the people, processes, and technology that are involved in the e-CRM project.

Having such a list helps to lessen the probability that problems will occur. And, if they do occur, a company may find that, by having listed and considered the problems in advance, the problems are more manageable than they would have been otherwise.

While a special approach is recommended for all enterprise systems, the CRM approach is most challenging, as you will find in the *Analysis Using Spreadsheets* at the end of this chapter.

Tangible and Intangible Benefits. Benefits typically include increases in staff productivity (e.g., closing more deals, avoiding costs, increasing revenues, and increasing margins) as well as reductions in inventory costs (e.g., due to the elimination of errors). Other benefits include increased customer satisfaction, loyalty, and retention.

Potential Pitfalls and Risks of e-CRM

• Taking on more than can be delivered. The e-CRM solution should target specific sales or service business functions or specific groups of users. Additionally, it is essential to manage the project's scope, goals, and objectives throughout the project development phase and deployment.

• Getting over budget and behind schedule.

• Poor user adoption. Ease of use and adequate training are essential.

• Expensive maintenance and support.

• Isolation. The effectiveness of a project may suffer if the CRM data is not used throughout the company.

• Garbage in–garbage out (GIGO). Because e-CRM systems require so much data entry, users often put in placeholders, misguided estimates, or inaccurate information, which leads to poor analytical results and decision-making errors.

• Failure to measure success. Measurement of pre-project status and post-project achievements is essential for a company to show success.

On-Demand CRM. Like several other enterprise systems, CRM can be delivered in two ways: on-premises and on-demand. The traditional way to deliver such systems was on-premises—meaning users purchased the system and installed it on site. This was very expensive, with a large upfront payment. Many SMEs (small and medium-sized enterprises) could not justify it, especially because most CRM benefits are intangible.

The solution to the situation is to lease the software. *Salesforce.com* pioneered the concept for its several CRM products, including supporting salespeople, under the name of *On-Demand CRM,* offering the software over the Internet. The concept of on-demand is known also as *utility computing* or *software-as-a-service* (SaaS). On-demand CRM is basically CRM hosted by a vendor on the vendor's premises, in contrast to the traditional practice of buying the software and using it on site.

On-demand CRM must be weighed against the following implementation problems:

• Service providers can go out of business, leaving customers without service.

• It is difficult, or even impossible, to modify hosted software.

• Upgrading could become a problem.

• Relinquishing strategic data to a hosting vendor can be risky.

• Integration with existing software may be difficult.

The benefits are:

• Improved cash flow due to savings in up-front purchase

• No need for corporate software experts

• Ease of use with minimal training

• Fast time-to-market

• Vendors' expertise available

Review Questions

1. Define *CRM.*
2. List the major types of CRM.
3. What is e-CRM?
4. List some customer-facing, customer-touching, and customer-intelligent CRM tools.
5. What is on-demand CRM?

10.6 Knowledge Management (KM) Systems

Forrester Research and IBM estimated that up to 85 percent of a company's *knowledge* is not stored in databases. Knowledge is dispersed in social media, e-mail, texts, intranets, drops (*drop.io*), Word documents, spreadsheets, and presentations on individual computers and mobile devices. Knowledge typically is unstructured and has strong experiential and reflective elements that distinguish it from information in a given context.

KNOWLEDGE

Having knowledge implies that it can be used to solve a problem, whereas having information does not. The ability to act is an integral part of being knowledgeable. For example, two people in the same context with the same information may not have the same ability to use the information with the same degree of success. There is a difference in the human capability to add value. The differences in ability may be due to different experiences, different training, different perspectives, and other factors.

Whereas data, information, and knowledge may all be viewed as assets of an organization, knowledge provides a higher level of meaning about data and information. It conveys meaning and tends to be much more valuable, yet more ephemeral.

In the IT context, knowledge is very distinct from data and information. See Figure 10.12. Whereas data is a collection of facts, measurements, and statistics, information is organized or processed data that is timely and accurate. Knowledge is information that is contextual, relevant, and actionable.

KNOWLEDGE MANAGEMENT (KM)

Knowledge management (KM) is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that are part of the organization's memory. The goal of KM systems is to identify, capture, store, maintain, and deliver useful knowledge in a meaningful form to anyone who needs it, anyplace and anytime, within an organization. KM systems support sharing, decision making, and collaborating at the organization level regardless of location.

KM initiatives focus on identifying knowledge, explicating it in such a way that it can be shared in a formal or systematic manner, and leveraging its value through reuse.

Through a supportive organizational climate and IT, an organization can bring its entire organizational memory and knowledge to bear upon any problem anywhere in the world and at any time. For organizational success, *knowledge, as a form of capital, must be exchangeable among persons, and it must be able to grow.* Knowledge about how problems are solved can be captured, so that KM can promote organizational learning, leading to further knowledge creation.

For example, a map giving detailed driving directions from one location to another could be considered data. An up-to-the-minute traffic bulletin along the freeway that indicates a traffic slowdown due to construction could be considered information. Awareness of an alternative, back-roads route could be considered knowledge. In this case, the map is considered data because it does not contain current relevant information that affects the driving time and conditions from one location to the other. However, having the current conditions as information is useful
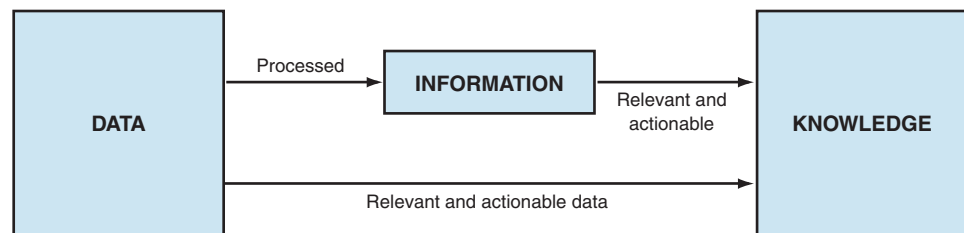
Figure 10.12 Data, information, and knowledge.

only if the individual has knowledge that will enable him or her to avoid the construction zone. Having knowledge implies that it can be used to solve a problem, whereas having information does not carry the same connotation.

KM Systems. **Knowledge management systems (KMSs)** refer to the use of the Internet, intranets, extranets, LotusNotes, software filters, agents, and data warehouses to systematize, enhance, and expedite intra- and interfirm knowledge management. KMSs are intended to help an organization cope with turnover, rapid change, and downsizing by making the expertise of the organization's human capital widely accessible. They are being built in part from increased pressure to maintain a well-informed, productive workforce. They also help organizations retain the knowledge of departing employees. Many organizations have been building KM systems in order to capitalize on the knowledge and experience of employees worldwide. For an example, see the case of Infosys in *IT at Work 10.6*.

IT at Work 10.6

Knowledge Management at Infosys Technologies

IS   GLOBAL

A global software services company based in India, Infosys Technologies is a worldwide leader in outsourcing. With over 23,000 employees and globally distributed operations, Infosys develops IT solutions for some of the largest corporations in the world. During the past 10 years, Infosys has experienced 30 percent annual growth rates. Infosys faced the challenge of keeping its large employee base up-to-date and ahead of both its competitors and clients as well as ensuring that the lessons learned in one part of the organization were available to other parts. Said a member of the KM group: "An IT company like ours cannot survive if we don't have mechanisms to reuse the knowledge that we create. . . . 'Learn once, use anywhere' is our motto." The vision is that every instance of learning within Infosys should be available to every employee. But how does an organization turn such a vision into a reality?

KM Solution. Infosys Technologies' effort to convert each employee's knowledge into an organizational resource began in the early 1990s and extended well into the first decade the 21st century. In the early 1990s, Infosys launched its bodies of knowledge (BOK) initiative. This involved encouraging employees to provide written accounts of their experiences across various topics, such as technologies, software development, and living abroad. These were shared in hardcopy form with all other employees. This early effort ballooned into a full-fledged KM effort supported by e-mail, bulletin boards, and various knowledge repositories. In 1996, a corporate intranet was developed to make BOKs, in HTML format, easily accessible to all, and in 1999 Infosys began an organization-wide program to integrate the various knowledge initiatives. A central knowledge portal was created, called KShop, and while the KM group developed the technology infrastructure, local groups were encouraged to maintain their own content on KShop.

The content of KShop consisted of different content types—BOKs, case studies, reusable artifacts, and downloadable software—

each with its own homepage. Content was carefully categorized by the KM group to ensure that as the amount of content increased, it would still be possible for people to quickly find what they needed.

In the early 2000s, Infosys appeared to have a very functional KM system, and yet patronage by employees remained low. The KM group therefore initiated a reward scheme to increase participation. The scheme gave employees who contributed to KShop knowledge currency units (KCUs) that could be accumulated and exchanged for monetary rewards or prizes.

This case illustrates that KM initiatives are much more than the implementation of technology tools to allow employees to post knowledge. Such initiatives involve processes to organize knowledge, to categorize knowledge, and to rate knowledge usefulness, as well as processes to encourage knowledge sharing and reuse.

Impacts on Performance. Within a year of the introduction of the KCU scheme, 2,400 new knowledge assets had been contributed to KShop by some 20 percent of Infosys employees. However, as the volume of content increased, so, too, did problems relating to finding useful information. Moreover, the heavy growth in contributions taxed the limited number of volunteer reviewers, who served an important quality control function. The KM group therefore modified the KCU incentive scheme. It developed a new KCU scheme that rated the usefulness of knowledge from the perspective of the users of the knowledge, rather than the reviewers. And, to increase accountability, the KM group requested tangible proof to justify any high ratings. Finally, the KM group raised the bar for cashing in KCU points for monetary awards.

Sources: Compiled from *infosys.com* and Garud and Kumaraswamy (2005).

Discussion Questions: Why are consulting types of organizations so interested in KM? How can organizations deal with the knowledge overload? Is a reward system the best approach to participation?
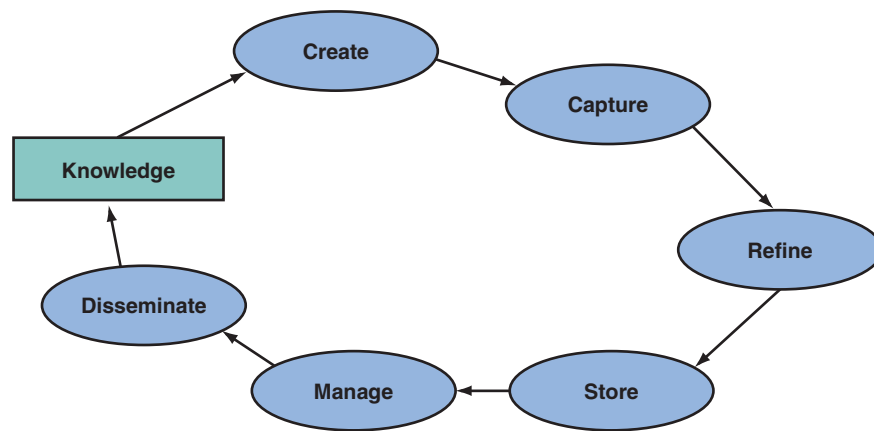
Figure 10.13 The knowledge management system cycle.

KM Systems Cycle. A functioning KMS follows six steps in a cycle, which is shown in Figure 10.13. The system is cyclical because knowledge is acquired and refined over time. The cycle works as follows:

1. Create knowledge. Knowledge is created as people determine new ways of doing things or develop know-how. Sometimes external knowledge is brought in.

2. Capture knowledge. New knowledge must be identified as valuable and be represented in a reasonable way.

3. Refine knowledge. New knowledge must be placed in context so that it is actionable. This is where human insights (tacit qualities) must be captured along with explicit facts.

4. Store knowledge. Useful knowledge must then be stored in a reasonable format in a knowledge repository so that others in the organization can access it.

5. Manage knowledge. Like a library, the knowledge must be kept current. It must be reviewed to verify that it is relevant and accurate.

6. Disseminate knowledge. Knowledge must be made available in a useful format to anyone in the organization who needs it, anywhere and anytime.

COMPONENTS OF KM SYSTEMS

KM systems are developed using the following sets of technologies: *communication* and *collaboration*, and *storage* and *retrieval*.

Communication and collaboration technologies allow users to access needed knowledge and to communicate with each other and with experts. Communication and collaboration also allow for knowledge solicitation from experts.

Storage and retrieval technologies originally meant using a database management system to store and manage knowledge. This worked reasonably well in the early days for storing and managing most explicit knowledge, and even explicit knowledge about tacit knowledge. However, capturing, storing, and managing tacit knowledge usually requires a different set of tools. Electronic document management systems and specialized storage systems that are part of collaborative computing systems fill this void. *Desktop search* is a major tool in knowledge retrieval.

KM SYSTEM IMPLEMENTATION

In the early 2000s, KMS technology evolved to integrate collaborative computing, databases, and network technology (previously independent of each other) into a single KMS package. Today, these include enterprise knowledge portals and knowledge management suites. These are sold with other enterprise systems packages, especially CRM, and are available on an on-demand basis, so even SMEs can use them. In addition, there were some innovative specific applications, such as expert locating systems.

Finding Experts Electronically and Using Expert Location Systems. People who need help can post their problem on the corporate intranet, blogs, or social media to ask for help. Similarly, companies may ask for advice on how to exploit an opportunity. IBM frequently uses this method. Sometimes it obtains hundreds of useful ideas within a few days. This method is a form of brainstorming. The problem with this approach is that it may take days to get an answer, if an answer is even provided, and the answer may not be from the top experts.

Therefore, companies use expert location systems. **Expert location systems (ELSs)** are interactive and help employees find and connect with colleagues—whether they are across the country or across the room—who possess the expertise required to solve specific, critical business problems quickly. The process includes the following steps, which are also listed in Figure 10.14:

Step 1. An employee submits a question into the ELS.

Step 2. The software searches its database to see if an answer to the question already exists. If it does, the information (research reports, spreadsheets, etc.) is returned to the employee. If not, the software searches documents and archived communications for an "expert."

Step 3. Once a qualified candidate is located, the system asks if he is able to answer a question from a colleague. If so, he submits a response. If the candidate is unable to respond (perhaps he is in a meeting or otherwise indisposed), he can elect to pass on the question. The question is then routed to the next appropriate candidate until one responds.

Step 4. After the response is sent, it is reviewed for accuracy and sent back to the querist. At the same time, it is added to the knowledge database. This way, if the question comes up again, it will not be necessary to seek real-time assistance.

IT at Work 10.7 demonstrates how an ELS works for the U.S. government.
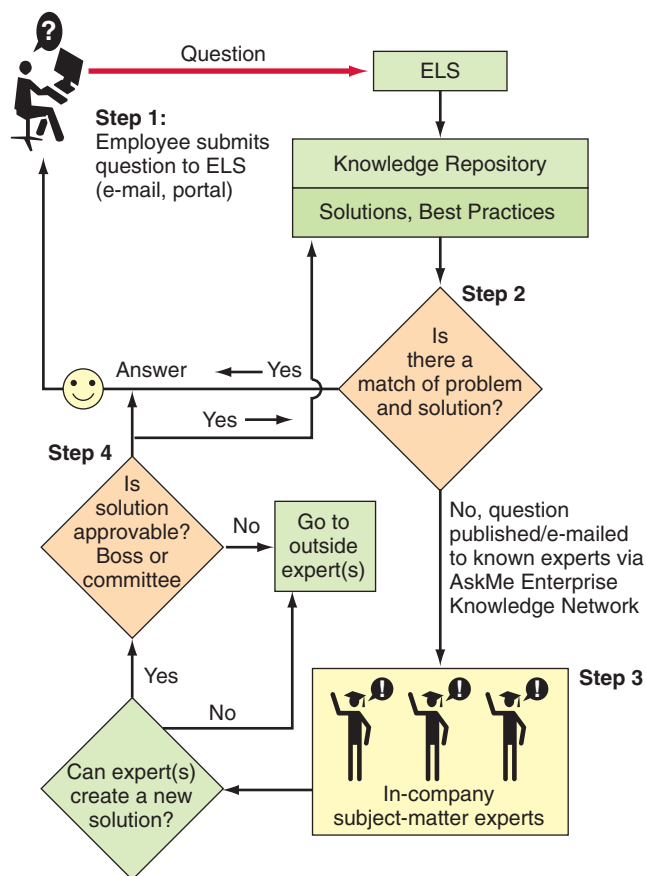
Figure 10.14 Expert location system of AskMe Corp.

IT at Work 10.7

U.S. Department of Commerce Use of an Expert Location System

The U.S. Commercial Service Division at the Department of Commerce (DOC) conducted over 200,000 counseling sessions a year involving $40 billion in trade. The division employs specialists who frequently need to do research or call on experts to answer a question posed by a U.S. corporation.

For example, in May 2004, a software company called on Brad Anderson, a DOC specialist, for advice. The software company wanted to close a deal with a customer in Poland, but the buyer wanted to charge the U.S. company a 20 percent withholding tax, a tax it attributed to Poland's recent admission into the European Union (EU). Was the tax legitimate?

To find out, Anderson turned to *DOC Insider*, an ELS from AskMe. After typing in his question, Anderson first found some documents that were related to his query, but they did not explain the EU tax code completely. Anderson next asked the system to search the 1,700-expert-strong Commercial Service for a live expert, and within seconds he was given a list of 80 people in the DOC who might be able to help him. Of those, he chose the 6 people he felt were most qualified and then forwarded his query.

Before the DOC Insider was in place, Anderson says, it would have taken him about three days to get the answer to the question. "You have to make many phone calls and deal with time zones," he says. Thanks to the ELS, however, he had three responses within minutes, a complete answer within an hour, and the sale went through the following morning. Anderson estimates that he now uses the system for roughly 40 percent of the work he does.

The DOC Insider is an invaluable tool. Anderson thinks the tool is vital enough to provide it to other units at the agency. In the first nine months the system was in place, it saved more than 1,000 hours of work.

Sources: Compiled from D'Agostino (2004) and Fox (2004).

Discussion Questions: What are the benefits of an ELS? Will the system impact privacy? Can it be integrated with wireless devices? If so, for what purposes?

INTEGRATION OF KM SYSTEMS WITH OTHER ISS

Since a knowledge management system is an enterprise system, it is usually integrated with enterprise and other information systems in an organization. Obviously, when a KMS is designed and developed, it cannot be perceived as an add-on application. It must be truly integrated into other systems. Through the help of the organizational culture, a knowledge management system and its activities can be directly integrated into a firm's business processes. For example, a group involved in customer support can capture its knowledge to provide help on customers' difficult problems. In this case, help-desk software would be one type of package to integrate into a KMS, especially into the knowledge repository. A major challenge is to integrate data that resides in a variety of systems, locations, and formats.

Review Questions

1. Define *KM* and relate it to knowledge and intellectual capital. What are the major benefits of KM to a company?
2. Distinguish knowledge from data and information.
3. Draw the KM life cycle and explain the major steps.
4. Describe the major components of a KM system.
5. Describe an expert location system.
6. Relate KM to training.

Key Terms

agility *287*
available-to-promise (ATP) *286*
back-office operation *299*
B2B gateway *293*
bullwhip effect *303*
collaborative planning, forecasting, and replenishment (CPFR) *304*
customer relationship management (CRM) *306*

e-CRM (electronic CRM) *307*
electronic data interchange (EDI) *305*
electronic funds transfer (EFT) *299*
enterprise application integration (EAI) *292*
enterprise information systems *287*
enterprise resource planning (ERP) *289*
external supply chain *285*

financial flow *299*
front-office operations *299*
information flow *299*
internal supply chain *285*
knowledge management (KM) *312*
knowledge management system (KMS) *313*
legacy system *285*
logistics *299*

Chapter Highlights and Insights

(Numbers refer to Learning Objectives)

1 Enterprise systems are information systems that support several departments and/or the entire enterprise. The most notable are ERP, which supports supply chains, and CRM.

1 Supply chains connect suppliers to a manufacturing company, departments inside a company to one another, and a company to its customers. The supply chain must be completely managed, from the raw materials to the end customers. Typical supply chains involve three segments: upstream, internal, and downstream. Most supply chains are supported by a variety of IT application programs.

2 It is difficult to manage the supply chain due to the uncertainties in demand and supply and the need to coordinate several (sometimes many) business partners' activities. One of the major problems is known as the bullwhip effect, in which lack of coordination and/or communication results in large, unnecessary inventories.

2 A number of solutions to supply chain problems are supported by IT, such as appropriate inventory management, vertical integration, information sharing, VMI, supply chain collaboration, RFID, supply chain teams, virtual factories, and wireless solutions.

3 The next step in SCM was to integrate routine transactions, including internal suppliers/customers and external suppliers/customers, in ERP and extended ERP software. The latest step in the evolution of integrated supply chain software is the addition of business intelligence and CRM applications.

4 CRM is an enterprise-wide activity through which an organization takes care of its customers and their needs. It is based on the idea of one-to-one relationships with customers. CRM is done by providing many communication and collaboration services, most of which are IT-supported and many of which are delivered on the Web.

5 Knowledge management is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that typically reside within the organization in an unstructured way. The knowledge management model involves following cyclical steps: create, capture, refine, store, manage, and disseminate knowledge.

5 A variety of technologies can make up a knowledge management system: the Internet, intranets, data warehousing, decision-support tools, groupware, and so on. Intranets are the primary means of displaying and distributing knowledge within organizations.

6 KM has many potential benefits resulting from reuse of expertise. The problem is how to collect, store, update, and properly reuse the knowledge. It is difficult to measure the success of a KMS. Traditional methods of financial measurement fall short, as they do not consider intellectual capital an asset. Nonfinancial metrics are typically used to measure the success of a KM, yet some firms have been able to determine financial payoffs.

Questions for Discussion

1. Distinguish between ERP and SCM software. In what ways do they complement each other? Why should they be integrated?
2. Discuss the benefits of e-procurement.
3. Find examples of how two of the following organizations improve their supply chains: manufacturing, hospitals, retailing, education, construction, agribusiness, and shipping. Discuss the benefits to the organizations.
4. It is said that supply chains are essentially "a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organization, until the ultimate end user." Explain. Use of a diagram is recommended.
5. Discuss why it is difficult to justify CRM.
6. A supply chain is much more powerful in the Internet marketplace. Discuss how Internet technologies can be used to manage the supply chain.
7. Explain how vendor-managed inventory can save costs in the supply chain.
8. State the business value of enterprise systems and how they can be used to make management of the supply chain more effective.
9. Discuss each of the steps in the ERP selection process.
10. What are the problems in implementing ERP systems? State solutions that make implementations more successful.
11. Describe and relate the different characteristics of knowledge.
12. Explain why it is important to capture and manage knowledge.
13. Compare and contrast tacit knowledge and explicit knowledge.
14. How can employees be motivated to contribute to and use KM systems?
15. Explain how the Internet and its related technologies (Web browsers, intranets, and so on) enable knowledge management.
16. Discuss the value for expert locating systems over simply using the Internet.

Exercises and Projects

1. Identify the supply chain(s) and the flow of information described in the opening case. Draw it. Also, answer the following.
   a. "The company's business is not to make the product, but to sell the product." Explain this statement.
   b. Why was it necessary to use IT to support the change?
   c. Identify all of the segments of the supply chain.
   d. Identify all supporting information systems in this case.

2. Visit Teradata Student Network and find the podcasts that deal with CRM and supply chains. Identify the benefits cited in the podcasts.

3. Enter Teradata Student Network and find the most recent Web seminar on data integration. Relate these tools to the integration issues discussed in this chapter.

4. Based on your own experience or on the vendor's information, list the major capabilities of a particular knowledge management product, and explain how it can be used in practice.

5. Visit *SAP.com* and identify all modules that are related to financial management and all those related to HRM.

Group Assignments and Projects

1. Each group in the class will be assigned to a major ERP/SCM vendor such as SAP, Oracle, Microsoft, and so forth. Members of the groups will investigate topics such as (a) Web connections, (b) use of business intelligence tools, (c) relationship to CRM and to KM, (d) major capabilities, and (e) availability of ASP services by the specific vendor.
   Each group will prepare a presentation for the class, trying to convince the class why the group's software is best for a local company known to the students (e.g., a supermarket chain).

2. Create groups to investigate the major CRM software vendors, their products, and the capabilities of those products in the following categories. (Each group represents a topical area of several companies.)
   • Sales force automation (Oracle, Onyx, Salesforce, Saleslogix, Pivotal)
   • Call centers [Clarify, LivePerson, NetEffect, Inference, marketing automation (Annuncio, MarketFirst)]

   • Customer service [Brightware (from Oracle), Broadvision]
   • Sales configuration (Selectica, Cincom)
   Start with *searchcrm.com* and *crmguru.com* (to ask questions about CRM solutions). Each group must present arguments to the class to convince class members to use the product(s) the group investigated.

3. Search the Internet for knowledge management products and systems and create categories for them. Assign one vendor to each team. Describe the categories you created and justify them. Examine Tolisma Knowledge base (see *knowledgebase.net*) and Intactix Knowledge base (from JDA Software, *jda.com*). What did the vendors' knowledge bases accomplish?

4. Visit Teradata Student Network and find the First American Corporation Case (by Watson, Wixon, and Goodhue), regarding CRM implementation. Write an executive summary listing the key lessons that you learned.

Internet Exercises

1. Visit *ups.com*. Examine some of the IT-supported customer services and tools provided by the company. Write a report on how UPS contributes to supply chain improvements.

2. Visit *supply-chain.org, cio.com, findarticles.com*, and *google.com* and search for recent information on supply chain management integration.

3. Visit *mySap.com*. Identify its major components. Also review the Advanced Planning and Optimization tool. How can each benefit the management of a supply chain?

4. Visit *i2.com* and review its SCM products that go beyond ERP. Examine the OCN Network and Rhythm. Write a report.

5. Visit *oracle.com*. Find the ERP modules offered by Oracle and identify their connection to CRM and customer services.

6. Visit *salesforce.com* and take the tour. What enterprise-wide system does the company support? How?

7. Enter *2020software.com*. Find information about the top 10 ERP solutions. View the demo; write a report on your findings.

8. How does knowledge management support decision making? Identify products or systems on the Web that help organizations accomplish knowledge management. Start with *brint.com, decisionsupport.net*, and *knowledge-management.ittoolbox.com*. Try one out and report your findings to the class.

9. Visit *internetdashboard.com*. View its products and relate them to the different enterprise systems described in this chapter.

BUSINESS CASE

ERP Helps Productivity at Northern Digital Inc.

Northern Digital Inc. (*ndigital.com*) in Ontario, Canada, is a supplier of electronic measurement products. The relatively small company employs 90 people and generates over $20 million in annual revenue.

Rapid Growth and Aging IT

Northern Digital Inc. (NDI) faced a challenge when rapid growth and aging technology threatened to stand in the way of company goals. Instead of enabling operational improvements, NDI's existing systems were impeding progress. Existing technology was causing missed deliveries and creating a high number of backorders. Inventory control was poor, and the planning was inaccurate. With some customers expecting shipment in as long as nine months and others expecting shipment in as little as nine days or even less, more sophisticated and accurate planning was critical. Customer satisfaction was at risk, and internal morale was slipping. After almost 20 years in business, NDI's well-established reputation for high-quality, high-performance products was at risk.

ERP from Intuitive

NDI selected an ERP system from Intuitive Manufacturing Systems based on factors that directly supported corporate objectives. Intuitive's ERP provided a level of system functionality that could immediately improve inventory management and the expandability and flexibility to support NDI's growth. The software includes a complete planning system, automated inventory management, and enhanced technology infrastructure. Equally important was the system's level of ease of implementation and ease of use.

Better Planning and Control

After implementing Intuitive ERP, Northern Digital experienced continued success in improving inventory management and increasing revenue. Prior to implementation, the company had struggled to achieve even two inventory "turns" (turnovers) per year. Inventory turns have now more than doubled, and expectations are that the company will better that in the near future. Since implementation, Northern Digital's revenue has increased

from $10 million to over $20 million with little increase in inventory value. In addition, the company has reduced order cycle time for its flagship product from four months to four weeks, an improvement of almost 80 percent. This was a result of improved planning capabilities due to the ERP.

Improvements in production control and inventory management have had a direct impact on customer delivery. The material requirements planning and forecasting capabilities of Intuitive ERP have allowed Northern Digital to better service its customers. The addition of better planning capabilities had an immediate positive impact on labor and materials. "We were able to better understand what was in stock, what we were buying, and what was needed," said Tom Kane, production manager. "Improved planning has made a huge difference in improving delivery."

Ease of use and system scalability have been important in utilizing Intuitive ERP to improve operations. When the system was first implemented, NDI needed only five user seats (user licenses). As NDI grew, that number increased to 25. Significantly increasing the number of users, and doing so without a lot of training (due to the ease of use), allowed the company to expand without worrying about putting constraints on its business infrastructure, supporting the growth strategy.

For Northern Digital, improving operations is more than just a way to reduce expenses. With the implementation of Intuitive ERP, NDI has found a way to increase the value it provides to customers while also improving financial performance.

Sources: Compiled from *managingautomation.com* and *ndigital.com*.

Questions

1. For a small company such as NDI, why is an ERP better than SCM applications?
2. Identify the supply chain segments that the ERP supports; be specific.
3. Relate this case to Porter's value chain and to its competitive model. Show the ERP's contribution.
4. Relate this case to business planning and strategy.

NONPROFIT CASE

Arbor Day Foundation Implements Constituent Relationship Management System

The Arbor Day Foundation (*arborday.org/*) is the world's largest tree-planting organization. The foundation has nearly 1 million members and a growing list of conservation and education programs. As the foundation expanded, leaders recognized the need to replace its aging legacy system with a flexible solution that the IT team could then customize to

manage interactions with an increasingly diverse group of supporting organizations.

The Arbor Day Foundation selected Microsoft Dynamics CRM to rapidly develop and deploy customized constituent relationship management applications for its many conservation programs.

Replaced Decades-Old Legacy System

The foundation's custom-built member relationship management application, which it relied on for nearly two decades, was designed primarily around interactions with individuals in just a few of its existing outreach programs. As the Arbor Day Foundation grew, adding dozens of new partners and programs in the last decade, its need for a more sophisticated constituent relationship management system increased.

"Previously, 75 percent or more of our operations centered on working directly with members," says Mike Ashley, IT Director for the Arbor Day Foundation. "As we've engaged more supporters, partners, and sponsors in connection with new conservation and education programs, our need to manage interactions with various groups has intensified."

The organization's six-person application development team extended the system whenever possible to handle changes in communicating with corporate partners and government entities and to support newly launched programs. Over time, however, this legacy model became unsustainable. Developing add-ons and applications to enhance existing functionality often required specialized skills sets, inevitably increasing project costs and delaying deployment. And each new application required IT staff to create and maintain large amounts of additional custom code, which increased the risk of failure and decreased IT efficiency.

Performance Improvements

This new platform helped the organization reduce application development time by as much as 300 percent, improved agility and scalability by empowering IT to drive change and innovation, and strengthened overall productivity. The top three benefits were:

- Increased employee productivity: Over the course of six months, the foundation continued to add programs and expand relationships with partners and supporters without the need to increase staffing levels.
- Provided greater scalability of operations: The ability to deploy new applications in substantially less time means that the Arbor Day Foundation can cost-effectively meet the unique needs of its emerging programs.
- Reduced application development time by 300 percent: Ashley estimates that his team completed development of the application to support the Tree Campus USA program three times faster than would have been possible with the organization's previous system. "We set a time frame of four weeks from start to finish for building and rolling out the application, and we comfortably hit that target," says Ashley. "We estimate that it would have taken three months or more to extend our old system in the same way."

Today, the organization provides enhanced service to the myriad groups, agencies, and individuals that it works with each day.

Sources: Compiled from *Microsoft.com* and *ArborDay.org*.

Questions

1. Why are changes to legacy ISs needed? Why were changes needed at the Arbor Day Foundation?
2. Why do organizations finally decide to replace their legacy systems?
3. In your opinion, what problems would the foundation be facing today if it had not replaced its legacy systems with the CRM software?
4. Compare and contrast constituent relationship with customer relationship management.

ANALYSIS USING SPREADSHEETS

Assessing the Value of E-CRM

FIN   HRM   ACC

Design a spreadsheet to perform the analysis detailed below.

Managers of a large food processing company would like to find the cost/benefit of installing an e-CRM application. The managers created a list of both tangible and intangible costs and benefits of the project.

Your assignment is to develop a spreadsheet in which you:

1. Calculate the tangible costs and benefits for 1 year.
2. List the intangible costs (and risks) for the year.
3. List the intangible benefits for the year.

The data to use for the 1 year analysis are:

- E-CRM software licensing: Cost per user $1,200; number of users 86 (including 50 direct sales employees)
- Technical support and maintenance: $20,000
- Training of 86 users for 5 days: Productivity loss $120/day
- Training of 4 supervisors: Productivity loss $200/day
- Fees to trainers: $8,000
- Additional hardware, networks, and so forth: $27,000
- Annual operating cost: 2 IT employees at $72,000 each; other costs $18,000
- Average *monthly* sales per direct sales employee: $50,000; gross profit from sales = 8 percent
- Productivity increase per CRM employee using the new system = 12 percent
- Overhead cost computed at 10 percent

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 10 are available at wiley.com/college/turban:

10.1 West Marine: A CPFR Success Story
10.2 Northrop Grumman Uses KM to Prevent Brain Drain

References

Alexander, D., "How Agile Are You?" *Manufacturing Automation*, May 2009. *globalshopsolutions.com/assets/pdfs/press/MA_May_09v2.pdf*

Bartholomew, D., "A Banker's $500,000 Lesson in CRM," *Baseline*, February 2007.

Boucher–Ferguson, R., "10 Cool CRM Developments," *eWeek.com*, March 24, 2008. *eweek.com/c/a/CRM/10-Cool-CRM-Developments*

Business Wire, "Research and Markets: Recent Overview of the Performance Apparel Markets," April 17, 2009.

Center for Disease Control (CDC), *CDC.gov/*

Chan, I., and C. K. Chao, "Knowledge Management in Small and Medium-Sized Enterprises," *Communications of the ACM*, April 2008.

D'Agostino, D. "Expertise Management: Who Knows About This? *CIO Insight,* July 1, 2004.

EFSA.europa.eu/

Feldman, S., "What Are People Searching For, and Where Are They Looking?" *KMWorld*, February 29, 2008.

Fox, P. "Using IT to Tap Experts' Know-How," *Computerworld,* March 15, 2004.

Garud, R., and A. Kumaraswamy, "Vicious and Virtuous Circles in the Management of Knowledge: The Case of Infosys Technologies," *MIS Quarterly,* (29)(1), March 2005.

House.gov/

Humanetics.com/

Intel, "Building the Digital Supply Chain: An Intel Perspective," *Intel Solutions White Paper*, January 2005.

Moss, M., "The Burger That Shattered Her Life," *New York Times,* October 2, 2009. *nytimes.com/2009/10/04/health/04meat.html?_r=1*

Reda, S., "1-800-FLOWERS.COM and AT&T Cultivate Relationship Rooted in Common Business Objectives," *Stores*, October 2006.

UnderArmour.com/

Weier, M. H., "Food Industry Looks to RFID to Avoid Next Catastrophe," *InformationWeek,* February 5, 2007.