CHAPTER 2

ENTERPRISE SYSTEMS

LEARNING OBJECTIVES

AFTER READING THIS CHAPTER, YOU SHOULD BE ABLE TO:

- DESCRIBE ENTERPRISE SYSTEMS.
- DESCRIBE ENTERPRISE RESOURCES PLANNING SYSTEMS.
- EXPLAIN THE ORGANIZATION VALUE CHAIN.
- DESCRIBE THE RELATIONSHIP OF THE ORGANIZATION VALUE CHAIN AND AN ENTERPRISE SYSTEM.
- ILLUSTRATE THE VALUE OF SYSTEMS INTEGRATION.
- DESCRIBE HOW AN ENTERPRISE SYSTEM SUPPORTS MAJOR BUSINESS EVENT PROCESSES.
- ENUMERATE THE PROS AND CONS OF IMPLEMENTING ENTERPRISE SYSTEMS.

At the time that Nestlé® SA, the Switzerland-based consumer goods company, embarked on a worldwide implementation of SAP®'s enterprise resource planning (ERP) software, the company had 200 operating companies in 80 countries. Nestlé USA, the $8.1 billion U.S. subsidiary, had 9 autonomous divisions that did not have common processes, systems, or organization structures. The company even had 29 different names for the ingredient vanilla and paid 29 different prices for that vanilla from the same vendor! Each division and factory was allowed to name and develop specifications for vanilla and all of their other raw material purchases.

One of the purposes for the worldwide SAP® implementation was to standardize processes and systems across the organization. The fact that Nestlé USA had 9 different general ledgers and 28 points of customer entry gives you some idea of the problems the company faced. To achieve common practices within divisional functions, such as manufacturing, purchasing, marketing, sales, and accounting, Nestlé would need to give up its old approaches to doing business.

The Nestlé SAP® project was not without its problems. The project team learned, for example, that this was not a software project nor was it an IT project. Because this project changed the way people worked, it required that the team focus its attention on change management. As a result, the project took several years longer and cost millions

of dollars more than had been planned.[1] Personnel resisted the changes in business practices that were taking place. For example, as a result of employees' unwillingness to adapt to new supply chain tools, turnover of personnel who forecasted demand for Nestlé products reached 77 percent.

In the end, Nestlé implemented six SAP® modules—purchasing, financials, sales and distribution, accounts payable, accounts receivable, and advanced planning and optimization (APO)—as well as parts of Manugistics'® supply chain module.[2] Business practices were standardized across divisions and operating companies. For example, the purchasing group for confections used the same best practices as the purchasing group for beverages. We'll have one vanilla, thank you! Also, as a result of using one common database, discount terms offered by the salesperson were honored by accounts receivable. Previously, with separate databases, communicating these terms proved difficult.

As of May 2002, the SAP® project had saved Nestlé USA $325 million, the majority of savings arising from improved demand forecasting. In the past, the sales force, demand planners, and factories all had separate databases. With the new business processes and ERP system, forecasts are more accurate, which results in reduced inventory and costs to redistribute inventory that had resulted from too much product being sent to one place and not enough to another.[3]

Synopsis

Nestlé undertook its SAP® project to take advantage of the benefits, including the competitive advantage that can accrue for organizations that integrate business processes and implement ERP systems. As Nestlé learned, however, significant costs and business disruptions may be endured before the benefits are realized. To function effectively in any modern organization, you need to understand the benefits and costs of organization-wide integration of information systems and the ERP software used in the integration process.

In this chapter, we explore the enterprise systems that assist in the operation of all of an organization's business processes and integrate, in the enterprise database, all of the data related to those business processes. We describe these systems and the functionality they provide. We broadly introduce the business processes that ERP systems support. What you learn here, although important in its own right, will provide important background for your study in later chapters of the text.

Introduction

ENTERPRISE SYSTEMS

We place the Enterprise Systems icon here to indicate that this entire chapter is entirely about enterprise systems. The other two icons, Controls and e-Business, will be placed at appropriate places throughout the remainder of the chapter.

As defined in the Preface and Chapter 1, **enterprise systems** (also known as **enterprise-wide information systems** and **enterprise information systems**) integrate the business process functionality and information from all of an organization's

1 The project was started in 1997 and restarted in 2000 with the signing of a $280 million contract with SAP. The last rollout of the SAP system took place in 2003.

2 Manugistics (http://www.manugistics.com) is a software vendor providing software to implement an organization's supply chain. Supply chain, APO, and the other software modules are described later in the text.

3 Ben Worthen, "Nestlé's ERP Odyssey," *CIO Magazine* (May 15, 2002): 62–70.

functional areas, such as marketing and sales, cash receipts, purchasing, cash disbursements, human resources, production and logistics, and business reporting (including financial reporting). They make possible the coordinated operation of these functions and provide a central information resource for the organization. For example, the enterprise system might facilitate the purchase of some office equipment by:

- Providing an electronic order form (a purchase requisition).
- Applying business rules to ensure that complete information and proper approvals have been obtained. For instance, the system might need to connect to accounting processes and data to determine that the purchase is within the requester's budget.
- Routing the order to appropriate authorities for specific approvals. The system may need to connect to human resource processes and data to determine appropriate approvers.
- Sending the order to a buyer in purchasing for preparation of a purchase order to be sent to a vendor. The system may assist the buyer with selection of an appropriate vendor, perhaps by consulting a list of pre-approved vendors.
- Connecting directly to the enterprise systems of business partners, such as the vendor that will sell you the office equipment. E-BUSINESS
- Completing the business process by making data available for ongoing management and analysis of the purchase and subsequent related events. For example, data would be available for (1) receiving the equipment and enabling routing of the equipment to the purchasing party, (2) projecting funding requirements to pay for purchases, (3) analyzing the vendor's performance (e.g., timeliness, quality, and price), and (4) comparing the purchasing party's budget and actual expenditures.

Notice that there are several points during this purchase process where controls might be implemented by the enterprise system. For example, by ensuring that proper approvals are obtained and that the purchase is within the purchaser's budget, the enterprise system reduces the risk that unauthorized purchases will be made. CONTROLS

Organizations install enterprise systems to differentiate themselves from their competitors. For example, with an enterprise system, an organization should be able to conduct business in a timelier and less costly manner and provide services to its customers that would otherwise not be possible. Also, as previously noted, the enterprise system collects data about each business event, as well as data about an organization's business partners and other aspects of the business, such as inventory, manufacturing, and human resources. This data contains nuggets of gold that management can mine and use to monitor the organization's operations, improve performance, and create additional business opportunities. We'll tell you more about the advantages and disadvantages of enterprise systems as our discussion continues.

Enterprise Resource Planning (ERP) Systems

Enterprise resource planning (ERP) systems are software packages that can be used for the core systems necessary to support enterprise systems. Think of the relationship between enterprise systems and ERP this way: an organization's enterprise system might comprise customer relationship management software from one vendor, warehouse and shipping software that was developed internally by the company's IT personnel, and an ERP system from a second vendor. Any combinations like this are possible. ENTERPRISE SYSTEMS

The point is that a company might adopt all modules offered by an ERP vendor. In that particular case, the ERP system and the enterprise system are, for all practical matters, one and the same. For example, the Walt Disney Corporation is engaged in a four-year, £240 million project to implement SAP® worldwide to replace ERP systems

TABLE 2.1 Selected[a] ERP Vendors

Company Name	Revenue Forecast, 2005 ($M))[b]	Revenue Share Forecast, 2005[b]	Number of Customers	Market[c]
SAP®	10,403	43%	32,000[d]	Large
Oracle®	4,534	19%	21,000[e]	Large
Sage Group	1,375	6%	4,700,000[d]	SME
Microsoft Dynamics™	891	4%	127,000[f]	SME, Small
SSA Global Technologies®[g]	700	3%	13,000[d]	SME, Small
Extensity[h]	445	2%	12,500[d]	Large, SME
Intentia[i]	407	2%	3,000[d]	Large, SME
Infor Global Solutions	395	2%	17,500[d]	Large, SME
Lawson Software[i]	358	2%	2,200[d]	Large, SME

Notes:
[a] Table contains top-nine companies and selected companies in the 1 percent market-share category.
[b] Kevin Reilly, "AMR Research Releases ERP Market Report Showing Overall Market Growth of 14% in 2004," *AMR Research* (July 14, 2005).
[c] Large: Sells mostly to large enterprises (>$1b revenue). SME: Sells mostly to small and medium-sized enterprises ($30 m - $1b revenues). Small: Sells mostly to enterprises with <$30m in revenues.
[d] Company Web sites as of March 14, 2006.
[e] Includes PeopleSoft, Inc. and J.D. Edwards & Company. Numbers for PeopleSoft and J.D. Edwards from http://www.asaresearch.com/articles/customers.htm, accessed March 21, 2006. Number of customers for Oracle Financials from "Information on Demand," at http://www.oracle.co.jp/industries/financial_services/pdf/050319_fn_brief_REV.pdf, accessed on March 21, 2006.
[f] Microsoft Dynamics (formerly Microsoft Business Solutions includes Dynamics products: XP (Axapta), GP (Great Plains), NAV (Navision), and SL (Solomon). Number of customers for each from http://www.asaresearch.com/articles/customers.htm, accessed March 21, 2006.
[g] Includes Baan.
[h] Formerly GEAC.
[i] In June 2005, Lawson announced that it was acquiring Intentia.

from multiple vendors.[4] Or, the ERP system might be one of many software solutions that comprise the enterprise system. You might find it helpful to think about enterprise systems as the general phenomenon and ERP systems as a specific instance of the phenomenon. A number of ERP systems are commercially available. The dominant player is SAP® whose ERP product commands the largest percentage of the Fortune 500 market. Table 2.1 lists some of the other ERP vendors, their market share, and number and type of customers.

ERP products are designed to offer integration of virtually all of an organization's major business functions. Figure 2.1 depicts this integration in the mySAP™ Business Suite. The square in the center depicts the core of the suite, including Financials (e.g., financial and managerial accounting, treasury and risk management), HR, Corporate Services (e.g., real estate management, project and portfolio management), and Operations (e.g., procurement and logistics, product development and manufacturing). Above and around this core, you see four modules—SRM, PLM, SCM, and CRM—that an organization might adopt to extend the core system's functionality. The SAP NetWeaver® portion of the figure is explained in Technology Summary 2.3 later in this chapter.

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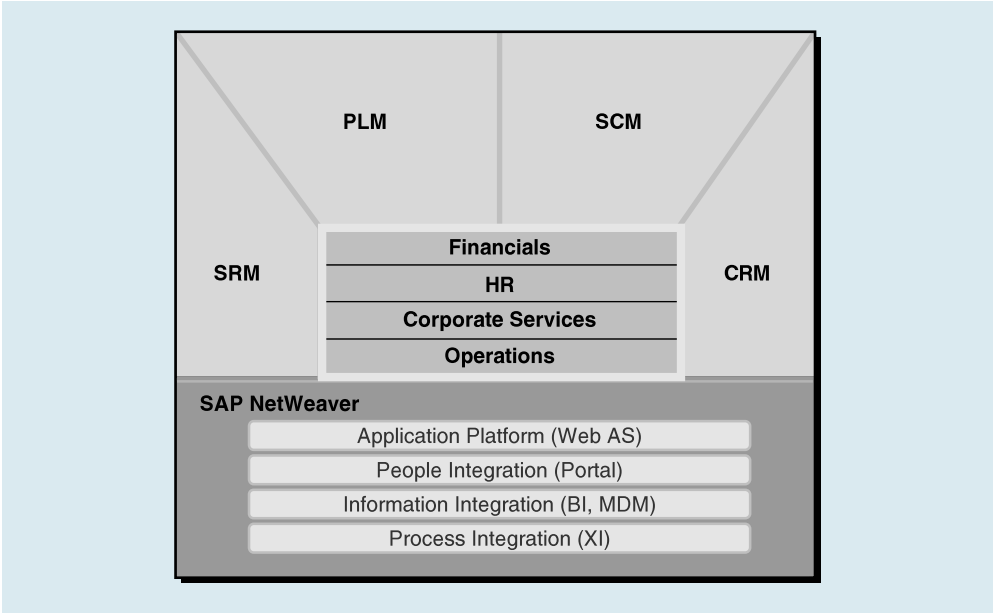
The SRM, PLM, SCM, and CRM modules that you see in Figure 2.1 are examples of modules that complement the core elements of an ERP system to provide the full range of functionality required of an enterprise system by an organization. Some of these modules, such as Web interfaces for customers and business partners, may be

4 Mike Simons, "Disney Keeps Global SAP Roll-out on Track by Making Local Executives Responsible," *ComputerWeekly.com* (July 1, 2003).

FIGURE 2.1 mySAP™ Business Suite



Source: Copyright by SAP AG. Reprinted with permission from SAP®.

required to engage in e-business. You might choose to acquire the modules provided by the ERP vendor, such as those shown in Figure 2.1, or you might choose to acquire them from a third party. The most common add-on modules include the following:

- **Customer relationship management (CRM) software**, such as that from Siebel Systems (now part of Oracle) and Salesforce.com, builds and maintains an organization's customer-related database. This data is collected from multiple customer interactions, such as the Web, call centers, field sales, service calls, and dealer and partner networks. The data is aggregated, managed, and coordinated across the entire organization (e.g., channels, departments, lines of business, worldwide) to support identification, acquisition, and retention of customers and to maximize the benefits of those relationships. CRM can help make it easy for a customer to do business with an organization and to make customers feel that they are dealing with one unified organization. You have experienced the functionality of a CRM system if you have set up an account with Amazon.com or other Web vendors. These vendors keep track of such things as your name, address, and purchases. In this way, they can personalize your shopping experience and increase their business by making the experience pleasant and more efficient for you and by offering to sell you products that are consistent with your buying habits.
- **Customer self-service (CSS) software**, often an extension of *CRM* software, allows an organization's customers to complete an inquiry, perform a task (including sales), or troubleshoot problems without the aid of an organization's employees. These solutions integrate with *ERP* systems to allow customers to check the status of their orders, review inventory availability, and even check production plans. Vendors such as Broad Daylight offer self-service solutions as well as agent-assisted solutions to assist call center employees in much the same way that self-service solutions assist customers directly. Again, you have experienced such software when making purchases on the Internet.

- **Sales force automation (SFA) software**, such as that from Salesforce.com, automates sales tasks such as order processing, contact management, inventory monitoring, order tracking, and employee performance evaluation. Even though SFA automates sales tasks, which *CRM* does not, the two terms are often used interchangeably.
- **Supply chain management (SCM) software**, such as that from Manugistics, Inc. and i2 Technologies, Inc., helps plan and execute the steps in an organization's supply chain, including demand planning; acquiring inventory; and manufacturing, distributing, and selling the product. You may recall that Nestlé implemented Manugistics supply chain software.
- **Product lifecycle management (PLM) software** manages product data during a product's life, beginning with the design of the product, continuing through manufacture, and culminating in the disposal of the product at the end of its life. PLM software integrates data across many units of an organization, such as engineering, logistics, and marketing, and data from partner organizations, such as vendors, contract manufacturers, and distributors. For example, Staples, Inc.'s internal designers, buyers, and financial experts use PLM software to collaborate with business partners, including designers, manufacturers, and quality-test houses, around the world to design and develop Staples-branded products.[5] PLM software is offered by vendors of engineering software, ERP vendors, and specialized providers such as Arena Solutions and Agile Software.
- **Supplier relationship management (SRM) software** manages the interactions with the organizations that supply the goods and services to an enterprise just as *CRM* software streamlines the processes between the enterprise and its customers. SRM functionality includes procurement and contract management. The goal of SRM is to reduce product costs and production costs and to enhance product quality.
- Other third-party modules extract data from ERP systems and from legacy systems that may still exist within an organization (or subsidiary of the organization). For instance, Hyperion Software focuses on financial and accounting applications but is very effective at executing consolidations of financial information for multinationals.

E-BUSINESS

SAP® and other similar products reflect large, monolithic ERP systems made up of a number of modules that can be selected for implementation. However, the ERP system modules may not be the best software for every organization. Third-party add-ons are selected by organizations to obtain world-class, or "best-of-breed" functionality for CRM, CSS, SFA, or other software solutions. However, this best-of-breed approach may sacrifice the tight integration offered by ERP systems because the third-party modules must be connected together and to the ERP system. Errors may occur during the translation and transmission between modules. The organization may also experience higher total licensing, implementation, and maintenance costs than with a stand-alone ERP system. However, these problems are being solved by a number of integration approaches and products as described next.

Third-party modules are connected to the ERP system using **middleware**, a software product that connects two or more separate applications or software modules. Middleware might be used to stitch together a number of legacy systems, an ERP system, best-of-breed applications, and Web-based applications. This middleware might be an **Application Programming Interface (API)**, a means for connecting to a system or application provided by the developer of that application. For example, the Process Integration portion of SAP NetWeaver® (refer to Figure 2.1) would provide an API for connecting SAP® to a piece of legacy software or to a third-party module such

5 L. Sullivan, "Retailers Ply Their Own Brands," *InformationWeek* (April 18, 2005): 61–62, 66–67.

Technology Summary 2.1

ENTERPRISE APPLICATION INTEGRATION (EAI)

Enterprise application integration (EAI) combines processes, software, standards, and hardware to link together two or more systems and allow them to operate as one. Originally developed to link together systems within an organization, EAI is now used to connect the enterprise systems of different organizations. EAI systems are characterized by integration of business processes, applications, databases, data standards (e.g., EDI, XML), and platforms (e.g., NT, UNIX). Examples of EAI integration include the following:

- ERP and CRM systems
- ERP and legacy systems
- Legacy or ERP systems with a data warehouse
- Applications from different vendors such as a manufacturing package with a general ledger package
- Enterprise systems in two or more organizations such as with supply chain collaborations between buyers and suppliers of goods and services

Companies offering EAI services and products include IBM, Microsoft, BEA Systems, webMethods, and Vitria Technology.

Sources: "EAI Overview," http://eai.ittoolbox.com/pub/eai_overview.htm, March 21, 2006.

as CRM. As another example, Microsoft Dynamics Snap line of tools, called Snap-Ins, connect Dynamics ERP software (e.g., Dynamics GP, Dynamics SL, and Dynamics AX) to the Office productivity suite.

Technology Summary 2.1 describes enterprise application integration (EAI), an approach to connecting together multiple pieces of an enterprise system. Technology Application 2.1 describes a few EAI examples. Notice that EAI is also an approach to connecting the enterprise systems of different organizations, such as would be needed for B2B integrations.

Technology Summary 2.2 (pg. 39) describes event-driven architecture, which is an alternative approach to integration whereby loosely coupled applications react intelligently to changes in conditions and launch several responses rather than waiting to be called into action. Communications-broker software called **Enterprise Services Bus (ESB)** uses standardized protocols to let event-driven applications communicate in a less-expensive manner than can the tightly coupled, synchronous EAI platforms. ESBs may be the means by which *Web services*, another method used for systems integration, will be implemented. The Web services approach is described in Chapter 3.

Technology Summary 2.3 (pg. 40) describes NetWeaver®, a Web services platform from SAP® (refer to Figure 2.1) used to build applications that integrate business processes and databases from a number of sources within and between organizations.

Technology Summary 2.4 (pg. 41) describes business process management (BPM), a concept much larger than systems integration, which provides a comprehensive method for integrating manual and automated internal processes, applications, and systems, as well as integration to external partners and services.

Originally, the implementation of ERP systems was targeted to large multinational manufacturers such as General Motors, Goodyear, and General Mills. Such early adoptions made sense, as companies like these expected to see the greatest benefits from ERP systems; that is, large multilocation and multidivision companies often present the greatest challenges to managers who want to coordinate worldwide activities and mine data from corporate databases to improve overall organizational decision making. Plus, ERP systems arose from early manufacturing requirement planning (MRP) applications, which were specifically designed for manufacturing companies; hence, it is no surprise that the early adopters were in the business of making products.

TECHNOLOGY APPLICATION 2.1

EXAMPLES OF ENTERPRISE APPLICATION INTEGRATION (EAI)

Case 1

As a result of several acquisitions, WellPoint Health Networks is the largest publicly traded commercial health benefit company in the United States. Acquisitions have included Anthem® Blue Cross® Blue Shield® providers in Georgia, Missouri, and Wisconsin, and several HMOs. WellPoint has used an EAI layer from IBM® to join several legacy claims-processing applications. This has reduced operating costs and enabled the company to integrate acquisitions quickly.

Case 2

7-Eleven®, Inc. has implemented a Web-based portal for exchanging orders and other business documents with smaller suppliers. webMethods' Integration Platform is used to exchange these business documents from the Web portal directly to the 7-Eleven legacy mainframe applications. Thousands of invoices are exchanged electronically with suppliers and automatically incorporated into 7-Eleven's financial applications. 7-Eleven reports reduced manual keying and associated errors, improved turnaround times, and visibility into the supply chain.

Case 3

Sappi Fine Paper North America (N. A.) has used an EAI tool from Sterling Commerce to integrate internal software and support electronic communication with customers; the tool has improved customer service and forged stronger relationships with customers. The Sterling tool, the Gentran Integration Suite (GIS), integrated customer orders with back-end order management, warehouse, and logistics applications to allow Sappi to move its 2:00 p.m. daily cutoff for next day delivery to 5:00 p.m. The GIS tool also allows Sappi customers to submit their orders through the EDI (see Chapter 3) methods that they had used or via the Internet using a variety of protocols. Finally, the GIS tool also supported interface capabilities to a variety of legacy applications to facilitate a phased integration of SAP® at multiple worldwide sites. GIS integrated pieces of the new (SAP®) with the old (legacy systems) as the SAP® implementation took place.

Sources: Lisa Valentine, "Mission: Integration," *Insurance & Technology* (November 2005, Vol. 30, Iss. 11): 52–53; "webMethods Integration: Thank Heaven for Web Integration 7-Eleven," May 13, 2004, accessed at http://www1.webmethods.com/PDF/7_11_ss.pdf on March 21, 2006; Monica Shaw, "Solution on Next-Day Service at Sappi," *Pulp & Paper* (November 2005, Vol. 79, Iss. 11): 28–30.

ERP systems have seen many improvements over time. Most ERP system vendors now offer solutions for a wide variety of industries, such as retail, banking, financial, entertainment, construction, and so on. ERP systems allow companies to standardize systems across multiple locations and multiple divisions to link business processes and data in a consistent fashion and provide organization-wide data accessibility. This is what we saw with the Disney example cited previously. Another reason that Disney was able to implement one ERP package worldwide is the ability of a single package to provide the needed capacity—to scale sufficiently—for the scope of Disney's operations.[6]

Not only were early adopters primarily involved with manufacturing, but also they were very large enterprises, primarily because implementation costs were so enormous that smaller companies simply could not withstand the economic burden. These systems typically took a year or more to implement at a cost of up to hundreds of millions of dollars, which necessitated a similarly significant return in benefits. As advances in the technology underlying these systems have evolved, small- and medium-sized enterprises (SMEs) have driven the new implementation base. You can see in Table 2.1 (pg. 34) that there are some major players in the market for ERP

6 Mike Simons, "Disney Keeps Global SAP Roll-out on Track by Making Local Executives Responsible," *ComputerWeekly.com* (July 1, 2003).

Technology Summary 2.2

EVENT-DRIVEN ARCHITECTURE (EDA)

Event-driven architecture (EDA) is an approach to designing and building enterprise systems in which business events[a] trigger messages to be sent by middleware between independent software modules that are completely unaware of each other. This differs from the traditional, internally driven, enterprise architectures. Event-driven processes operate in the following manner:

1. Each business event is handled individually as it appears, rather than waiting for a batch of events to accumulate. Business events are then processed in a timely manner.
2. The business unit that experiences a business event "pushes" the event to the recipient rather than waiting for the recipient to request, or "pull," the event. Recipients learn immediately about relevant business events.
3. Business events are pushed immediately and simultaneously to all interested parties. For example, when a vendor sends a notice that a shipment will be delayed, interested parties such as purchasing, receiving, manufacturing, sales, and the customer are notified.
4. The meaning and attributes of each business event are documented—as a process is developed—and is shared across multiple processes within the system.
5. Event notifications are managed in a systematic way to ensure that event data is sent to the correct recipient at the right time and that there is appropriate follow-up.

These technical-level design aspects of an EDA generate two business-level opportunities that enable the enterprise to operate in real-time and to choose the best available modules for the enterprise system—the best-of-breed approach to software selection. A "real-time enterprise" driven by an EDA experiences reduce delays and business processing overhead resulting in more responsive and flexible business units. For example, senders and receivers can operate asynchronously, and the sender is not tied up waiting for the receiver to respond or to process the event. And, not being restricted to software modules provided by the ERP vendor or those that can be connected to existing ERP and legacy systems, the organization can put together an enterprise system that is more closely tailored to the needs of each business unit and business process. These modules need not know about the existence or location of any other modules. When a business event occurs, they send an event notification to the middleware (also known as a "publish" or "send") and the middleware notifies those modules that have asked to receive this type of event (also known as "subscribe").

Note:
[a] A **business event** is a meaningful change in the state of the enterprise such as creating a new employee record, submitting a purchase order to a vendor, receiving a payment from a customer, picking goods from the warehouse and delivering them to the shipping department, and revaluing inventory.

Sources: Carol Sliwa, "Event-Driven Architecture Poised for Wide Adoption," *Computerworld* (May 12, 2003): 8; Roy Schulte, "A Real-Time Enterprise Is Event-Driven," Gartner, Inc. Research Note T-18-2037, September 26, 2002.

systems for SMEs. For instance, Microsoft's acquisition of Great Plains and Navision and formation of the Dynamics line of products speaks to the importance of this market segment.

Enterprise Systems Value Chain

ENTERPRISE SYSTEMS

To examine the role that enterprise systems play in the success of an organization, you can look at the activities performed by the organization as a **value chain**, a chain of activities performed by the organization to transform inputs into outputs valued by the customer. An organization creates a competitive advantage by creating more value for its customers than does its competition. Value is created by performing the activities at lower costs and by enhancing differentiation of its products or services.[7] Differentiation

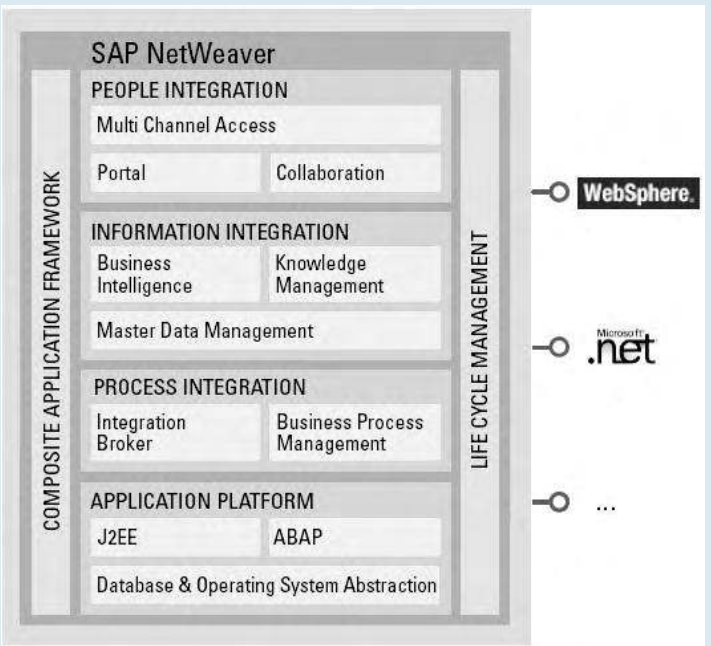
7 M. E. Porter and V. E. Millar, "How Information Gives You Competitive Advantage," *Harvard Business Review* (July-August 1985): 149–160.

Technology Summary 2.3

SAP NetWeaver®

SAP NetWeaver® is a platform or collection of capabilities constructed from a number of SAP® products that work with each other to make applications work together. The following figure depicts the core capabilities of NetWeaver®: the integration of people, information, and processes.

We'll describe here a few of the NetWeaver® integration components that are related to the discussion of systems and applications integration. The Enterprise Portal (Portal, Collaboration, and Knowledge Management) gives users access on a single screen/consistent user interface to software and data that they need for their job using links to, for example, SAP®, e-mail, calendar, an intranet, and the Internet. Business Intelligence integrates information from various sources and processes inside and outside the organization. Master Data Management provides consistency of data (e.g., formats) within and across applications and systems. The Exchange Infrastructure (Integration Broker and Business Process Management) allows different applications within and between organizations (i.e., B2B) to communicate by, for example, sending, receiving, and translating messages. The Business Process management component allows systems to monitor a complex series of events and react to them automatically.



Sources: Ellen Monk and Bret Wagner, *Concepts in Enterprise Resource Planning*, 2nd edition, Thomson Course Technology, 2006; Dan Woods and Jeffrey Word, *SAP NetWeaver® for Dummies*, John Wiley and Sons, Inc., 2004. Figure reprinted with permission from John Wiley and Sons, Inc.

is created through production of superior quality with innovative products and services, by responsiveness to customer requirements for such features as product design and customization, and through quality of service during and after the completion of a sale.

You may be familiar with Dell™, Inc. (http://www.dell.com), the online seller of computers, printers, TVs, MP3 players, and related goods and services. The company has a reputation as an extremely efficient manufacturer and distributor. Dell's value

Technology Summary 2.4

BUSINESS PROCESS MANAGEMENT (BPM)

Business process management (BPM), a term often used interchangeably with **business process management systems**[a], includes modeling, automating, managing, and optimizing *business processes*. BPM usually includes the following:

- A design environment for modeling and documenting business processes. This is often integrated with the process engine to support iterative design and implementation efforts for maximum process agility.
- Conversion, wherever possible, of manual processes to electronic processes.
- A BPM engine to execute processes, including calls for manual execution of tasks (i.e., workflow), automated tasks, and calls to other applications (e.g., an ERP, legacy applications), to services (e.g., *Web services*), or to external partners (i.e., *E-Business*).
- Flexible interfaces for developers, users, and linking to other applications.
- The BPM engine that is separated from data and business rules on which the engine operates thus facilitating changes to facts, rules, and process flows.
- An audit trail of all process activity to provide visibility about the status of processes and to enable process improvement and optimization.

Note:
[a] BPM system vendors include PegaSystems, Lombardi, TIBCO, and Ultimus.

Sources: "A Closer Look at BPM," Ultimus, Inc., January 2005, as of March 25, 2006 available at http://www.bitpipe.com/detail/RES/1103736098_704.html; Setrag Khoshafian, "Web Services and Virtual Enterprises," © Tect, 2002, accessed on March 25, 2006 at http://www.webservicesarchitect.com/content/articles/WSAVEKHOSHAFIAN220502.pdf.

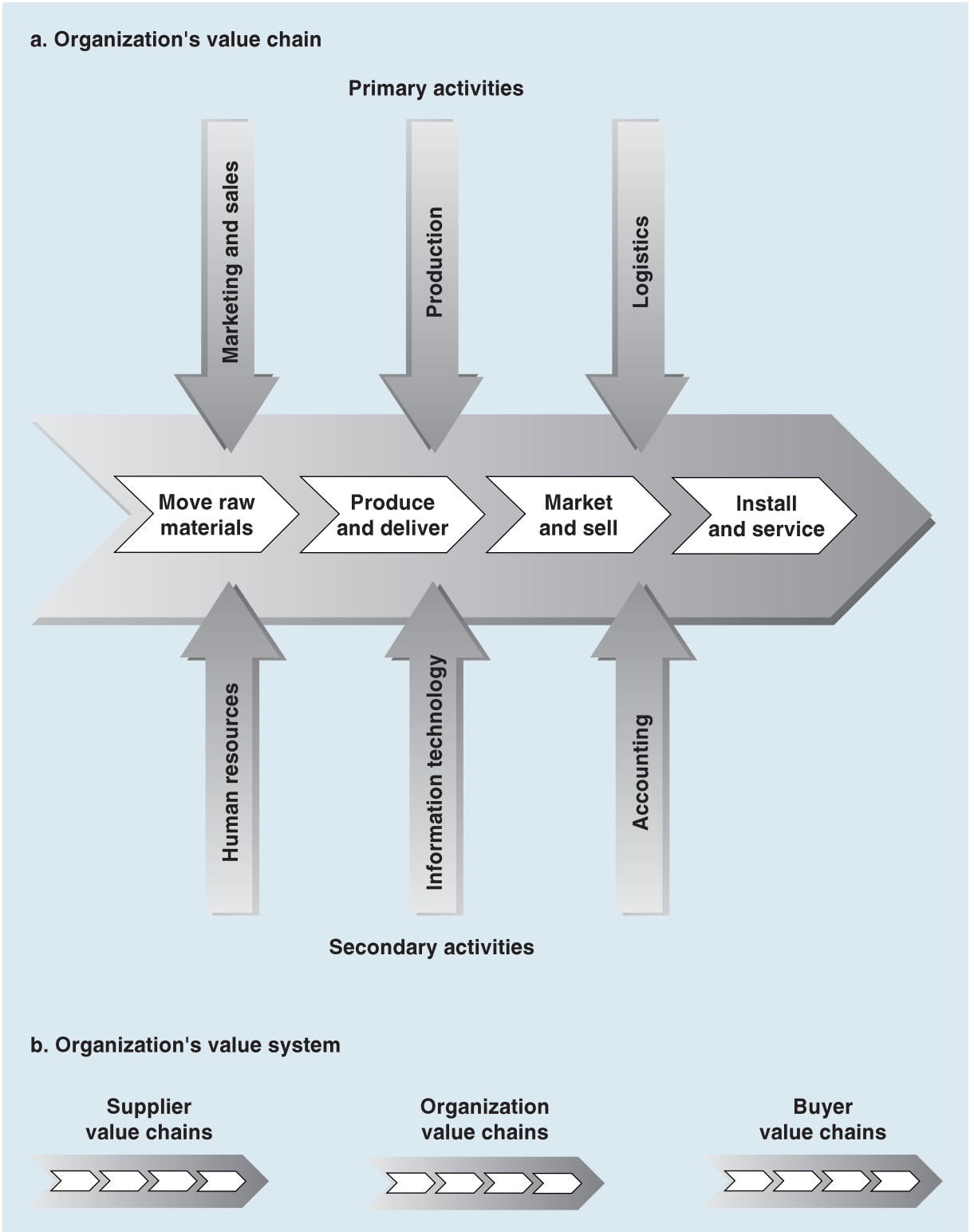
chain is, in fact, one of the best in the world. Dell takes raw materials, manufactures computers and other products, and delivers them to customers in a timely manner at an attractive price. The keys to Dell's success are its business processes (Dell holds 550 patents for them) and the application of IT to drive those processes and to integrate its suppliers, customers, manufacturing, shipping, and after-sales support (i.e., the value chain). In this section, we describe some ways that enterprise systems play a key role in creating the value customers seek.

Figure 2.2 (pg. 42) depicts a generic organization value chain and value system. The activities in the value chain, the value activities, are *business processes* that convert inputs to valued outputs. For example, the "move raw materials" activity converts cash into raw materials for the production activity. These activities may be divided into two categories: primary and support activities.[8] The primary activities are depicted in the figure and are those directly involved in marketing, selling, producing, and delivering the good or service to the customer, and include functions such as moving raw materials into and around the organization, producing and delivering goods to the customer, and performing services such as installation and after-sales support. The secondary activities provide the supporting infrastructure to enable the primary activities and include functions such as procurement, information technology (IT), human resources, and accounting. Note that we depict the value chain as overlaying the functional activities of an organization. To efficiently and effectively serve the customer, the value chain must traverse these traditionally independent activities, often referred to as "silos,"[9] and join

8 M.E. Porter and V. E. Millar, "How Information Gives You Competitive Advantage," *Harvard Business Review* (July-August 1985): 149–160.

9 The term *silo* is used to refer to organization functions—such as product development, marketing, and manufacturing—that stand alone, disconnected, and often unaware of activities taking place in the other functions.

FIGURE 2.2 Value Chain and Value System



these activities together into an end-to-end business process (often called *cross-functional integration*).

IT has been able to assist in creating additional value by reducing the cost or improving quality in the performance of these activities. For example, IT has been successfully applied to optimize the cost and quality of raw materials by providing information to help select the right material at the right cost from the right vendor. Also, IT has been applied to the production-scheduling process to balance the cost and timeliness of manufacturing. Notice that in both of these examples, IT assisted in creating value by lowering costs and differentiating the product. In the first case, quality differentiates the product in that we obtain the materials that allow us to manufacture a product that is consistent with our quality objectives. In the second case, the timeline of product availability was the differentiating factor.

In these two examples, IT assisted in value creation within individual activities. However, value activities are interdependent and need to be closely coordinated to be most effective in creating value for the customer. As described in the next section, enterprise systems are required to provide the necessary interactivity (and inter-business processes) communication and coordination. For example, to really optimize value to the customer (e.g., Dell), the activities related to marketing the product, receiving the customer order, scheduling the order into production, delivering and installing the product, and providing after-sales support must all be coordinated to ensure the delivery of the product at the cost and with the quality that the customer expects.

Finally, an organization's value chain is but one component in a value system that extends back (upstream) to the organization's suppliers—each with their own value chain and value system—and forward (downstream) to the customers—each with their own value chain and value system. Value optimization in the value system requires interorganizational information sharing and coordination in the supply chain, which is discussed in Chapter 10.

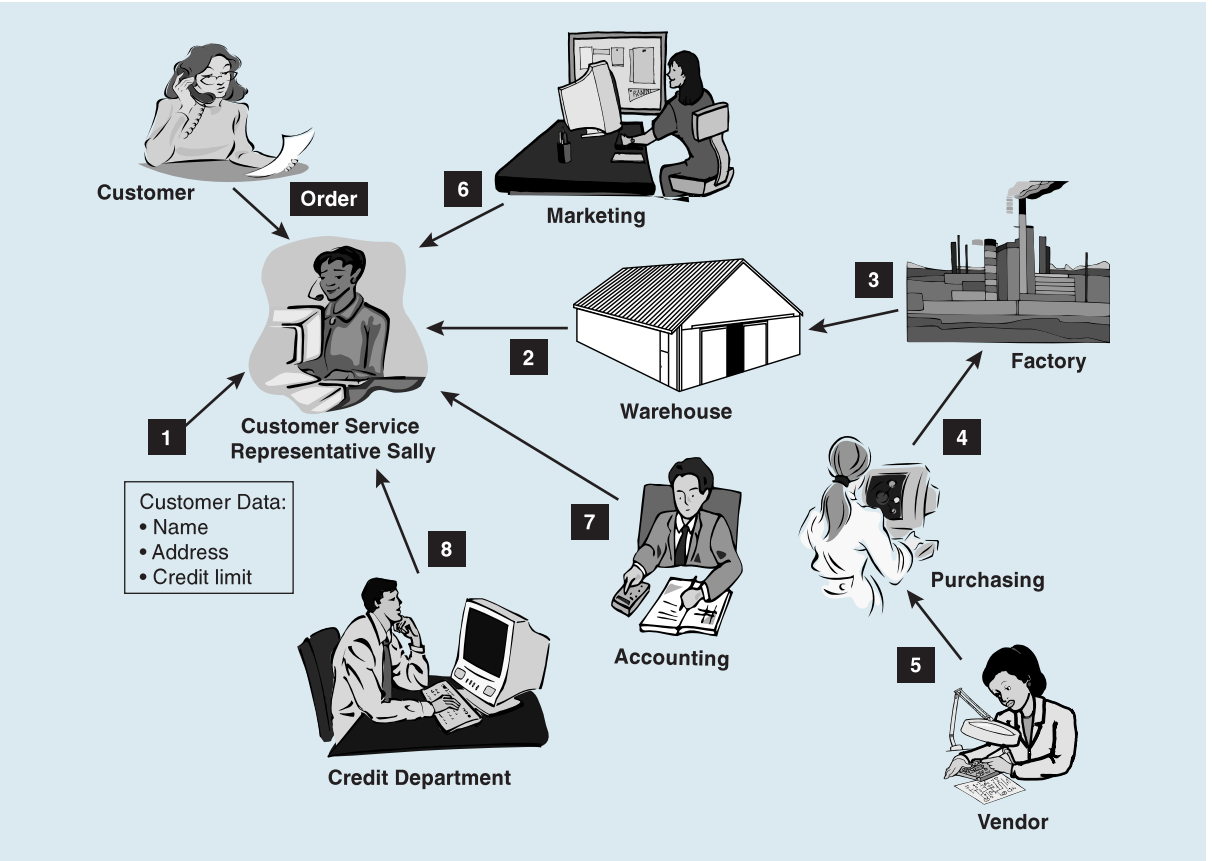
The Value of Systems Integration

As previously discussed, one of the values provided by an enterprise system is the coordination of value activities in the value chain. The system performs this coordination by sharing data across business processes. In this section, we describe what life would be like without integrated systems and then how enterprise systems solve some of those problems. Figure 2.3 (pg. 44) depicts the processing of a customer order in the Customer Service Department at Sudbury, Inc., a hypothetical company that manufactures and sells electronic subassemblies. As you can see in the figure, Sally the Sudbury customer service representative (CSR) needs to have access to information from a variety of sources to tell customers when and if they can expect to receive their order and how much that order will cost.

The Problem

Imagine first, that Sudbury's information processes are completely disaggregated and follow along as we describe the problems that it would cause for Sally. First (see flow 1), Sally needs to know if this is an existing customer in good standing (i.e., that the customer has good credit). Let's assume that Sally can key in the customer's name and obtain this data.

FIGURE 2.3 Sudbury Customer Service Process



Second (see flow 2), Sally needs to be able to tell the customer when she would receive the item. This date, known as "available to promise" (ATP), may be a function of several elements of data:

- If the item is on the shelf in one of Sudbury's warehouses and is not committed to another customer, the item would be available after it has been picked from the shelf, packed for shipment, and delivered to the customer. With no automated link to current inventory data, Sally would need to examine computer printouts of inventory balances or call the warehouses to ask someone to look on the shelf.
- If the item is not on the shelf (see flow 3), the item would be available when released from manufacturing, unless that quantity has been committed to another customer. Sally could review production schedules to determine when the item would be available and would add to that the time normally required to pick, pack, and ship the item to this customer. This would not, however, tell her if the item had already been allocated to another customer.
- In the event that the item must be scheduled for manufacturing, Sally would need to know when it could be scheduled and how long the manufacturing process would take. This would depend on the availability of the production line and personnel, as well as the required raw materials (see flow 4). This latter piece of information may require contacting the vendors that supply these materials to determine when they can promise delivery (see flow 5). This is the ATP from Sudbury's vendors.
- Let's assume that Sally has determined when the item will be available to ship to the customer. What price will be charged to this customer for this order? This price

may be found on a static price list that Sally keeps near the phone. However, prices may be dynamically determined by the marketing department (see flow 6), and this determination may be based on customer status, market conditions, quantity being purchased, and current manufacturing costs. This implies multiple flows to and from marketing that are not depicted in Figure 2.3.

- After pricing has been determined, Sally needs to know if the amount of the order falls within this customer's credit limit. Now, we assume that Sally has obtained the credit limit from the customer data that she has (flow 1); however, let's assume that the amount of money that the customer already owes Sudbury must be considered (see flow 7). Without direct access to the open accounts receivable data, Sally will need to call accounting to approve this order.
- Finally, let's assume that it is Sudbury policy not to turn down an order for insufficient credit without first checking with the credit department (see flow 8). Without an integrated system, this would require that Sally call the credit department.

CONTROLS

Do you think that Sally wants to keep the customer on the phone throughout this process? Not likely. Would you consider this to be good customer service? We hope not. What does Sudbury need to do?

The Solution

The solution, as we are sure you have surmised, is to integrate the disaggregated processes of Figure 2.3 into an enterprise system. Look again at Figure 2.3, and let's see how the process would change if the pieces of the customer service process were integrated:

- As before, input of the customer name or number would give Sally access to the customer data (flow 1).
- Upon entering the number of the requested item, the enterprise system would establish the ATP date by determining whether the item is available in any of Sudbury's worldwide warehouses (flow 2), is scheduled to be manufactured (flow 3), and if scheduled for manufacture, when it would be available (flows 4 and 5).
- After the source of the item is known, the system will automatically determine the price (flow 6) and the customer's credit worthiness (flows 7 and 8).

So, Sally does not need to keep the customer on the phone forever! With an integrated system, all of the previous steps would be determined in a matter of seconds. Should the item not be available in a time consistent with the customer's request, the system can provide data with which management can make decisions to allocate available items from other customers; plan increased production; streamline warehouse and factory logistics to reduce manufacturing, picking, packing, and shipping time; and other such decisions. This process, called "capable to promise (CTP)," and ATP will be discussed further in Chapter 12.

Additional Value

In addition to support for Sally and the Sudbury supply chain activities, the integration provided by an enterprise system provides additional value. For example, data stored in various systems must be manually shared, checked, or entered into multiple systems. Data entered multiple times may lack *consistency*, *completeness*, and *accuracy*. Multiple versions of data must, therefore, be reconciled, consuming valuable time. Inadequate integration of financial systems with logistics, fixed assets, and other systems can cause delayed and inaccurate financial reporting, analysis, and monitoring of operations. For example, integration of marketing, sales, and financial systems is required to obtain timely assessment of sales, margins obtained on sales, impact of marketing campaigns, and so on. The bottom line is that without integrated information systems, organizations have difficulty managing on a day-to-day basis and being successful in the long run.

Enterprise Systems Support for Organizational Processes

An information system supports the functioning of an organization in several ways. First, it facilitates the functioning of the organization's operations as business events occur by, for example, providing data as required to complete the event, applying business rules to ensure that the event is handled properly, and communicating the need for action to business units. Second, the information system retains records about business events that have occurred. Third, the information system stores data that is useful for decision making. In the sections that follow, we describe how the information system provides this support and how that support is more robust when an enterprise system provides the support. First, however, we provide an overview of capturing data during the execution of business processes.

Capturing Data During Business Processes

The data captured as business processes unfold should be sufficient for someone who was not a party to the business event to reconstruct every aspect of what happened—whether he or she is in accounting, marketing, human resources, financial management, manufacturing, or any other part of the organization. Typically, this mandates that data be collected and stored related to the four Ws:

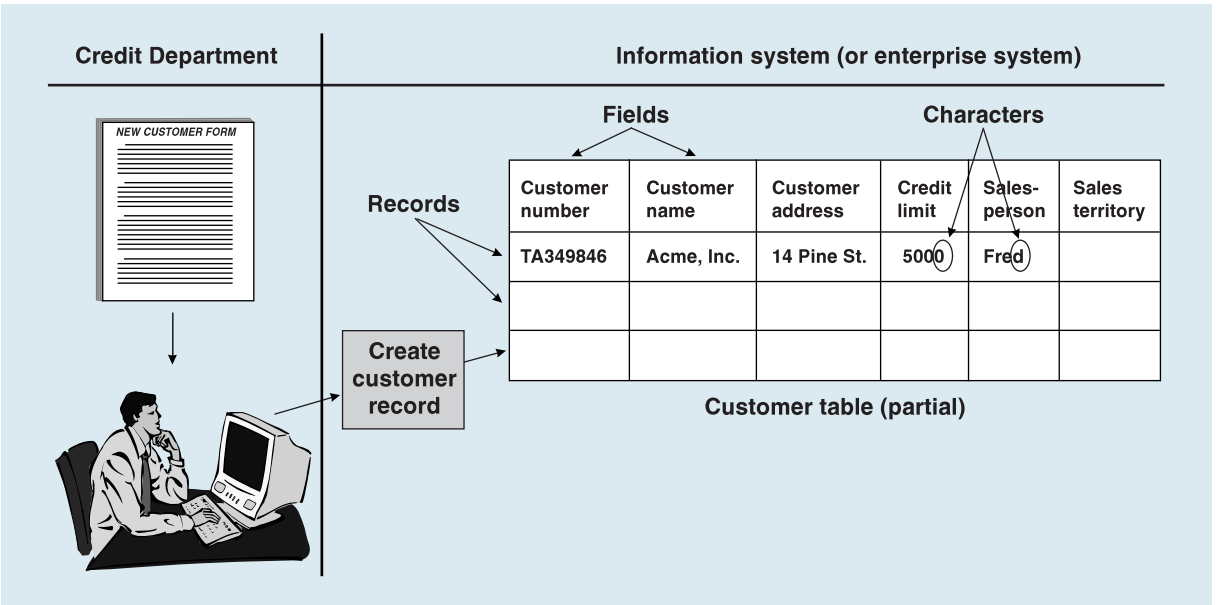
- The *who* relates to all individuals and/or organizations that are involved in the event (sometimes called *agents* to the event).
- The *what* relates to all resources that are exchanged as a result of the event.
- The *where* relates to the locations in which (1) the event takes place, (2) exchanged resources reside before and after the event, and (3) the agents are during the event.
- The *when* relates to the time periods involved in completion of the event, including future exchanges of resources (e.g., payment of cash for an account receivable) arising from the event.

After the details of the four Ws (i.e., the event data) are collected and recorded, the data can be aggregated and summarized in any manner that a given user chooses. Aggregations and summarizations are temporary and for the user's application only, but the event data remain available to other users in their original form. For routine applications such as the generation of accounting reports, programmed procedures can be developed to generate such reports automatically.

Enterprise Systems Facilitate Functioning of the Organization's Operations

In Chapter 1, we introduced you to two types of data: master data (entity-type data) and business event data (event-type data). Normally, a business event processing system operates with one or more data tables (often called "files"). Some of these tables are used to obtain reference information, such as the warehouse location of an item of merchandise. Other tables are used to organize and store the data that are being collected, such as sales order or inventory data. We hope that the hierarchy of data pictured in the table on the right side of Figure 2.4 is familiar to you from your computer programming or management information systems courses. Let's quickly review. A *character* is a basic unit of data such as a letter, number, or special character. A *field* (a single cell in a table) is a collection of related characters that comprise an attribute, such as a customer number or a customer name. A *record* (a row in a table) is a collection of related data

FIGURE 2.4 Data Maintenance: Create Customer Record



fields (attributes) pertaining to a particular entity (person, place, or thing, such as a customer record) or event (sale, hiring of a new employee, etc.). A *table* (or file) is a collection of related records (sometimes called entity/event instances), such as a customer table or a sales order table.

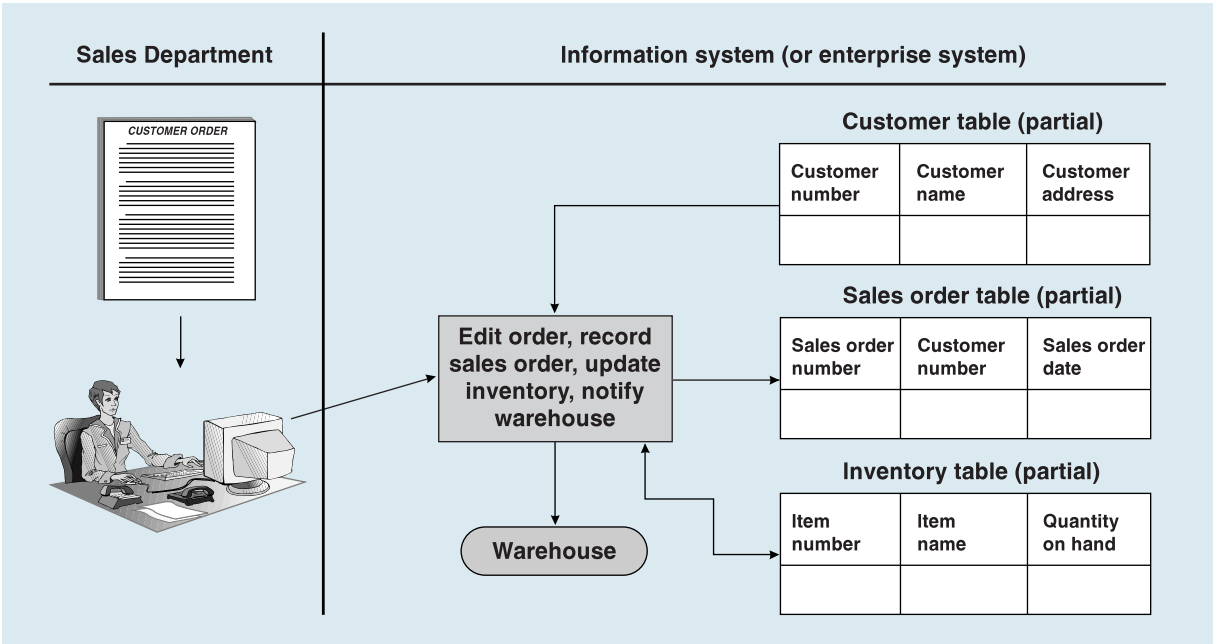
CONTROLS

Figure 2.4 depicts a typical data maintenance activity—the addition of a new customer record to the customer table—and provides an example of how an information system can facilitate the functioning of the organization's business processes. For example, the name and the address fields will be used to prepare monthly invoices. Figure 2.5 depicts how the existence of the customer record—including the credit limit—provides the basic authorization required to accept and record the customer's order. Without the customer record, the computer should reject the customer order and require that the credit department (or some entity *other than* the sales department) create the customer record before proceeding with entering the customer's order. Thus, it is important to separate authorizations for data-maintenance activities from authorizations for business event-processing activities. This separation between, for example, the credit department in Figure 2.4 and the sales department in Figure 2.5, provides an important control, *segregation of duties*, which is explored in greater detail in Chapters 8 and 9.

Figure 2.5 (pg. 48) depicts a typical business event-processing activity—entering a customer's order. Let's examine a series of events that might take place during the course of capturing a customer's order and delivering the goods to the customer. First, as noted previously, the customer table provides the credit and other customer data required to authorize the order. Next, data regarding the quantity and selling price of the inventory is obtained from the inventory table. Finally, an order to pick, pack, and ship the ordered goods (including the inventory location obtained from the inventory table) is sent to the warehouse.[10]

10 Notice the direction of the flows into and out of the tables. We obtain data *from* the customer and inventory tables and send data *to* the sales order (i.e., to record a new sales order) and inventory (i.e., to change the quantity on hand) tables.

FIGURE 2.5 Business Event Data Processing: Enter Customer Order



ENTERPRISE SYSTEMS

In enterprise systems, there should be only one version of each of the tables depicted in Figure 2.5, and that central database would be used by all functions in the organization, such as marketing, accounting, and logistics. For example, there will be only one record for each customer and one credit limit, worldwide. All of the inventory data worldwide would be available (often called "visible") during the processing of customer orders. The centralization of the data permits an organization to have accurate and reliable data and to operate its business processes in a consistent manner throughout the organization.

In addition, the communication across functions is enhanced in enterprise systems. For example, in Figure 2.5, data related to the inventory is readily available during entry of the customer order, and a request for shipment is sent directly to the warehouse. (We don't see any document here because the transmission to the warehouse is electronic.) Finally, although not shown in the diagram, the purchasing function could be informed immediately that merchandise has been sold and may need to be replenished. Thus, the enterprise system with a centralized database and communication among the organization business functions provides a higher level of support for the functioning of the business than is possible by less-integrated approaches to the information system.

Enterprise Systems Record That Business Events Have Occurred

As the business event progresses, the information system must capture the multifaceted data to track the progression of the process. To capture the sales event, we need to record data related to the customer and the salesperson (the who), the goods ordered (the what), the delivery location (the where), and the date of sale and promised

delivery (the when). This information is then linked with information already stored that relates to, for example, the supplier of goods that might not have been available. Based on the combined information, a purchase order might be sent to the supplier. For the purchase order, we record the supplier (the who), the goods (the what), the location to which the goods will be delivered (the where), and the delivery date from the supplier to our company (the when) and then link the purchase order to the order from our customer.

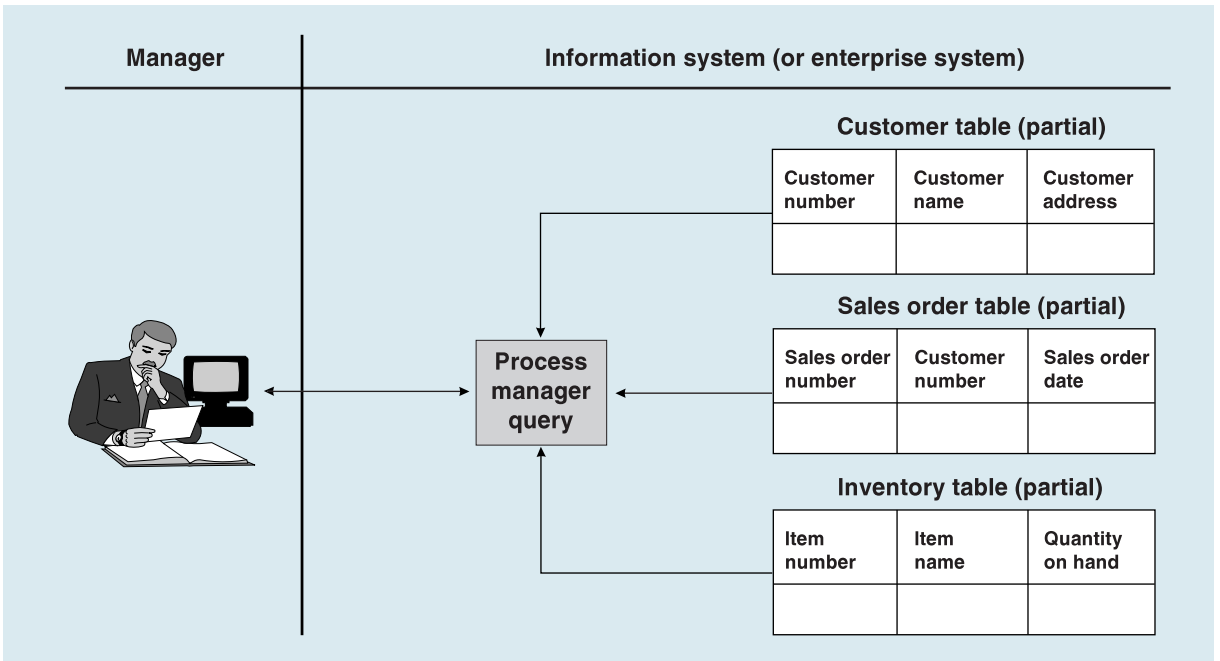
All of the data in our example that is required for the sales, billing, purchasing, and general ledger functions are captured and available in a typical information system; however, with an enterprise system, the data is linked together. Thus, if the delivery date is changed by the supplier, the salesperson has immediate access to the change and can notify the customer. To accomplish this, the salesperson pulls together the necessary data by utilizing links between the changed order information, the sales order, and the customer, and narrows the search to only the sales that he or she is handling. Very quickly, the salesperson has the information needed to notify the customer of any delay in shipment.

Notice how this discussion relates to the event-driven architecture in Technology Summary 2.2 (pg. 39). If there was an event-driven architecture, the notice from the supplier about a changed delivery date would cause the "pushing" of notices to the salesperson, the customer, and other interested parties.

Enterprise Systems Store Data for Decision Making

Figure 2.6 depicts a manager using the data collected and stored by the organization's information system. We show only those data tables that we had in Figure 2.5. Hundreds, indeed thousands, of tables of data are available in a typical information system.

FIGURE 2.6 Using Stored Data for Decision Making



Some simple examples follow of how our manager might use the data to make decisions. A warehouse manager might look at sales orders that have not yet been shipped to follow up and find out why. An inventory manager might look at the inventory data to follow up on those items with low balances on hand.

ENTERPRISE SYSTEMS

With an enterprise system, potential queries can be complex and yield results that are more significant. For example, a marketing manager might want to have a list of those customers who have not made a purchase in a month. To obtain this information, the manager would need to combine the customer and sales tables. Or, the credit manager might want to compare customer credit limits, sales, billing, and payment data to determine whether credit limits need to be adjusted for customers with high sales or late payments. Finally, a logistics manager might want to examine the time of day that orders are received and delays in shipping those orders to determine whether staffing in the warehouse needs to be scheduled at different times. All of these queries assume that data can be shared across multiple functional areas, which is a common situation with enterprise systems.

Major ERP Modules

To give you an appreciation for the typical core modules in an ERP system, we will describe five modules in the SAP® system: (1) sales and distribution, (2) materials management, (3) financial accounting, (4) controlling and profitability analysis, and (5) human resources. These modules are part of the mySAP™ Business Suite, shown in Figure 2.1 on pg. 35. Most ERP systems have similar modules with comparable functionality.

Sales and Distribution

The Sales and Distribution Module (SD) of the SAP® system contains the functions related to the sale of goods to customers and includes recording a customer order, shipping goods to the customer, and billing the customer. There are connections to the Materials Management module to check the availability of inventory and to record the issue of the goods, to the Financial Accounting module to post the sale, and to the Controlling module for profitability analysis related to the sale. The three major steps in the SD process (order entry, shipment, and billing) are briefly outlined here.

The SD order entry process might start with receiving and recording an inquiry from a customer and preparing and recording a sales quotation. Should the customer choose to place an order, the process continues with the receipt and entry of a customer order. Upon entering the order, the SAP® system would check the customer's credit, determine availability of the goods ordered, and record the customer's order (after the order is entered, it is called a *sales order*). If this is a new customer, the customer data would be added to the database using a data-maintenance activity similar to that shown earlier in Figure 2.4 (pg. 47) *before* the customer order could be entered.

The SD shipment process includes scheduling the shipment, picking the goods from the shelf, packing the goods for shipment, and recording the shipment. Organizations often choose to record each of these steps as they occur to keep a complete record of the sale as it progresses. After the shipment has been recorded, the inventory quantity-on-hand is reduced, and the sale is scheduled for billing.

The SD billing process creates invoices for all shipments. The billing process may be automatically triggered by each shipment or may be executed periodically by a billing clerk. In this latter case, multiple shipments to a customer might be consolidated and placed on a single invoice.

Materials Management

The Materials Management (MM) module of the SAP® system contains the functions related to the acquisition of goods from vendors and management of the goods while they are in stock. The module includes preparing and recording a purchase order, receiving the goods from the vendor, and recording the vendor's invoice. The MM module interacts with the SD module during the processing of customer orders, with the Financial Accounting module to post the receipt of the goods and the vendor invoice, and with the Controlling module for analysis of the costs associated with the purchases. The three major steps in the MM process (creating a purchase order, receiving the goods, and recording the vendor invoice) are briefly outlined here.

The MM purchase order process might start with the preparation of a purchase requisition by a person or function within the organization and sending a request for quotation (RFQ) to one or more vendors. After responses to the RFQ have been processed and a vendor selected, the purchase process continues with the creation and recording of a purchase order and communication of that purchase order to the vendor. Should this be a new vendor, the vendor data would be added to the database using a data-maintenance activity similar to that in Figure 2.4 (pg. 47) *before* the purchase order could be entered.

The MM goods receipt process includes comparing the received and ordered quantities, recording the receipt, and increasing the quantity-on-hand. When the vendor invoice is received and entered, the system performs a three-way match between the purchase order, the receipt, and the invoice. If these agree, the invoice is recorded.

Financial Accounting

The Financial Accounting (FI) module plays a central role in the SAP® system. Business events from other modules, such as SD and MM, are incorporated by the FI module into the general ledger accounts and included in the external statements, the balance sheet, profit and loss statement, and statement of cash flows. The FI module also includes accounts receivable and accounts payable functions to record and manage that data directly and to complete events begun in the SD and MM modules. Some specific examples follow.

After a customer is billed in the SD module, the accounts receivable portion of the FI module manages that receivable until paid (e.g., aging of open receivables, dunning for late payments) and records the customer payment. Also, in the absence of the SD module and for special circumstances, such as one-time sales of nonmerchandise items, invoices may be directly entered in the FI module.

After a vendor invoice has been entered in the MM module, the accounts payable portion of the FI module schedules the invoice for payment and executes that payment at the appropriate time.

Controlling and Profitability Analysis

The Controlling (CO) module of the SAP® system, often called Controlling and Profitability Analysis (CO/PA), handles internal accounting, including cost center accounting, profitability analysis for sales, activity-based accounting, and budgeting. For example, the CO module can produce internal profit and loss statements for portions of an organization's business.

Human Resources

The Human Resources (HR) module of SAP® includes functions related to the recruitment, management, and administration of personnel, payroll processing, and personnel training and travel. For example, when a new employee is hired, it is from

within the HR module that the human resources department would add the personnel data to the database using a data-maintenance activity similar to that in Figure 2.4 (pg. 47). The HR module is also used to maintain data related to benefits, training, and work shifts. Finally, the payroll function facilitates the processing of payroll for countries throughout the world and the preparation of payroll reports in accordance with the jurisdictions of those countries.

Enterprise Systems Support for Major Business Event Processes

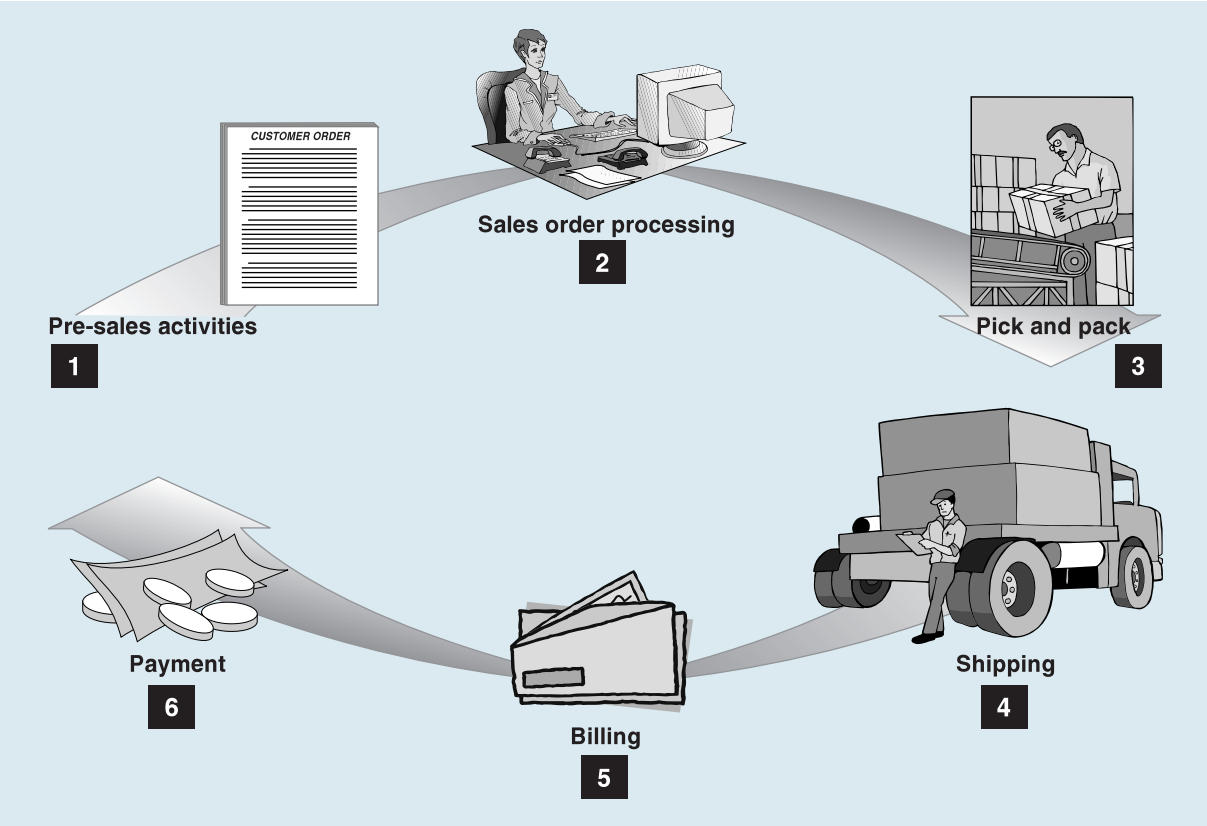
Most organizations group their major business events into two processes: the order-to-cash process and the purchase-to-pay process. For ease of presentation, this text divides these further into processes comprised of a few closely related events. For example, we describe the process employed to enter a customer's order and to ship the goods to the customer as the order entry/sales process, whereas the management of the accounts receivable, billing the customers, and recording customer payment are included in the accounts receivable/billing/cash receipts process. In the sections that follow, we describe the two major processes, order-to-cash and purchase-to-pay; describe how an enterprise system supports those business processes; and map those processes into the chapters where they are covered in this text. Our discussion is limited to the purchase of goods, not services, and to goods acquired for resale, not goods acquired as raw material inputs to a manufacturing process.

Order-to-Cash

Figure 2.7 depicts the **order-to-cash process**, which includes the events surrounding the sale of goods to a customer, the recognition of the revenue, and the collection of the customer payment. The order-to-cash process comprises all activities in the *order entry/sales process* (Chapter 10), the *billing/accounts receivable/cash receipts process* (Chapter 11), and the applicable parts of the *general ledger process* (Chapter 16). Follow along as we describe the numbered steps in Figure 2.7 and how an enterprise system supports the business activities in those steps. The order-to-cash process includes the following:

- Step 1, presales activities, includes responding to customer inquiries and requests for quotes (RFQs). Organizations may choose to collect and retain a rich assortment of customer-related data about prospective and active customers. This data is recorded in an ERP system and can be analyzed to determine the goods being requested by customers and the RFQs that do, and do not, result in customer orders. Some organizations purchase separate CRM packages to supplement the customer-related features in standard ERP systems.
- Step 2, sales order processing, includes capturing and recording customer orders. At this point in the process, an enterprise system would link together customer, inventory, purchasing, and vendor data to determine whether the customer is in good standing and likely to pay the bill (i.e., using customer credit and inventory pricing data) and where and when inventory will be available to send to the customer (i.e., ATP using worldwide inventory quantity-on-hand, on-order, and vendor data). At the conclusion of step 2, the enterprise system schedules the order for delivery and sends a picking request to the appropriate warehouse. If goods are not available within the organization, a purchase order would be sent to a vendor.
- Step 3, pick and pack, includes picking the goods from the shelf in the warehouse and packing the goods for shipment. Each of these events may be recorded in the

FIGURE 2.7 Order-to-Cash Process

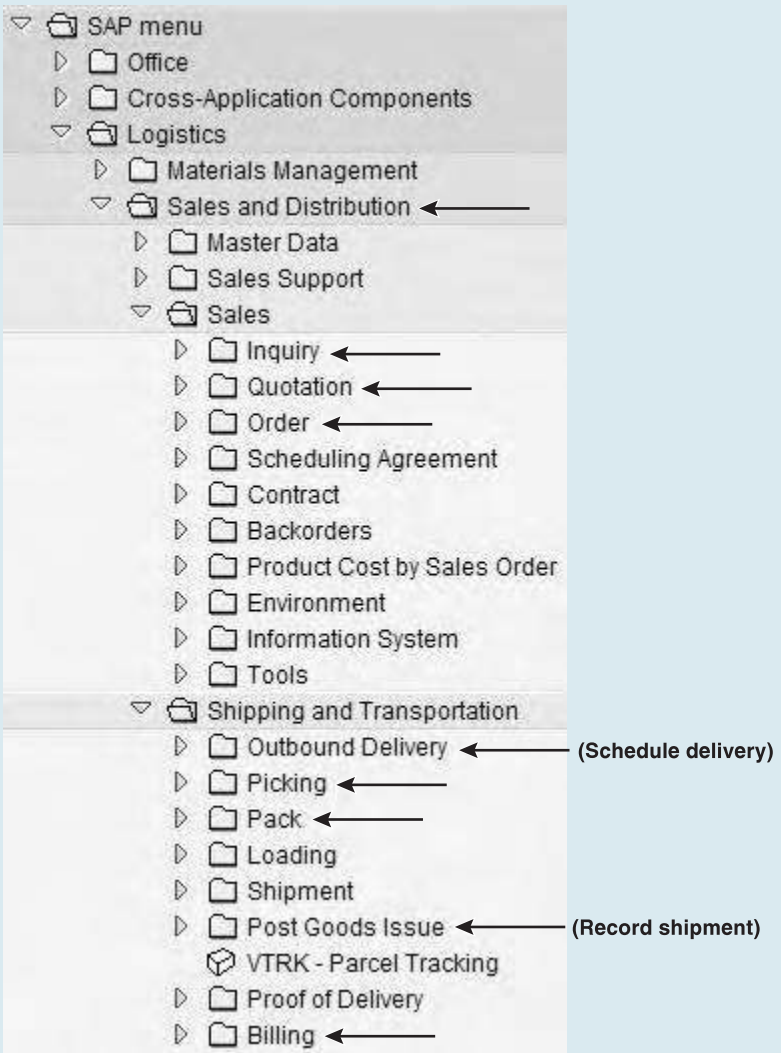


enterprise system to maintain a record of the progress and to retain control over the location of the goods.

- Step 4, shipping, include transferring the goods to the organization's transportation function, or to a third-party carrier, for shipment to the customer. The enterprise system would choose the appropriate routing and carrier, record the reduction in the inventory quantity-on-hand, calculate and record the cost of goods sold and inventory reduction in the general ledger, and record data to be used in the billing process. Some enterprise systems are configured to immediately trigger the billing process when a shipment takes place.
- Step 5, billing, includes preparing the customer invoice and recording sales and accounts receivable data in the general ledger. The enterprise system links together sales, customer, and inventory data to ensure that the invoice contains correct quantities, prices, terms, addresses, and so on. At this point, the enterprise system can be used to analyze sales profitability by comparing product costs to selling price.
- Step 6, payment, includes capturing and recording cash receipts and updating cash and accounts receivable amounts in the general ledger. Data in the enterprise system will be used to manage customer credit and invest available cash.

Figure 2.8 (pg. 54) depicts the SD menu from the SAP® system and points to the SD options described previously. Figure 2.9 (pg. 55) shows the audit trail that the system retains to document the completion of the steps in the sales process. The accounting document includes the entry to the general ledger associated with the invoice.

FIGURE 2.8 SD Menu Options in the SAP® System



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Purchase-to-Pay

Figure 2.10 depicts the **purchase-to-pay process**, which includes the events surrounding the purchase of goods from a vendor, the recognition of the cost of those goods, and the payment to the vendor. The purchase-to-pay process comprises all of the activities in the *purchasing process* (Chapter 12), the *accounts payable/cash disbursements process* (Chapter 13), and the applicable parts of the *general ledger process* (Chapter 16). Follow along as we describe the numbered steps in Figure 2.10 and how an enterprise system supports the business activities in those steps. The purchase-to-pay process includes the following:

- Step 1, requirements determination, includes preparing a purchase requisition to request the purchase of goods from a vendor. An enterprise system may automatically

FIGURE 2.9 SD Audit Trail for Completion of Steps in the SAP® Sales Process

Doc.	Date	Overall Processing Stat
Quotation 20000016	08/19/04	Completed
Standard Order 9792	08/19/04	Completed
. Delivery 80013262 (Schedule delivery)	08/19/04	Completed
.. WMS transfer order 865 (Picking ticket)	08/19/04	Completed
.. GD goods issue:delvy 4900031319 (Shipment)	08/19/04	complete
.. Invoice 90034394	08/19/04	Completed
... Accounting document 100000130	08/19/04	Cleared

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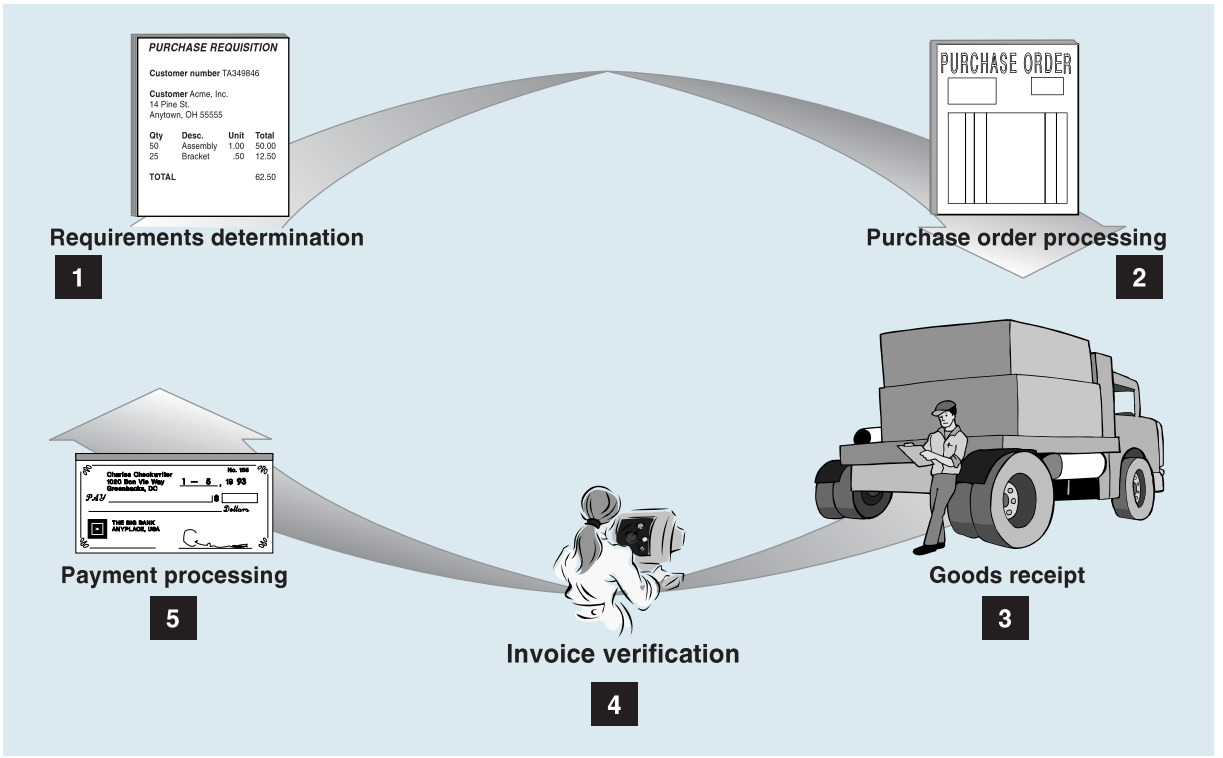
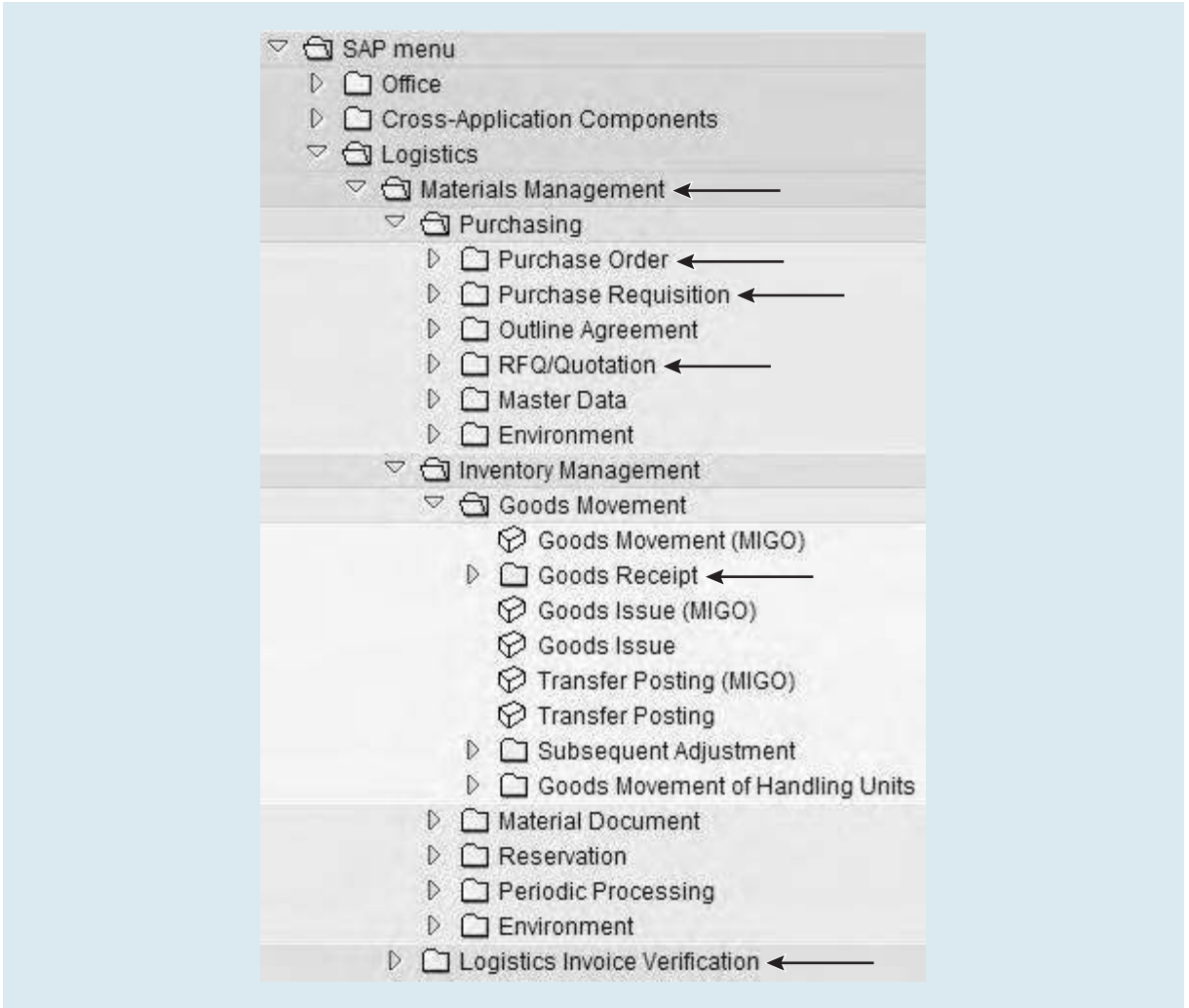
FIGURE 2.10 Purchase-to-Pay Process



generate the purchase requisition on the basis of data such as quantity-on-hand, quantity-on-order, and expected demand. Authorized individuals within the organization may enter ad-hoc requests. An enterprise system will review purchase requests to determine that they are authorized and within budget.

- Step 2, purchase order processing, includes preparing and recording purchase orders. An enterprise system assists the buyer in identifying sources of supply for the requested item, preparing RFQs to be sent to vendors, analyzing vendor quotations, and selecting vendors by comparing vendor prices, terms, and past performance (e.g., timely, accurate deliveries).
- Step 3, goods receipt, includes comparing the on-order quantity and the quantity received, increasing the quantity-on-hand, creating a record of the receipt, and

FIGURE 2.11 MM Menu Options in the SAP® System



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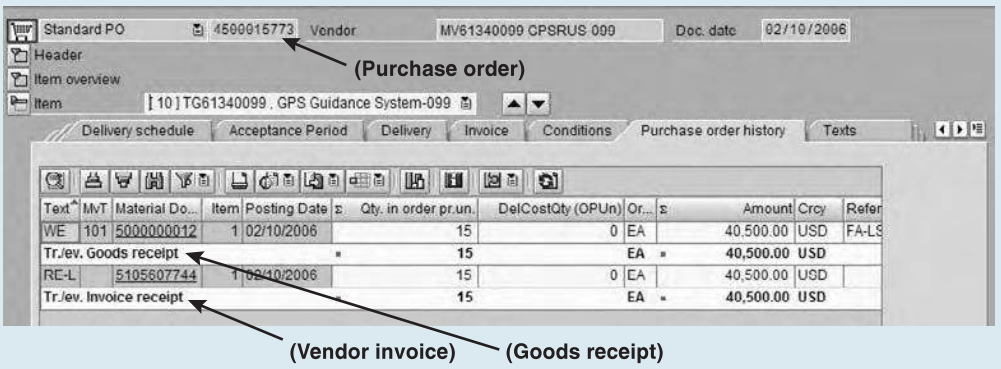
recording the cost of inventory in the general ledger. If the two-way match fails, the enterprise system notifies the proper personnel to ensure timely reconciliation of differences. The enterprise system also ensures timely availability of the goods by routing them to the function that requested them or directing that they be placed on the shelf in the warehouse and made available for immediate sale. Finally, the enterprise system records data related to the vendor's performance (e.g., delivery accuracy and timeliness) to be used in future purchasing decisions.

- Step 4, invoice verification, includes receiving vendor invoices; three-way matching of the purchase order, receipt, and vendor invoice; and recording accounts payable in the general ledger. An enterprise system links this data together to make the three-way match possible and provides the interface to the general ledger. If the three-way match fails, the enterprise system notifies the proper personnel to ensure timely reconciliation of differences.
- Step 5, payment processing, includes preparing and recording cash disbursements and updating cash and accounts payable amounts in the general ledger. An enterprise

FIGURE 2.12 Audit Trail for Completion of Steps in the SAP® Purchase Process



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system facilitates this process by using vendor and accounts payable data to schedule payments in accordance with vendor terms and to receive discounts, as appropriate.

Figure 2.11 depicts the MM menu from the SAP® system and points to the options described previously. Figure 2.12 shows the audit trail that the SAP® system retains to document the completion of the steps in the purchase process.

Summary

In Chapter 1, we introduced the qualities of information (see Figure 1.6 on pg. 19 and Exhibit 1.2 on pg. 20) that should be the goals of any information system. Enterprise systems achieve these goals in the following manner:

- *Enterprise systems* can collect a wide variety of data about *business events* and make that data available for use by all interested and authorized parties inside and outside the organization. The data should help all users (i.e., *relevance*, *understandability*) make decisions (i.e., *decision usefulness*) and analyze past events to make predictions about future events (i.e., *predictive/feedback value*).
- An enterprise system's central database retains one version of data elements, uses that data to verify the accuracy of new data elements entered into the database, and applies business rules to permit only authorized changes to the database. Combined, these improve the *reliability*, *validity*, and *accuracy* of the database.
- Organization-wide enforcement of data standards and business rules means that *business events* will be handled *consistently* across the organization, that all relevant data will be collected (i.e., *completeness*) and that the collected data will be *verifiable* and *neutral*.
- The integrated nature of the enterprise system makes all data available in a *timely* manner.
- The system facilitates the sharing of services for *efficiency* and *consistency*. For example, an organization can ship products to customers from multiple shipping points while billing its customers from one central location.

Table 2.2 summarizes some of the advantages and disadvantages of enterprise systems for an organization. Notice that some of the advantages and disadvantages relate to the ERP systems that are used to support the core systems of the enterprise system.

TABLE 2.2 Pros/Benefits and Cons/Disadvantages of Enterprise Systems

Pros of Enterprise Systems
• Single database • Integrated system (e.g., visibility to do ATP) • Process orientation (vs. function) • Standardization of business processes and data, easier to understand across the organization • Faster business processes (e.g., customer fulfillment, product development) • Timely information • Better financial management (partly due to integration) • One face to the customer • Reduced inventory • Improved cash management • Productivity improvements, reduced personnel • Full and accurate financial disclosures • Improved budgeting, forecasting, and decision support • Seamless integration and accessibility of information across the organization • Catalyst for reengineering old, inefficient business processes
Pros of ERP Packages
• One package across many functions (if one ERP) • "Best practices" • Modular structure (buy what you need) • No development needed • Configurable • Reduced errors (i.e., business rules, enter data once)
Cons of Enterprise Systems
• Centralized control vs. decentralized empowerment • Inability to support traditional business processes that may be best practices for that organization • Loss of flexibility in rapidly adapting to desired new business processes in the post-implementation period • Increased complexity of maintaining security, control, and access permissions for specific information embedded in central database • The rigidity of "standardization" can impede creative thinking related to ongoing business process improvements
Cons of ERP Packages
• Complex and inflexible • Implementation horror stories • Best practices are shared by all who buy • Difficult to configure • Long implementation • Best of breed might be better (than single ERP package) • Can't meet all needs (i.e., developed for many user types)

Key Terms

enterprise systems
enterprise-wide information systems
enterprise information systems
enterprise resource planning (ERP) systems
customer relationship management (CRM) software
customer self-service (CSS) software
sales force automation (SFA) software
supply chain management (SCM) software
product lifecycle management (PLM) software
supplier relationship management (SRM) software
middleware
application program interface (API)
enterprise application integration (EAI)
enterprise services bus (ESB)
event-driven architecture (EDA)
business process management (BPM)
business process management systems
business event
value chain
order-to-cash process
purchase-to-pay process

Review Questions

RQ 2-1 Describe the key features/characteristics of an enterprise system.

RQ 2-2 Describe the key features/characteristics of an enterprise resource planning (ERP) system.

RQ 2-3 Describe the add-on modules that may be used to complement the core functionality of an ERP system.

RQ 2-4 Describe the methods used to integrate ERP systems with third-party modules, back-end or legacy systems, the Web, and business partners.

RQ 2-5 What is a value chain?

RQ 2-6 What is the relationship of the organizational value chain and an enterprise system?

RQ 2-7 Describe the problems caused by lack of information systems integration.

RQ 2-8 Explain why it is important to capture the who, what, where, and when in describing business events.

RQ 2-9 Describe the three ways that an enterprise system supports the functioning of an organization's processes.

RQ 2-10 Describe the activities performed by the five modules of the SAP® system.

RQ 2-11 Describe the six steps in the order-to-cash process.

RQ 2-12 How does an enterprise system support the order-to-cash process?

RQ 2-13 Describe the six steps in the purchase-to-pay process.

RQ 2-14 How does an enterprise system support the purchase-to-pay process?

RQ 2-15 List the advantages and disadvantages of an enterprise system.

Discussion Questions

DQ 2-1 After the core of an ERP system has been implemented, any of the modules may then be implemented separately. What is the implication of being able to implement an ERP system on a piece-by-piece basis?

DQ 2-2 Dover Company is considering taking customers' orders on their Web site.

a. What information would Dover collect from the customer during this process?

b. What information would need to come from Dover's Web and back-end systems to complete the order?

c. How would an enterprise system facilitate this exchange of information?

DQ 2-3 Discuss the pros and cons of consolidation of the ERP software industry.

DQ 2-4 Refer to Figure 2.5 (pg. 48) and identify the key business event data (who, what, where, and when) you would want to capture.

DQ 2-5 Describe how an enterprise system can assist an organization in optimizing its value system.

DQ 2-6 Consider a business process that you have experienced at work, as a customer, or as a student. Examples might include any process in a work setting such as payroll and purchasing, or any process with which you have interacted, such as ordering from a Web site, obtaining a loan, eating at a restaurant, or registering for classes at your college or university. Describe the degree to which the steps in the process are integrated. What is/was the impact of that integration on you and on the organization?

DQ 2-7 Describe a situation in which information would be shared between two of the ''silos'' in Figure 2.2 (pg. 42). What data would be shared? Why would the data be shared? (*Hint:* You might refer to Figures 2.3 (pg. 44), 2.7 (pg. 53), or 2.10 (pg. 55).)

DQ 2-8 Why might a firm decide to implement only certain modules in an ERP system rather than a complete implementation?

Problems

P 2-1 Conduct research on the Web sites of either *CIO Magazine* or *CFO Magazine* for stories about ERP implementation successes and failures. Using specific examples, describe the reasons for the successes and failures. What conclusions can be reached?

P 2-2 Conduct research on an ERP package other than SAP® that would be suitable for a large organization (>$1b in revenue) and compare the modules that it has to those described within this chapter for the SAP® system.

P 2-3 Conduct research on an ERP package, such as Microsoft Dynamics GP (Great Plains) or Microsoft Dynamics NAV (Navision), intended for small- to medium-sized (SME) organizations (between $30m and $1b in revenue). Compare that package for available modules, functionality, and so on to the SAP® system.

P 2-4 Choose a familiar Web site, such as Dell, Amazon, and so on. Describe the order-to-cash process from the customer's perspective as illustrated by that site.

P 2-5 Imagine that you are conducting a field-based research project for your AIS class in a small local business. Assume that the business is a custom furniture manufacturer. In the course of your project, you tell the owner that you are using SAP® in your AIS class. The owner asks if he should be using SAP® or some other ERP system in his business. What would be your response? What questions would you ask or what information would you need to answer that question?