• I 1 H I H M

ENTERPRISE iNfORMATION SYSTEM

LEARNING OBJECTIVES

- **Describe the concepts, definitions, and issues in enterprise information systems.**
- **Determine how to extract information needs from executives and managers.**
- **Compare the features and capabilities of enterprise information systems and DSS/BI.**
- **See the relationships among enterprise information systems, data warehouses, online analytical processing, data mining, and other forms of business intelligence/DSS.**
- **Discuss the capabilities and characteristics of (Web-based) enterprise information portals.**
- **Describe supply chain management issues and how enterprise information systems handle them.**
- **Discuss customer relationship management concepts and issues.**
- **Describe how the Web impacts enterprise information systems, and vice versa.**
- **Describe how enterprise information systems have improved frontline decision-making by providing access to real-time data.**
- **Describe emerging enterprise information systems, including product life-cycle management, business process management, and business activity monitoring.**

Support systems optimize their effectiveness when they are easily accessible by all users. Web Portal technologies using the Internet, intranets, and extranets have emerged as efficient means to deliver a vast array of information to quickly and effectively support individual decision-makers making specific decisions (Chapters 3-6, and 9), and the processes of individuals collaborating from a distance, as well as group work (Chapters 7 and 9). In this chapter, we shift our attention to systems that deal with enterprise-wide support. First, attention is given to top executives, especially to their role in discovering problems, or trends that may create problems, and in identifying opportunities. The work of executives has been transformed by the vast amounts of information made readily accessible by computer technology. Second, attention is given to decisional situations involving decision-makers in different locations. Next we describe enterprise resource planning (ERP)/enterprise resource management (ERM) systems that integrate all the routine transaction processing in the organization and in the customer and supply chain management systems that integrate business processes throughout the organization. Then we turn to customer relationship (resource) management (CRM) systems that directly enhance the organization's customer service and

bottom line. We also discuss frontline systems that use real-time data capture and access to provide decision-making assistance at the tactical and operational levels. Finally, we introduce some emerging enterprise information systems. Many of these technologies have a data warehouse as their foundation, and utilize the Web for data access from servers and for communication and collaboration.

8.1 OPENING VIGNETTE: THE UNITED STATES MILITARY TURNS TO PORTALS[1]

The U.S. Army, Air Force, and Navy have each implemented Web-based portals as a method to enhance communications, improve quality-of-life issues, and rapidly share front-line combat intelligence, as was demonstrated in the recent war with Iraq. AKO *(Army Knowledge Online)* **was built using Art Technology Group Inc's. Dynamo software to serve a community estimated at 1.2 million users. This allows information to be pushed out to users based upon rank, division, location, and duties. The portal can be accessed through the Internet and the Army's proprietary SIPRnet (Secret IP Router Network) to enable logistics services, personnel and operations applications, e-mail, and instant messaging to be accessed from virtually anywhere in the world. It is comprehensive in scope, ranging from supporting combat readiness to handling issues such as informing noncommissioned officers about what they need to do to earn promotion, since the portal is linked to the Army's personnel files.**

[1]Adapted from Dennis Callaghan, "Armed Services Turn to Portals," *eWeek*, November 19,2001; Jade Boyd, "Navy to Add Web to Its Battle Plan," *InternetWeek*, No. 881, October 8,2001, p. 11.

The Navy's portal, part of a $6.9 billion intranet consolidation project, links land-based logistics and support operations with onboard ship systems. This provides commanders with enhanced strategic and tactical information to improve their decision-making ability. This is not just a battle-support system. There are many daily activities that must be supported for a ship to remain at sea for months. The system handles everything from payroll and benefits to providing up-to-date technical manuals. One of the main goals of the portal was to link disparate legacy systems and databases, providing a single easy-to-use interface. This integration was critical to the system's use and success.

Portals are used not only to provide a bridge to connect support applications with tactical applications, but also to link systems and technologies which, up until now, have been separately developed, maintained, and accessed.

• QUESTIONS FOR THE OPENING VIGNETTE

1. **How can timely access to information be used by the military to support its operations?**
2. **What capabilities should a military portal support?**
3. **How does portal technology support an overall information systems architecture?**
4. **Identify issues of concern when developing a portal.**
5. **The vignette does not mention a data warehouse. In your opinion, is one needed? Why or why not?**
6. **Identify the supply chain activities that military portals might need to support.**

8.2 ENTERPRISE INFORMATION SYSTEMS: CONCEPTS AND DEFINITIONS

The ,Opening Vignette introduces us to systems that support tactical and strategic decision-making at all levels of an organization. In many organizations, a variety of decisions are made on a daily basis by middle and top managers, marketing analysts, and other knowledge workers in many locations, even in different countries. In the 1980s and through most of the 1990s, systems serving the needs of top executives were designed as independent (standalone) systems and were called executive information systems (EIS). This approach made such systems affordable mostly to large corporations. Today, executives are supported by systems that support other employees as well. They are called enterprise information systems (EIS). The Opening Vignette demonstrates that these systems serve many users, and therefore are very cost-effective. Well-built enterprise information systems provide executives with the same capabilities that were provided by EIS. In addition, as a result of improved system integration and delivery methods, they serve many other users throughout the enterprise.

Enterprise information systems projects were a high priority among CIOs for the next several years. See DSS in Focus 8.1 for a breakdown from two surveys.

In this chapter, we cover several types of enterprise information systems. We will start with a discussion of the information needs of executives and what IT capabilities are available to meet these needs across the enterprise. Then we relate enterprise

DSS IN FOCUS 8.1

CIO SPENDING PLANS: NOW AND LATER

The Gartner Group surveyed 620 CIOs in January 2003 to determine what priorities they had for the new year, -«nd Merrill Lynch & Co. surveyed 50 U.S. CIOs in February 2003 for their priorities when the economy improved. Most of these spending plans involved developing enterprise information systems.

The top 10 priorities for 2003 included:

1. Security enhancement tools
2. Application integration/middleware/messaging
3. Enterprise (information) portal deployment
4. Network infrastructure/management tools
5. Internal e-enabling infrastructure
6. Web design, development, and content management tools
7. Storage management
8. Customer relationship management (CRM)
9. Web services (internal and external)
10. XML-based processes/messaging

The most important first software projects to be funded once the economy improved were

- Customer relationship management (CRM) (20%)
- Security (20%)
- Enterprise resource planning (ERP) (16%)
- Storage (16%)
- Application integration (14%)
- Corporate (enterprise information) portals (14%)
- Supply chain management (SCM) (14%)
- Business intelligence/data warehousing (DSS/BI) (12%)
- Analytic applications (DSS/BA) (10%)

Source: Adapted from Kathleen Melymuka, "Ready, Set.. *ComputerWorld,* July 21,2003, pp. 37-38.

information systems to the data-warehousing concepts presented in Chapter 5. Following that, we discuss organizational decision support systems, which leads to the concept of the supply chain and its management. We finish the chapter by covering several high-impact, emerging enterprise information systems: process life-cycle management (PLM), business process management (BPM), and business activity monitoring (BAM) systems. In Table 8.1, we describe the impacts of the Web on each of these enterprise information systems, and vice versa.

8.3 THE EVOLUTION OF EXECUTIVE AND ENTERPRISE INFORMATION SYSTEMS

During the 1980s it was felt that the then-existing information technologies, including DSS, were not adequate for executive use (Rockart and Delong, 1988). The published information about DSS showed that most personal DSS supported the work of professionals and middle-level managers. Organizational DSS provided support primarily to planners, analysts, and researchers. Rarely did top executives directly use a DSS. The situation was in contrast to the fact that the most important job of top executives is to make decisions. What was needed was a tool that could handle executives' special needs for timely and accurate information in a meaningful format.

Executive information systems (EIS), also known as executive support systems (ESS) (Watson et al., 1997), are a technology that emerged in response to the situa-

TABLE 8.1 Enterprise Information Systems Technologies, and Web Impacts

Enterprise Information System Technology	*Web Impacts*	*Impacts on the Web*
Executive Information Systems (EIS)	Consistent, friendly, graphical user interface Convenient, fast, and direct access to (hard and soft) data on servers and data warehouses Web graphics have improved the reporting of information Drill down and rollup capabilities are enabled by automatic hyperlinks Enhanced communication and collaboration Improved decision-making	Better management and use of Web resources at the strategic level Data captured are utilized in improving Web site design and performance
Executive Support Systems (ESS)	Same as above Access to analytical models (business intelligence)	Same as above
Enterprise Information Systems (EIS: as evolved from Executive Information Systems)	Same as above	Same as above Plus better management and use of Web resources at the tactical and operational levels (improved frontline decision-making)
Supply Chain Management Systems	Same as above Quick and ready access to needed information Simplifies and enables effective collaboration and communication along the supply chain Can provide access to analytical tools with which to use to *optimize* the supply chain Links customers' and vendors' value and supply chains to your organization's Improved performance of the supply chain	Same as above Specifically, improved performance of Web-enabled businesses and e-commerce sites Enables logistics tools for Web-based operations
Enterprise Resource Planning/Enterprise Resource Management (ERP/ERM) Systems	Same as for executive information systems Provides an architecture for data access and use Improved decision-making throughout the organization, and especially in human resources, accounting, finance, marketing, and production and service delivery	Provides a need for more Web servers and other infrastructure, including integrating suppliers and customers into an organization's operations
Customer Relationship (Resource) Management (CRM) Systems	Same as for executive support systems, with a focus on the customers' needs Provides access to data mining, OLAP, and other business analytic and business intelligence tools to improve sales and customer service Increased sales	Helps target specific customer segments so that the Web site is more effective and useful
Product Life-cycle Management (PLM) Systems	Browser technology provides a convenient GUI interface Access to real-time data Access to product documentation for items in every stage of development Access to collaboration and communication technologies by all individuals involved in product development, including those outside the organization	For organizations developing Web infrastructure and software: improvements in the Web itself and e-commerce
Business Process Management (BPM) Systems	User interface Data Access Communication and collaboration tools Increased need due to e-commerce	Same as above
Business Activity Monitoring (BAM) Systems	Same as above	Same as above

tion just described (see also DSS in Focus 8.2). In a survey conducted by the Center for Information Systems Research (CISR) at MIT, it was found that people with the title of chief executive officer (CEO), chief financial officer (CFO), or chief operations officer (COO) were the major users of EIS. Nord and Nord (1996) found that the most popular uses of EIS were for decision support by providing data and information (50%), for scheduling (50%), to set agendas and schedule meetings (43.8%), for electronic briefing (31.5%), and for browsing data and monitoring situations (31.3%).

In the mid-1990s, with advances in data warehousing (Chapter 5) and in Web technologies, the independent EIS concept was replaced by the more cost-effective enterprise system. The current trend is toward increased integration of vast amounts of decision support information by Web-enabling legacy databases. Web portals enable organizations to reach their constituents (e.g., customers, vendors, employees) providing large amounts of information that can be personalized to the needs of the individual. They have also had an impact on organizational business processes, providing a forum for such activities as virtual meetings and remote training.

DEFINITIONS

The terms *executive information system* **and** *executive support system* **mean different** things to different people. Often the terms are used interchangeably. The following definitions, based on Rockart and DeLong (1988), distinguish between EIS and ESS.

DSS IN FOCUS 8.2

WHY EIS?

The most common benefits of an EIS are improvement in the quality and quantity of information available to executives. The following factors were identified by Watson et al. (1996,1997).

INFORMATION NEEDS (INTERNAL AND EXTERNAL)

- More timely information
- Greater access to operational data
- Greater access to corporate databases
- More concise, relevant information
- New or additional information
- More information about the external environment
- More competitive information
- Faster access to external databases
- Faster access to information
- Reduced paper costs.

EIS IMPROVEMENTS IN EXECUTIVE JOB PERFORMANCE ABILITY

- Enhanced communications
- Greater ability to identify historical trends
- Improved executive effectiveness
- Improved executive efficiency
- Fewer meetings and less time spent in meetings
- Enhanced executive mental models
- Improved executive planning, organizing, and control
- More focused executive attention
- Greater support for executive decision-making
- Increased span of control.

- ***Executive information system (EiS).*** **An EIS is a computer-based system that serves the information needs of top executives. It provides rapid access to timely information and direct access to management reports. EIS is very user-friendly, is supported by graphics, and provides exceptions reporting and drill-down capabilities. It is also connected to the Internet, intranets, and extranets.**
- ***Executive support system (ESS).*** **An F.SS is a comprehensive support system that goes beyond EIS to include communication, office automation, analysis support, and business intelligence.**
- ***Enterprise information system (EIS).*** **litis is a corporate-wide system that provides holistic information from a corporate point of view. Different users across the enterprise can use the system for different purposes. These systems serve the needs of top executives as well. Enterprise systems arc an important part of the *enterprise resources management* (ERP) concept, which we present later in this chapter.**

For an example of an EIS, consider the executive information system of Health Management Systems, Inc. (www.hmstn.com), which is customized to increase productivity and management effectiveness in the health-care industry. Srivihok (1999) also investigates EIS success factors, while Hung (1999) investigated ESS usage patterns between experts and novices.

ENTERPRISE SUPPORT SYSTEMS

The most important goal of enterprise support systems (ESS) is providing a tool for *enterprise support.* For this reason, one can distinguish two types of EIS: one designed especially to support top executives, and the other intended to serve a wider community of users.

An executive-only EIS can be modified to be part of an enterprise-wide information system. As such, executive systems have become less strictly defined, and EIS applications are embracing a range of products targeted to support professional decision-makers throughout the enterprise (see DSS in Action 8.3). EIS are already providing some of the needed capabilities. In addition, there are an increasing number of tools designed to help functional managers (finance, marketing, etc.). These tools are integrated with EIS.

Enterprise support systems have even been found to help developing countries. They have had impact in Malaysia, China (PRC), Uzbekistan, South Africa, Egypt, and Ukraine (see Lalkaka and Albetti, 1999). Lalkaka and Albetti (1999) describe how ESS can lead to better use of agricultural resources and skills, higher value added in light chemical engineering, and garment goods for both export and domestic consumption. Rouse (1993) indicates that ESS contribute to the creation of plans for new products and services, as well as new ventures that accelerate job creation. These lead to important contributions to economic development.

Enterprise information systems continue to diffuse into lower organizational levels. They have definitely moved down the organization to the management level (see Xianzhong and Kaye, 2002). Capabilities once provided exclusively to executives are now provided at the operational level for frontline support (see Section 8.15). Nord and Nord (1995), in their study of all *Fortune 500* companies using EIS, discovered that 50 percent of all CEOs, 31.3 percent of all presidents, 93.8 percent of all vice presidents, and 87.5 percent of all middle managers used EIS on a regular basis. For this reason,

DSS IN ACTION 8.3

GENERAL MOTORS EMPLOYEE-CENTRIC PORTAL SHIFTS INTO HIGH GEAR

Employee benefits, such as the 401K plan, affect all 180,000 U.S. employees of General Motors Corporation. In light of the Enron scandal, many employees pay much closer attention to where their retirement funds are invested, and as a result, they change their investment options much more frequently. Employees at General Motors Corp. have been given immediate access to all benefits-related information, including forms, FAQs, and policies and procedures.

GM's chief technology officer,Tony Scott, reported that one of the company's primary goals was to provide access to all employees regardless of location, even for employees who work at home. The portal was built on the Sun Microsytems Solaris platform and iPlanets application server. It is a self-service application that provides HR and benefits services *immediately* **to each employee. The development of the portal did not undergo a formal cost/benefit analysis, but should greatly reduce administrative costs and simplify the communication of benefits-related changes. The new portal has greatly enhanced communciation to employees delivering personalized information on a real-time basis.**

Source: **Adapted from Elisabeth Goodridge, "Portal Gives Workers Cruise Control,"** *InformationWeek*, **No. 864, November 19,2001, p. 73.**

the acronym EIS is now interpreted to mean *enterprise information system* **or** *everybody's information system.* **As a matter of fact, most vendors do not use the term** *executive information systems* **at all in the names of their products. Instead, the term business intelligence (BI) or** *enterprise systems* **is used to describe the new role of EIS, especially now that data warehouses can provide data in easy-to-use, graphics-intensive query systems capable of slicing-and-dicing data and providing active multi-dimensional analysis (see Chapter 5). As an example, Crystal Enterprise provides a default interface called e-Portfolio that allows users to view, schedule, and export reports in a Web-browser. It includes alerts, so an executive or enterprise information system can be developed in this system. See McAmis (2003) for details.**

In 2003, MasterCard completed a $160 million overhaul of its IT system at the enterprise level. The System Enhancement Strategy (SES) was completed by rewriting *all* **of the system's applications internally. The system includes a massive data warehouse and includes all of its enterprise applications. MasterCard has not reported on the payoff, but it appears to be substantial. See Gibson (2003). On the other hand, the high level of complexity that plagues enterprise information systems often leads to failure, as was the case with McDonald's, described in Case Application 8.2.**

8.4 EXECUTIVES' ROLES AND INFORMATION NEEDS

In Chapter 2 we discussed the roles of managers, including decision-making. Even though providing executive information is no longer the focus of EIS, the process for identifying information needs is exactly the same as for enterprise information systems. The executive decisional role is a major one, and so we divide it into two phases. Phase I involves the identification of problems and opportunities. Phase II involves decisions on what to do about them. Figure 8.1 provides a flowchart of this process. This division can be used to understand executives' information needs and consequently the capabilities of an enterprise information system.

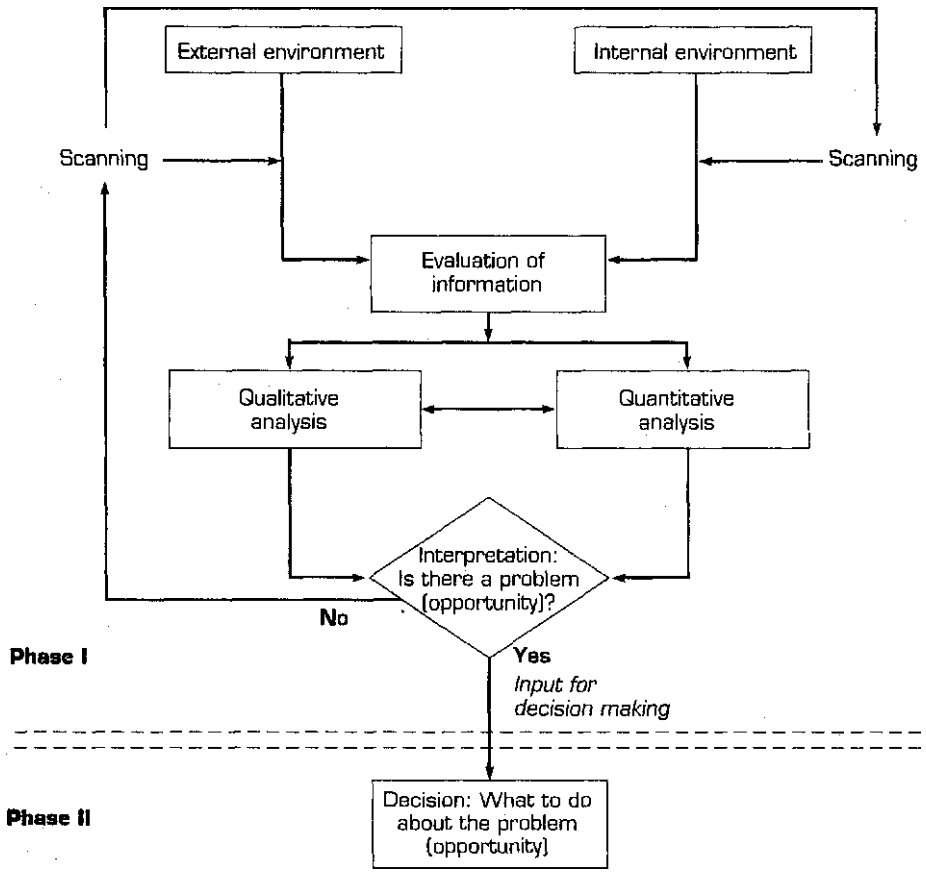

FIGURE 8.1 THE DECISION-MAKING PROCESS OF EXECUTIVES (DECISIONAL ROLE)

As shown in Figure 8.1, information flows to the system from the external and internal environments. Internal information is generated from the functional units (finance, marketing, production, accounting, personnel, etc.). External information comes from the Internet and other online databases, newspapers, Internet news services, industry publications, government reports, and personal contacts. Web-enabled data warehouses have provided a repository of external information that was not readily available as recently as 10 years ago. Clearly the combined information is an extremely valuable organizational resource needed for successful competition and survival. However, because of the large amount of information available, environmental scanning is needed to identify and determine what is relevant. Some scanning of news stories, internal reports, and Web information can be performed by intelligent software agents (see Liu et al., 2000). The collected information is evaluated and channeled to quantitative and qualitative analyses (carried out by experts and/or expert systems when needed). Then an executive or a team decides whether a problem or opportunity

exists. If it is decided that there is a problem, this interpretation becomes an input to the next phase: making a decision on what to do about the problem. Not shown in the figure is the extensive communication that may take place among executives, managers, and staff. The basic purpose of EIS is to support Phase I of the process as shown in Figure 8.1. Phase II can be supported by specific DSS/business intelligence (BI)/business analytics (BA) applications.

METHODS FOR FINDING INFORMATION NEEDS

There are several methods for determining executives' information needs (Watson et al., 1997) (also see the Web Chapter on this book's Web site, prenhall.com/turban/).

One major complication in ascertaining the information needs of executives is that *needs change* as *tasks and responsibilities change.* To respond to this challenge, organizations have emphasized flexibility in meeting their EIS needs through the use of business intelligence tools (Chapter 5). Because of this, many organizations see EIS as constantly evolving and thus never completely finished (unlike most DSS/BI/BA applications; see Chapter 6).

8.5 CHARACTERISTICS AND CAPABILITIES OF EXECUTIVE SUPPORT SYSTEMS

The desired characteristics of an EIS and some of its capabilities are presented in Table 8.2. Most vendors provide these capabilities in their business intelligence enterprise systems. The important ones are described next in some detail.

DRILL DOWN

One of the most useful capabilities of an EIS is to provide details of any summarized information. For example, an executive may notice a decline in corporate sales from a daily (or weekly) report. To discover the reason, he or she may want to see the sales for each region. If a problematic region is identified, the executive may want to see further details (e.g., by product or by salesperson). In certain cases, this drill-down process may continue into several levels of detail.

Drill-down paths that are manually constructed and maintained typically use hypertext-style connections rather than menus in systems with a GUI (i.e., the button for requesting a drill-down path is typically defined as a *hot spot* directly over the high-level data to be explained). This frees up screen space for delivering information and can speed access to drill-down information by eliminating the additional mouse movements typically required by pull-down or pop-up menus. Similarly, Web tools and hyperlinks can be used for an intranet-based drill down. Songini (2003f) describes how Boehringer developed an integrated enterprise information system that successfully blended an ERP with business intelligence/business analytic tools. One critical feature of the EIS is its drill-down capabilities. See DSS in Action 8.4.

Menu-driven drill down is generally a characteristic of ad hoc query applications, and the menus in these applications are almost always automatically generated by the

TABLE 8.2 THE Characteristics and Benefits of EIS

Quality of information

- **Is flexible**
- **Produces correct information**
- **Produces timely information**
- **Produces relevant information**
- **Produces complete information**
- **Produces validated information**

User interface

- **Includes a sophisticated graphical user interface (GUI)**
- **Includes a user-friendly interface**
- **Allows secure and confidential access to information**
- **Has a short response time (timely information)**
- **Is accessible from many places**
- **Includes a reliable access procedure**
- **Minimizes keyboard use by including infrared controllers, a mouse, touch pads, and a touch screen**
- **Provides quick retrieval of desired information**
- **Is tailored to the management styles of individual executives**
- **Contains a self-help menu**

Technical capability provided

- **Access to aggregate (global) information**
- **Access to electronic* mail**
- **Extensive use of external data**
- **Written interpretations**
- **Highlighting of problem indicators**
- **Hypertext and hypermedia**
- **Ad hoc analysis**
- **Multidimensional presentation and analysis**
- **Information presented in hierarchical form**
- **Incorporation of graphics and text in the same display**
- **Management-by-exception reports are provided**
- **Trends, ratios, and deviations are shown**
- **Access to historical and inost current data is provided**
- **Organization around critical success factors**
- **Provides forecasting**
- **Information produced at various levels of detail (drill down)**
- **Filtering, compressing, and tracking of critical data**
- **Support of open-ended problem explanation**

Benefits

- **Facilitates the attainment of organizational objectives**
- **Facilitates access to information**
- **Allows the user to be more productive**
- **Increases the quality of decision making**
- **Provides a competitive advantage**
- **Saves time for the user**
- **Increases communication capacity**
- **Increases communication quality**
- **Provides better control in the organization**
- **Allows the anticipation of problems and opportunities**
- **Allows planning**
- **Allows a search for the cause of a problem**
- **Meets the needs of executives**

software based on the user's logical position in the database and knowledge of the structure of the database. This knowledge of the database structure may have been specified in advance, or it may have been obtained dynamically by the application directly querying the database dictionary. Conceivably, a query application could generate several hundred menus and submenus covering all possible combinations of logical positions and valid drill-down paths.

Drill-down paths, supported by star schemas or snowflake schemas within the enterprise data warehouse, enable the executive or other key decision-maker to formulate an area for further investigation, then easily transfer between highly summarized to detailed information. Online analytic processing (OLAP) tools (see Chapter 5) include drill-down where, at a mouse click, a user can disaggregate a summary row or column in a tabular report. In contrast, rows and columns can be "reaggregated" through a process called *roll up*. Try this out in the Temtec Executive Viewer OLAP package (www.temtec.com).

DSS IN ACTION 8.4

BOEHRINGER CURES SLOW REPORTING WITH AN ERP/BI COMBINATION

The pharmaceutical giant Boehringer turned to an SAS/Cognos integrated system to speed up financial reporting. Boehringer Ingelheim GMBH is a massive company, with $7.6 billion in revenue, and 32,000 employees in 60 countries. Web-enabled reporting and financial applications are keeping the company very, very competitive.

The firm uses a Web-enabled version of SAP AG's Financials software, allowing it to *drill down* and draw conclusions based on the latest financial and operational data. The financial Status of the firm is known on a daily basis by top executives. With the new applications, it takes the firm just two hours after the close of business at the end of each month to close its books. This can be done daily, if need be. (It formerly took three days or more). The system contains three years of SAP data in its Oracle data warehouse. The data are used to spot sales trends and track expenses.

In addition to the SAS software, the system utilizes a Manugistics production and planning application, and Cognos Impromptu (see Chapter 5) to report financial results from the Oracle data warehouse. Impromptu creates standard income statements, cost-center reporting, and account-level analysis. The firm also uses the Cognos PowerPlay analysis tool for multidimensional views of and *drill down* through profit-and-loss data. Cognos UpFront provides reporting to executives over the Web.

Currently there is a one day lag in getting results through the system. This is very close to the real-time analytics and active warehousing described in Chapter 5.

Source: **Adapted from Mark L. Songini, "Boehringer Cures Slow Reporting,"** *ComputerWorld,* **July 21,2003, p. 30.**

CRITICAL SUCCESS FACTORS

Factors that must be considered in attaining an organization's goals are called critical success factors (CSFs). Such factors can be strategic, managerial, or operational and are derived mainly from three sources: organizational, industrial, and environmental. Success factors exist at the corporate level as well as at the industry, division, plant, department, level, and individual levels. The strategic planning process involves identifying CSFs at all levels.

Once identified, critical success factors can be monitored according to five types of information: key problem narratives, highlight charts, top-level financials, key factors, and detailed responsibility reports (Kogan, 1986).The monitoring can be done by intelligent agents. A brief description of each of the five types follows:

- ***Key problem narratives.*** **These reports highlight overall performance, key problems, and possible reasons for the problems within an organization. Explanations are often combined with tables, graphs, or tabular information.**
- ***Highlight charts.*** **These summary displays show high-level information based on the user's own judgment or preference. Because they are designed from the user's perspective, these displays quickly highlight areas of concern, visually signaling the state of organizational performance against CSFs.**
- ***Top-level financials.*** **These displays-provide information on the overall financial health of the company in the form of absolute numbers and comparative performance ratios.**
- ***Key factors.*** **These factors provide specific measures of CSFs, called key performance indicators (KPIs), at the corporate level. The displays are often used on an exception basis to examine specific measures of CSFs flagged as problems on highlight charts (see DSS in Focus 8.5).**

DSS IN FOCUS 8.5

TYPICAL KEY PERFORMANCE INDICATORS

Profitability	**Profitability measures for each department, product, region, and so on; comparisons of departments and products and with competitors**	**Human resources**	**Turnover rate, level of job satisfaction**
Financial	**Financial ratios, balance sheet analysis, cash reserve position, rate of return on investment**	**Planning**	**Corporate partnership ventures, sales growth and market share analysis**
Marketing	**Market share, advertisement analysis, product pricing, weekly (daily) sales results, customer sales potential**	**Economic analysis**	**Market trends, foreign trade and exchange rates, industry trends, labor cost trends**
		Consumer trends	**Consumer confidence level, purchasing habits, demographic data**

- ***Detailed KPI responsibility reports.*** **These reports indicate the detailed performance of individuals or business units in areas critical to the success of the company.**

STATUS ACCESS

In this mode, the *latest data* **or reports on the status of key indicators can be accessed at any time via networks. The** *relevance* **of information is important, and emphasis is placed on current data. This may require daily (as in the Pizzeria Uno situation described in a Web Chapter) or even hourly operational tracking and reporting. In extreme cases, real-time reporting may be required. See Chapter 5 for a detailed discussion of** *real-time (business) analytics* **and** *active warehousing.*

ANALYSIS

Analytic capabilities are available in executive information systems. Instead of merely having access to the data, executives can use the EIS to do analyses on their own. Analyses, generally handled by BI/BA software systems embedded in EIS, can be performed in the following ways:

- ***Using built-in functions.*** **Several EIS products include built-in analytic functions similar to those available in DSS/BI/BA integrated tools (generators). For example, Comshare's DecisionWeb features ad hoc analysis capabilities that allow executives to easily compute trends and variances. It is also possible to perform multidimensional analyses on data and convert tables to graphics. Most recent software packages include an integrated analysis capability as part of their online analytical processing (OLAP) engine. These include Pilot Software's Decision Support Suite, Informix's MetaCube Product Suite, Cognos's PowerPlay and Impromptu Data Access (see Figure 5.8), and Temtec's Executive Viewer (see Figures 5.9 and 5.10, and DSS in Action 5.29).**
- ***Integration with DSS products.*** **Several EIS products have easy interfaces to DSS tools. For example, Comshare's DecisionWeb includes an open scripting language that allows it to integrate easily with many mainframe, server, or workstation DSS tools, such as Excel. Others export multidimensional data cubes for further analy-**

sis by OLAP engines. Tools like Cognos Powerplay and Impromptu generate the SQL code required to access data from an enterprise data warehouse or other data source, thereby freeing up a user from having a requisite skill in understanding and utilizing the DBMS. Some fourth-generation (natural) languages have evolved to enable analysis while directly accessing a database or data warehouse.

- *Analysis by intelligent agents.* Simple comparisons, trends, or ratios can be calculated automatically and an alert issued if there are significant deviations from standards.

Liu et al. (2000) provide an example of the use of intelligent agents for strategic management in the pulp and paper industry in Finland. The agent scans the environment by monitoring certain Web sites, looking for relevant news and price information. Findings are customized into reports for each executive and can be sent as e-mail alerts. Alerts are very important to executives because often they do not read routine reports. See DSS in Focus 5.20.

Analysis can be done as follows. First, executives identify information that they want to analyze in more depth. TTien they either directly request the analysis action from an EIS menu (e.g., to compute a trend line), using a Web-based drag-and-drop operation (see Figure 5.11 for how Brio's OLAP does this), or they export the data shown in the current display to a separate product that offers the desired analysis capability. Depending on the EIS, the process of exporting to and starting up another tool may simply be a menu choice within the EIS or can require the executive to save the display to a file, exit the EIS, launch the other tool, and read the file written by the EIS. Once the executive accesses the other tool (often a spreadsheet), analysis features are typically selected from menus. Whether the analysis is performed within the EIS or by an external tool, the results of the analysis are displayed in a default format, and the executive then has options to modify the display to improve its understandability. See Figures 5.9 through 5.12.

EXCEPTION REPORTING

Exception reporting is based on the concept of *management by exception.* Accordingly, the executive should give attention to exceptions to standards. Thus, exception reporting calls the executive's attention only to cases with a very bad (or very good) performance. For example, the EIS can compute variances and highlight them if they exceed a certain threshold. This approach saves considerable time in sifting through data for exception conditions.

USE OF COLORS AND AUDIO

Typically, critical items are reported not only numerically but also in traffic light colors: green for OK, yellow for a warning, and red for performance outside the preset boundaries of the plan (danger) (see Figure 5.10 for how Temtec's Executive Viewer does this). The colors (or shading, for the color-blind) alert the user to problems requiring immediate attention. Some systems are equipped with audio signals to alert the user to arriving information.

NAVIGATION OF INFORMATION

Navigation of information is a capability that allows large amounts of data to be explored easily and quickly. This capability can be enhanced with hypermedia tools

(Frolick and Ramarapu, 1993) and intelligent agents (Lamont, 2003). The drill-down and roll up capabilities of EIS (OLAP/BI/BA) enables information navigation. Multidimensional data cubes (see Chapter 5) can also be easily navigated via a variety of visualization tools, including those based on virtual reality (see DSS in Action 5.51).

COMMUNICATION

Executives need to communicate with one another. Communication can be verbal, by e-mail, a transfer of a report addressed to someone's attention, a call for a meeting, a comment made to a news group on the Internet, or the interface of a voice mail to a PDA. Additional communication can be provided through collaborative computing technologies such as those provided by GSS (e.g., Lotus Notes/Domino, Groove.net, Microsoft's NetMeeting; see Chapter 7). Executive chat rooms, bulletin boards, and other Web-support tools are popular, as are integrated personal electronic communication devices, such as cell phones that support Web browsing and PDA's.

8.6 COMPARING AND INTEGRATING EIS AND DSS

The characteristics and capabilities described above are unique primarily because an EIS is designed to support top executives, helping them to discover problems and opportunities. A DSS, on the other hand, supports analyses that attempt to answer the question of what to do with a specific problem or opportunity *(what-if).* Tables 8.3 and 8.4 compare the two systems. Table 8.3 contains portions of typical DSS definitions related to EIS. Table 8.4 compares EIS and DSS along several dimensions derived from the characteristics and capabilities of EIS.

Examination of the two tables shows that in a general sense, EIS is definitely part of the decision support field. That is, EIS is designed to support some tasks of the top management decision-making process. However, in a functional sense EIS and DSS are two different but complementary applications. The differences are simple but profound. Fundamentally, EIS is a structured, automated tracking system that operates continuously to keep management abreast of what is happening in all important areas both inside and outside the corporation. EIS has been described as being similar to a pilot's cockpit in an airplane. The gauges and indicators tell the pilot the current status and the direction in which the airplane is heading. The pilot knows that there are prob-

TABLE 8.3 Definitions of DSS as They Relate to EIS

Relevant Portion of DSS Definition	*Author*	*Comparison to EIS*
CBIS consisting of three subsystems: a problem-solving subsystem ...	Bonczek et al. (1980)	No problem-solving subsystem exists in an EIS.
DSS can be developed only through an adaptive process ...	Keen (1980)	EIS may or may not be developed through an adaptive process.
Model-based set of procedures ...	' Little (1970)	EIS is not model-based.
Extendible system supporting decision modeling used at irregular intervals	Moore and Chang (1980)	EIS is not extendible, might not have modeling capabilities, and is used at regular intervals.
Utilizes data and models ...	Morton (1971)	EIS does not use models.

TABLE 8.4 Comparison of EIS and DSS

Dimension	*EIS*	*DSS*
Focus	Status access, drill down	Analysis, decision support
Typical users	Senior executives	Analysts, professionals, managers (via intermediaries)
Impetus	Expediency	Effectiveness
Application	Environmental scanning, performance evaluation, identification of problems and opportunities	Diversified areas where managerial "decisions are made
Decision support	Indirect support, mainly high-level and unstructured decisions and policies	Supports semistructured and unstructured decision making, ad hoc decisions, and some repetitive decisions
Type of information	News items, external information on customers, competitors, and the environment; scheduled and demand reports on internal operations	Information supporting specific situations
Principal use	Tracking and control, opportunity identification	Planning, organizing, staffing, and controlling
Adaptability to individual users	Tailored to the decision-making style of each individual executive, offers several options of outputs	Permits individual judgments, what-if capabilities, some choice of dialog style
Graphics	A must	Important part of many DSS
User-friendliness	A must	A must if no intermediaries are used
Processing of information	Filters and compresses information, tracks critical data and information	EIS triggers questions, answers worked out by using the DSS and fed back into the EIS
Supporting detailed information	Instant access to the supporting details of any summary (drill down)	Can be programmed into the DSS but usually is not
Model base	Limited built-in functions	The core of the DSS
Construction	By vendors or IS specialists	By users, either alone or with specialists from the information center or IS department
Hardware	Mainframe, RISC workstations, Web, LANs, or distributed systems	Mainframe, RISC workstations, Web, PCs, or distributed systems
Nature of software packages	Interactive, easy access to multiple databases, online access, sophisticated DBMS capabilities, complex linkages	Large computational capabilities, modeling languages and simulation, application and DSS generators
Nature of information	Displays pregenerated information about the past and present, creates new information about the past, present, and future	Creates new information about the past, present, and future

lems if certain indicators are out of the safe range, colored lights flash, or a siren sounds. The automobile dashboard provides another analogy. In fact, digital dashboards (portals) in enterprise information systems have evolved from this notion. See Section 5.9 and Figure 5.7 for some details.

EIS delivers information that managers need in their day-to-day jobs. The information is typically presented in a structured, easy-to-access manner with only limited capability for direct ad hoc analysis. If there are analytic capabilities in EIS, they tend to be of a repetitive nature (e.g., trend analysis), as opposed to the unique ad hoc analysis of DSS, which can be provided through OLAP systems. Although this is the usual case, both DSS and EIS may center on the investigation and understanding of problems that are not necessarily predictable, structured, or repetitive.

EIS is designed very differently from DSS. For example, a good EIS must offer a high-speed, nontechnical way for managers to investigate business dynamics (i.e., to understand where and why things are happening so that tactical changes and course corrections can be made). This is also a major area that distinguishes EIS from a standard MIS reporting system. Any summary appearing on an EIS screen must offer instant access to the supporting detail; otherwise, it is just a glorified briefing book (slide show) showing dynamically refreshed data. In addition, the supporting details must be meaningful (e.g., time-series orientation with graphical and numerical content, written narratives from knowledgeable staff, or artificial intelligence (Al)-provided explanations).

INTEGRATING EIS AND DSS: AN EXECUTIVE SUPPORT SYSTEM

We have just concluded that EIS differs from DSS. Indeed, they are treated as independent system applications in many organizations. However, in some cases there are major benefits in integrating the two technologies. For example, at a large drug company, product managers download the previous day's orders of their products from an EIS to their PCs. Then they run a spreadsheet DSS model with the data to predict their end-of-month status. The results of this model are then uploaded to the EIS. By 11:00 a.m. every day, senior managers can check their EIS to see each brand manager's end-of-month status prediction.

The integration of EIS and DSS can be accomplished in several ways. One alternative is to use the EIS output to launch the DSS application. For instance, if executives at General Electric's major appliance division decide that an immediate marketing response is needed to a competitor's action reported by the EIS, exactly what that response should be is determined by DSS models and simulation tools. The DSS is fed from the same reservoir of raw data that feeds the EIS (e.g., the data warehouse), but the DSS action is triggered by the EIS. More sophisticated systems include feedback from the DSS to the EIS, and even an explanation capability. If an intelligent module with explanation and interpretation capabilities is added, then the system can be defined as an intelligent ESS.

The user's role is another dimension along which EIS and DSS can be integrated. Executive roles differ substantially from the roles of typical DSS users, namely, middle-line and functional supervisory levels and functional analysts, such as financial and marketing analysts. Lower-level managers focus much of their time on pursuing predetermined strategies, but executives are faced with developing these strategies. Ambiguity and uncertainty characterize an executive's environment, resulting in a need for the what-if and goal-seeking analyses provided by most DSS. Studies have shown, however, that many senior executives leave this technical analysis to lower-level functional managers and staff analysts.

Most business intelligence and enterprise software vendors (e.g., Business Objects, Cognos, Pilot, Microstrategy, TemTec) provide software products for EIS and DSS applications, such as sales reporting and analysis, product profitability reporting, profit/loss analysis and reporting, enterprise budget reporting, critical success factor and key performance indicator reporting, and performance analysis and reporting. Such software transforms existing corporate data into usable performance information for management decision-making. In addition, such products often include productivity tools (e.g., a personal calendar) and communication tools designed to meet the divergent information needs of executives.

Integration is a key issue. As executives have become increasingly technologically savvy and mobile, the need to provide EIS in mobile computing devices such as

cell telephones and PDA's (e.g., the Blackberry devices at blackberry.com) continues to increase.

INTEGRATING EIS AND GROUP SUPPORT/COLLABORATION

As shown in Figure 8.1, the information generated in Phase I flows to Phase 11, where a decision is made on what to do about the problem. A DSS supports the quantitative analysis of Phase I and can support Phase II as well. In Phase II, however, the decision can be made by a group. EIS include collaboration tools (see Chapter 7), sometimes through enterprise information portals (see Lipschutz, 2003), and sometimes through the products that database vendors provide (see Callaghan, 2003c). Several EIS vendors have developed direct interfaces to GSS. For example, IMRS has enhanced its On Track product with a Lotus Notes/Domino application called Executive Forum. Several enterprise software vendors have Lotus Notes/Domino-based enhancements and Web links in their major products. Others use products by Microsoft, Groove.net, and other GSS vendors. This is especially crucial in supply chain management systems, a very specific kind of enterprise information system that requires collaboration to function properly.

8.7 EIS, DATA ACCESS, DATA WAREHOUSING, OLAP, MULTIDIMENSIONAL ANALYSIS, PRESENTATION, AND THE WEB

In Chapter 5 we discussed the data warehouse: a repository of cleansed and filtered enterprise-wide data for read-only access and use by executives, managers, and analysts. The issue of data access in an enterprise was also discussed in Chapter 5. Rather than designing and implementing an EIS to access several disparate databases in a variety of formats on different computing platforms, data warehouses are increasingly being used as the sole data sources for EIS. When a data warehouse is front-ended by an SQL query code generator (e.g., PowerBuilder), natural language query system, or automatic form builder, it enhances the ability of any user (not just executives) to access needed data. In the mid-1990s, developers and researchers started to explore advanced data-visualization methods (Chapter 5) and multimedia use within EIS. Multimedia can be provided over an intranet. Storage and network capacities have increased to the point where vasts amounts of audio and video data are stored and easily disseminated.

Once data are accessed and provided, analysis and display become important. The combination of multidimensional analysis with online analytical processing (OLAP) tools allows the display of data in both spreadsheet and graphical formats, along with the ability to slice-and-dice the multidimensional data cube that the user requests from the data warehouse. OLAP methods provide analysis tools (see DSS in Action 8.6 and 8.7). Many of these tools are being developed to be Web-ready so that OLAP of the data from the data warehouse can be directly tapped into via the corporate intranet. Some representative packages include

- BrioQuery (BrioTechnology Inc).
- Business Objects (Business Objects Inc).

DSS IN ACTION 8.6

NEIMAN MARCUS USES NATURAL LANGUAGE SEARCH TO BOOST ONLINE SALES

The online portion of Neiman Marcus (www. neiman-marcus.com), one of the industry leaders in luxury retail, determined that more than 50 percent of its customers had abandoned its Web site because they could not find what they were looking for. The problem was not a lack of inventory. In fact in most cases Neiman Marcus had the product, but the search engine worked so poorly that it was frequently not found. To overcome this problem, Neiman Marcus implemented an iPhrase Technologies One Step natural language search engine. This allows customers to input queries in English-language sentences. The search language improves search capabilities by removing ambiguities and often suggests other products, thereby improving the sales experience, and *increasing sales.*

Source: **Adapted from Martin Scheiner, "Nieman Marcus Uses Natural Language Search to Boost Online Sales,"** *Customer Relationship Management*, **January 1,2003, p. 57.**

DSS IN ACTION 8.7

ALLIED SIGNAL SAYS YES TO EIS

Allied Signal is a $12 billion worldwide manufacturer of aerospace and automotive components and specialty materials, such as fibers, chemicals, plastics, and circuit board laminates. Aerospace president Dan Burnham was the catalyst for the EIS. The project started in January 1993 because he wanted faster reports and better-organized information, and to get it all on his desktop. The biggest hurdle was distribution. Dozens of division executives at remote sites needed to contribute information that could be collated quickly into a single system. Comshare's Commander OLAP was used to develop a prototype of the information Burnham requested. In a month, expansive drill-down capabilities with charts and graphs were demonstrated to financial executives. Then they ironed out what data they were going to collect to report.

Three months later, Dan Newsum, manager of distributed applications, installed the first EIS on Dan Burnham's desktop. Then, after a month of training sessions and fine-tuning based on user reactions, Newsum rolled out the system to the desktops of more than 150 people at 15 different sites. Commander's ability to accommodate rapid application updates made it possible to use rapid prototyping to provide updates to users in a couple of hours without user involvement.

In the first 18 months, system use spread to 500 users, and when new applications were completed, it reached 750. "People are working with information they never could access before in ways they had never thought possible," Newsum remarks. When the EIS was getting started, Newsum's group tracked 29 general metrics on the company's performance. After months of user feedback, many of these abstract numbers have been fleshed out into full-blown applications using Comshare's Execu-View and Prism. Many of the applications are running on client/server platforms using Comshare's OLAP Server, which includes a multidimensional data store. This OLAP Server has greatly improved users' ability to analyze data. Now Comshare's OLAP is being employed for new budgeting applications and a financial data warehouse. These applications have raised the level of knowledge in the company about how to work with information.

Source: **Adapted from Comshare Brochure 718282,1995, and www.comshare.com, 2003.**

- DecisionWeb (Comshare Inc).
- DataFountain (Dimensional Insight Inc).
- DSS Web (MicroStrategy Inc).
- Focus Fusion (Information Builders Inc).
- InfoBeaconWeb (Platinum Technology Inc).
- Oracle Express Server (Oracle Corporation).
- Pilot Internet Publisher (Pilot Software Inc).

BusinessQuery for Excel from Business Objects is an example of an OLAP tool that uses Excel as its front end. It lets Excel users easily define their queries in the spreadsheet and add information extracted from corporate databases directly to the spreadsheet for further analysis. This Excel interface enables users who are familiar with spreadsheets to instantly access and manipulate data from a variety of sources. On the data mining side, XL Miner (Cytel Statistical Software) is a handy system that works within the Excel spreadsheet package.

Of special interest is Pilot Software's Decision Support Suite. With Decision Support Suite, an end user can extract data from various sources and turn them into intuitive, screen-based information. The on-screen data view allows the user to drill down into deeper levels of information.

Pilot Decision Support Suite's interface is based on objects, such as documents, menus, images, charts, and text. These items can have data or actions (e.g., an SQL query) associated with them. Building an interface includes selecting an object, pasting it in the workspace, sizing it, and then tying a desired action or predefined function to it. Generally, various objects combine to produce a particular result. This is an easy-to-use form of object-oriented programming.

We briefly describe the system developed at Sara Lee Corporation in DSS in Action 8.8. The Sara Lee system combines an integrated set of executive information and decision support applications to perform multidimensional OLAP dynamically with a three-tier architecture (see Figure 5.3) data warehouse in an open environment. For further information, see Barquin and Edelstein (1997a), the five articles entitled "Data Warehousing: The Essential Guide," *CIO,* October 1,1998 (you can find current articles at www.cio.com),dmreview.com, and the Data Warehousing Institute Web site, www.dw-institute.org.

ENTERPRISE INFORMATION PORTALS AND EIS

Earlier, we described the cockpit analogy of an executive or enterprise information system. Enterprise portals (also known as dashboards, see Chapter 5 and Bochner, 2003) via the Internet or company intranets have evolved into the main platform that integrates all systems across an organization. See the Opening Vignette and DSS in Action 8.3.

An enterprise (information) portal integrates internal applications, such as database management, document management, and e-mail, with external applications, such as news services and customer Web sites. It is a Web-based interface that gives users access to all these applications through their PCs. Enterprise portals bring both external and internal information to all employees' desktops, much as an EIS does.

The most important reasons for deploying an enterprise information portal (sometimes called a corporate portal) include distributing information more effectively, encouraging collaborative work, managing content and information, integrating with enterprise applications, supporting customers, supporting suppliers and partners, improving Internet administration, and reducing training costs (see Fry, 2002). Portals provide internal collaboration (see Lipschutz, 2003) leading to effective and fast decision-making. Virtual communities (Chapter 9) can thrive utilizing enterprise infor-

DSS IN ACTION 8.8

SARA LEE UPGRADES SALES ANALYSIS WITH A DSS/E1S SUITE

As a consumer products manufacturer, Sara Lee Corporation depends on its ability to analyze the sales of the retailers it serves. In 1993, however, the meat division of Sara Lee, which represents about $4 billion of the company's $16 billion in annual sales, was having a tough time performing sales analyses for the brands it supports. The division's DSS was running in an older-generation proprietary IBM legacy mainframe environment that could not be easily upgraded or expanded to accommodate the growing number of users. The solution, which began to be installed in late 1993 and went live in May 1994, was a three-tier client/server system now known as the IA Decision Support Suite from Information Advantage. The suite is an integrated set of executive information and decision support applications designed to perform multidimensional online analytical processing dynamically against a data warehouse in an open environment. Users can drill down, drill up, skip multiple hierarchy levels, and create personal sets and calculations without having the IS department predefine drill paths or write stored procedures. In doing so, they can identify trends and exceptions, draw comparisons, perform calculations, and obtain fast answers. Users also benefit from the intuitivity and flexibility of a customizable GUI. The data warehouse is based on a high-speed relational database sorting and indexing engine from Red Brick Systems.

Source: **Condensed from** *Chain Store Age,* **Vol. 71, No. 9 (Sec. 3), September 1995, pp. 22B-22C. Also see "How Sara Lee Replaced a Mainframe Decision Support System with Client/Server-based Analysis Tools,"** *I/S Analyzer Case Studies,* **Vol. 34, No. 4, April 1995, pp. 7-11.**

mation portal collaboration features, especially when members are scattered around the globe (see Grodner, 2003).

The main goal of an enterprise portal is to give each user a personalized and integrated view of business information, applications, and services. Portal users may be internal or external to an organization (see White, 2002). Enterprise portals have diverse capabilities and therefore employ several layers of multiple technologies, such as the following:

- *Groupware/collaboration technologies:* **discussions, chat sessions, and library projects**
- ***Presentation:*** **data visualization tools, such as Web OLAP, JavaScript, and VBScript for Web display**
- ***Personalization and customization:*** **software agents that customize information for individual users using push technology**
- ***Publishing and distribution:*** **storehouses of documents in portable formats, as well as publish and subscribe engines; content management systems are accessed via enterprise information portals**
- ***Search:*** **both full-text search engines and those that search descriptions of documents and other content**
- *Categorization:* **tools for creating and maintaining different categories of information for different audiences, such as multidimensionality tools**
- ***Integration:*** **tools for accessing disparate back-end data sources, such as ERP packages, relational databases, and external data, such as stock price quotations.**

The enterprise information portal has become the de facto standard Web interface for delivering content to business users. In many organizations, personalized portals are rapidly replacing generalized Web-browser interfaces to corporate intranets and e-commerce applications (White, 2002).

Portals are often integrated with enterprise applications such as ERP, CRM, and supplier relationship management/electronic procurement. Consequently, organizations are deploying portals to support strategic business initiatives and using them as tools for managing enterprise applications (Varon, 2002). Portals provide the much-needed ability to integrate and unify access to a firm's applications, back-end systems, data sources, and content repositories. Unlike many other enterprise applications, portals have an excellent return on investment. By mid-2003, the major portal vendors had migrated their products completely to a lava server technology foundation, and XML for their data structures. Consequently, they all support the creation of Web services. Here are seven excellent enterprise information portal products: Art Technology Group Inc.'s ATG, BEA Systems Inc.'s WebLogic Portal, Computer Associates International Inc.'s Cleverpath Portal, IBM WebSphere Portal, Plumtree Software Inc.'s Corporate Portal, Sybaselnc.'s Enterprise Portal, and Vignette Corp.'s Application Portal. In addition, many specific EIS vendors have developed portals that are tightly aligned with their main products. Notably, these include SAP AG's MySAP. In the past, detailed knowledge of a portal's programming structure was necessary for applications development. Now, expertise in Java and XML are sufficient background for anyone to develop a portal application in most vendor portal products. See Rapoza (2003) for details. Covisint, the North American automobile industry exchange extranet, utilizes a portal and functions directly with an XML-based data representation in its hub-based portal *(Portals Magazine,* 2003).

Cap Gemini Ernst & Young (www.cgey.com) has developed a set of questions to help organizations determine the value they can derive from implementing a portal. These questions follow along the scales of intent, usage, user experience, technology, support, learning, Web- content management, and Search. We provide a sample in DSS in Focus 8.9

The Delphi Group studied 600 companies considering developing portals. The breakdown of the types of portals that the companies were considering was: enterprise information (62%), customer (55%), employee (54%), supplier partner (30%), and other (8%) (see Copeland, 2001).

All of the major DSS/business intelligence/business analytics vendors provide enterprise information portals as top layers to their products. Look at Hummingbird's

ENTERPRISE INFORMATION PORTAL EFFECTIVENESS

Here is a sample of Cap Gemini Ernst & Young's portal effectiveness questions, to be answered on a 1 to 7 scale (see www.cgey.com for more on this survey and how to use it):

Intent:

Portals are being positioned/used for Web-enabling **routine business transactions.**

Portals are being positioned/used for community enablement and knowledge sharing.

Portals are being positioned/used for collaborative decision-making among functional areas.

Analytics/Collaboration:

- **Transactions on the portal are supported by quantitative analytics and history.**
- **Transactions are supported by qualitative Web data.**

Source: Adapted from Jim Rapoza,"EIPs More Compelling Than Ever," *eWeek,* July 21,2003, pp. 51-58.

Enterprise Information Portal as a representative of the set. See the annual "Portals Buyers Guide" in the July issue of *Portals Magazine* for more on specific products.

The cost of a portal depends on its purpose. Highly customized portals that integrate many applications can cost millions of dollars to develop. On the other hand, a simple portal with minimal integration effort can cost as little as $50,000, especially if it is developed on top of existing platforms (see Konicki, 2000). Even though spending on e-business projects fell in 2002, more than a third of executives planned to purchase portal software (Varon, 2002). The enterprise portal market was $80 million in 2002. It is expected to grow to $2 billion in 2005 (see Fry, 2002). Gartner Dataquest forecast in the summer 2002 that portal sales would grow an average of 24 percent per year from 2001 to 2006. In DSS in Focus 8.10, we discuss the growth of the enterprise information market. See McDonnough (2003b) for more details.

ENTERPRISE INFORMATION PORTAL EXAMPLES

Hewitt Associates in Lincolnshire, Illinois, a human resources outsourcing company, saves $8 million per year and provides 75 percent faster responses to client requests for benefits information through its enterprise information portal. Clients from various companies enter a personalized portal environment and obtain their pension information updated from a personal profile. Hewitt expects a 100 percent return on its portal investment within two years. The portal is the primary desktop for 500 employees, and the company is investigating how to expand it to 11,000 employees worldwide (see Copeland, 2001; Konicki, 2000).

DSS IN FOCUS 8.10

THE ENTERPRISE INFORMATION PORTAL MARKET

The enterprise portal software market is expected to continue double-digit growth. Several factors that will contribute to its growth through 2007 are:

- Software vendors that have recently added enterprise portals to their product portfolio will penetrate their installed base at a rapid rate.
- Demand for portals will increase as more companies begin to understand the technology and benefits associated with them.
- More direct and measurable benefits will be marketable as portals are deployed to improve specific business processes.
- Benefits will become more widely understood as larger software vendors invest significant marketing dollars in educating the prospect base.
- Broader adoption and deployment of enterprise portals will increase sales among organizations that initially deployed a portal to focus on the needs of a single department or employee.

The areas in which the organizations surveyed have targeted their first portal are

- Corporate (23.7%)
- HR (20.7%)
- Marketing (20.5%)
- Sales (20.2%)
- Customer services (19.8%)
- IS (19.7%)
- Line of business employees (19.3%)
- Finance (16.6%)
- Research & development (10.3%)
- Other (4.2%)

Source: Adapted from Brian McDonnough, "The State of Enterprise Portal Initiatives: Portal Adoption Trends 2003," Special IDC Report, *Portals Magazine,* Vol. 33, No. 22, July 2003, pp. 23-25.

Cigna's portal (MyCigna.com) integrates data from multiple health-care and retirement benefit plans in an effort to increase sagging market share. With the economy in decline, Maysteel could not afford a new ERP system, so it developed a portal application that would allow executives and quality control staff to access the data they need (Varon, 2002). At Maysteel, portals link legacy systems to new systems. The structure of this portal matches that of the executive information system. One of Pratt & Whitney's 100 portal-supported applications (for 4,000 users) helped the firm to reduce jet aircraft engine overhaul time by 30 percent. The portal provides detailed information about the use of the engine's 28,000 parts, so engineers can predict potential failures and replace the part in advance. Consequently, Pratt is expanding its engine repair business, a $37.9 billion market in 2002. And engineers on the road can access the portal from anywhere (Varon, 2002).

Clarian Health Partners, an integrated health-care company (Indianapolis, Indiana) has developed an enterprise information portal for its three hospitals. It directly assists doctors, administrators, and consumers (see Ericson, 2002). Bank One Corp. developed a foreign currency exchange portal to let its customers examine exchange rates, execute trades of foreign currency, confirm settlement, make cross-currency payments, and view account status (see Boyd, 2001). We described how the U.S. military has successfully adopted enterprise information portals in the Opening Vignette. In DSS in Action 8.3, we described the General Motors enterprise information portal (also see Goodridge, 2001). General Electric, Staples, and DuPont have all developed successful portals as well.

Even governments and other state agencies and universities are developing enterprise portals that save time and money for their constituents. See DSS in Action 8.11 for details on the state of New Jersey's home-grown e-government portal (www.nj.gov; Yamada, 2003). Other government agencies that have developed portals include the U.S. federal government (FirstGov.com; Kaneshige, 2002), the U.S. Internal Revenue Service (www.irs.gov; *Portals Magazine,* 2002), and the states of New Mexico (Rapoza, 2002) and Rhode Island (Vaas, 2003a). Rapoza (2002) provides a list of Web resources for government XML and Web services. Companies like ezgov.com specialize in developing Web-based solutions for governments and their agencies. Many colleges and universities have turned to enterprise information portals to enable information resources and tools for students, staff, and faculty. Vaas (2003b) describes Texas Tech University's portal efforts.

Portals deliver almost immediate productivity gains to workers, customers, and business partners (see DSS in Action 8.11). They add context to business data, and executives like having a single, personalized window into the health and well-being of their organizations (see Copeland, 2001). Portals leave data in their original format and provide users with a window into them. Portals are relatively inexpensive and scalable, in that new users and applications are literally added daily (as in the State of New Jersey portal).

Another application area for portals is knowledge management, another type of enterprise information system (see Kim, 2002). The collaboration features of portals enable the creation and sustainability of virtual communities *(of practice),* which is very important to the smooth functioning of knowledge management systems. See DSS in Action 8.12 and Maybury (2001). Other capabilities of portals enable knowledge management systems. For example, Orbital Software Group's Organik provides a question-and-answer infrastructure for portals. Users can ask questions, find experts, and share knowledge (see Copeland, 2001). For more on how portals are used in knowledge management systems, see Chapter 9 and McDonough (2003a).

DSS IN ACTION 8111

NEW JERSEY GETS AGGRESSIVE ABOUT ITS E-GOVERNMENT PORTAL

New Jersey's state government has developed a portal (www.nj.gov) that has hundreds of Web services, 100 online communities, massive amounts of important information, financial transactions, a kids' section, an extranet, and an intranet, and attracts 3,000 newly registered users every month. The $2.5 million portal, built from scratch over two years, was developed and is maintained by state employees with no outsourcing. Though it is difficult to determine a direct savings, the portal provides many new services and options. By way of example, one group of 500 users saves the state about $1 million annually by using the portal instead of a customized dial-up system.

The successful New Jersey portal allows state residents to register cars, pay for fishing licenses, and buy gifts from the state museum's gift shop. Lottery agents can check on ticket orders, merchants can register business names, and corporations can pay state taxes. Each member has a set of individual, customized services and information.

In July 2003, there were 33,000 users, including 22,500 residents, 4,000 state employees, 4,000 business owners, and 2,500 local government officials. The features and services offered over the portal continue to grow over time.

Source: **Adapted from Ken Yamada, "Jersey Online,"** *Portals Magazine*, **Vol. 33, No. 22, July, 2003, pp. 27-29.**

DSS IN ACTION 8.12

THE MYHONEYWELL PORTAL ENABLES KNOWLEDGE MANAGEMENT: BREAKS DOWN KNOWLEDGE BARRIERS

Honeywell developed its MyHoneywell Portal to break down its silos of knowledge in deploying a knowledge management initiative. Honeywell faced and managed the standard organizational culture issue of developing an information- and knowledge sharing culture. Empirical research indicates that knowledge-sharing capabilities and tools are the most important features required for employee portals. The typical breakdown of the most important portal characteristics is knowledge management and search (32%), integration (25%), collaboration (22%), application development/deployment (13%), and expertise location *(8%).* **See Kaneshige (2003) for details.**

8.8 SOFT INFORMATION IN ENTERPRISE SYSTEMS

Watson et al. (1996) recognized that decision-makers require soft information, often provided informally, for making decisions. They performed an in-depth study of how and to what extent soft information is included in EIS. Soft information is "fuzzy, unofficial, intuitive, subjective, nebulous, implied, and vague." They found that soft information was used in most EIS, broken down into the following categories:

- **Predictions, speculations, forecasts, and estimates (78.1 %)**
- **Explanations, justifications, assessments, and interpretations (65.6%)**
- **News reports, industry trends, and external survey data (62.5%)**
- **Schedules and formal plans (50.0%)**
- **Opinions, feelings, and ideas (15.6%)**
- **Rumors, gossip, and hearsay (9.4%).**

DSS IN ACTION 8.13

SERFIN FINANCIAL GROUP IN MEXICO CITY USES EIS

Because of the critical economic situation in 1994, Mexican banks found themselves burdened with a large amount of loan obligations. Serfin Financial Bank, the third-largest bank in Mexico, survived by implementing an EIS and a data warehouse to enable its top managers to review and continue tracking outstanding loans and to monitor the daily growth of liabilities on a **branch-by-branch basis.**

Serfin realized that it was technologically behind the times because its decision-makers had been using simple graphical spreadsheet software to view daily customer data. To update its capabilities, the bank instituted an EIS that allowed users to perform more complex tasks, such as monitoring daily performance, budgeting, and forecasting activities. The system was linked to a Sybase database and collected data **from** disparate **operating systems at the three primary** data centers **in Mexico City, Guadalajara, and** Monterey. The **data warehouse took more time to complete** than **the EIS development.**

In the beginning, the SAS EIS served only the top 12 executive officers. By using the new system, Serfin reduced its response time for performing a forecast from 2 hours to 30 seconds, leading to better performance. The system helped the bank get through the financial crisis.

Source: Condensed from Thomas Hoffman, "Mexican Bank Finds Crisis Control," *ComputerWorld.* Vol. 29, No. 25, June 1995, p. 79.

The widespread use of soft information in the form of predictions, speculations, forecasts, and estimates is important for planning purposes. Other research documents the use of these types of soft information. Generally the EIS support staff can enter this information, but sometimes the EIS may generate the information automatically based on historical data (by data mining) or by intelligent agents (IA) scanning news sources and internal reports. Explanations, justifications, assessments, and interpretations help executives make sense of what is happening inside and outside the firm. Many enterprise systems allow users to clip explanations onto screens or e-mail before providing the information to other users. News reports are gaining popularity as news feeds, both textual and video, and have become widely available, especially via the Web. As intelligent agents filter news (internal and external), we expect more news feeds to be provided through enterprise systems. On an individual basis, CNN.com provides free access to news feeds in a similar manner.

The inclusion of soft information enhances the value of enterprise systems for executive users (see DSS in Action 8.13). Most of the participants in the Watson et al. (1996) study indicate that with respect to soft information they plan to concentrate efforts on external news services, competitor information, and the ease of process entering soft information. A few firms are focusing on making it easier for users to add soft information themselves.

8.9 ORGANIZATIONAL DSS

Organizational decision support was first defined by Hackathorn and Keen (1981), who distinguished three types of decision support: individual, group, and organizational. They maintain that computer-based systems can be developed to provide decision support for each of these levels. They perceive organizational decision support as focusing on an organizational task or activity involving a sequence of operations and actors (e.g., developing a divisional marketing plan or corporate capital budgeting). Furthermore,

they believe, each individual's activities must mesh closely with other people's work. Computer support was seen primarily as a vehicle for improving communication, coordination, and problem-solving. A visualization of an organizational decision support system from a research dimension is provided by Konsynski and Stohr (1992).

There are several definitions of organizational decision support system (ODSS):

- Watson (1990) defined an ODSS as "a combination of computer and communication technology designed to coordinate and disseminate decision-making across functional areas and hierarchical layers in order that decisions are congruent with organizational goals and management's shared interpretation of the competitive environment."
- Carter et al. (1992) defined ODSS as "a.DSS that is used by individuals or groups at several workstations in more than one organizational unit who make varied (interrelated but autonomous) decisions using a common set of tools."
- Swanson (Swanson and Zmud, 1990) called ODSS a distributed decision support system (DDSS). He stated that an organizational DSS should not be thought of as a manager's DSS. Rather, it should be viewed as supporting the organization's division of labor in decision-making. He defined a DDSS as a DSS that supports distributed decision-making.
- King and Star (1990) provided a different perspective. They believe that the concept of ODSS is fundamentally simple: Apply the technologies of computers and communications to enhance the organizational decision-making process. In principle, ODSS takes the vision of technological support for group processes to the higher level of organizations in much the same way that group DSS extends the vision of technological support for individual action to the group process. This is done today on an intranet (see Ba et al., 1997).

Based on the above definitions, George (1991/1992) found that all ODSS have certain common characteristics:

- The focus of an ODSS is an organizational task, activity, or decision that affects several organizational units or corporate problems.
- An ODSS cuts across organizational functions or hierarchical layers.
- An ODSS almost necessarily involves computer-based technologies and may also involve communication technologies.

For implementation issues of ODSS, see Kivijarvi (1997).

RELATIONSHIP OF ODSS TO GSS AND ENTERPRISE INFORMATION SYSTEMS

Because of its complexity, and the need for internal communication and collaboration, an ODSS can be integrated directly with a group support system (GSS), an executive information system, or any enterprise information system. For example, the Egyptian cabinet ODSS (see DSS in Action 8.14) includes an executive information system. Within such a system, GSS could help prioritize items and resolve conflicts by providing direct collaboration capabilities. Clearly, ODSS are a type of enterprise information system that directly provides decision support (business intelligence/business analytics). Even though such systems were deployed as independent systems in the past, they are now typically integrated with intranet support infrastructures, obtaining data from data warehouses and including OLAP and other business intelligence/business analytic capabilities. In fact, such ODSS are often integrated directly with ERP systems, which we describe next.

DSS IN ACTION 8.14

ODSS IN THE EGYPTIAN CABINET

INTRODUCTION

The Egyptian cabinet is composed of 32 ministers, each responsible for one department (e.g., labor, energy, or education).The cabinet is headed by the prime minister and deals with countrywide policies and strategic issues. The cabinet also includes four sectored ministerial committees assisted by staff. The cabinet makes extremely important decisions in areas such as national socioeconomics and infrastructure. Many of the issues are complex and require considerable preparation and analysis. Because of conflicting interests, there is sometimes considerable disagreement among the ministries.

The cabinet must work with the parliament and with many government agencies. In addition, there are many links between the cabinet and external agencies, ranging from universities to international bodies. Information is essential for effective decision-making. Decisions are made by many people (individually or in groups) at many locations and levels, and the composition of the decision-makers changes frequently. All this makes the decision-making process very complex.

THE CABINET S INFORMATION AND DECISION SUPPORT CENTER

To properly support the information needs of the cabinet, a special center was developed—the information and decision support center (IDSC). Dozens of specific DSS were developed; since the center's inception in 1985, several of them have been highly interrelated and interconnected. Examples of specific DSS are the following:

Customs tariff policy formulation DSS. This problem area involved six ministries, so coordination was difficult and the diversity of opinions played a major role in decisions. The DSS helped to achieve a consistent tariff structure and increased government revenue (yet minimized the burden on low-income families).

Debt management DSS. Egypt relies on foreign debt (about 5,000 loans amounting to more than $40 billion in the mid-1990s). The purpose of the DSS was to manage the debt (e.g., to schedule payments, decide on appropriate refinancing, simulate projections of the debt structure).

CONCLUSION

The use of ODSS has significantly leveraged the strategic decision-making process in Egypt. However, the system supported by the ODSS was very complex. It provided for ODSS analysis throughout a complex organization and was used by many people in several organizational units. This large-scale ODSS was highly integrated with an extensive data-management system.

Source: Based on material from H. El Sberif, "Managing Institutionalization of Strategic Decision Making for the Egyptian Cabinet," *Interfaces,Vol.* 20, No. 1,1990; H. El Sherif and O. A. El Sawy, "Issue-Based Decision Support Systems for the Egyptian Cabinet," *MIS Quarterly,* Vol. 12, No. 4, December 1988.

8.10 SUPPLY AND VALUE CHAINS AND DECISION SUPPORT

Enterprise systems related to the supply chain and its management constitute a special class. In this section we present some basic information on supply chains and their management.

DEFINITIONS AND BENEFITS

The concept of a supply chain originally referred to the flow of materials from its sources (suppliers) to a company and then inside the company to areas where it was needed. Concomitantly there was recognition of a demand chain that described order generation, taking, and fulfillment. Soon it was realized that these two concepts are interrelated, and so they have been integrated under the name *supply chain.*

DEFINITIONS

A supply chain refers to the flow of materials, information, and services from raw material suppliers through factories and warehouses to the end customers. A supply chain also includes the *organizations* and *processes* that create and deliver products, information, and services to the end-customers. It involves many activities, such as purchasing, materials handling, production planning and control, logistics and warehousing inventory control, and distribution and delivery.

The function of supply chain management (SCM) is to deliver an effective supply chain and do it in an effective manner, namely, to plan, organize, and coordinate the supply chain's activities. Good supply chain management practices generally lead to increased revenue, as we describe in DSS in Action 8.15. For an overview of SCM, see Hugos (2003), Sheikh (2003), and Handfield and Nichols (1999).

BENEFITS

The goals of modern SCM are to reduce uncertainty and risks in the supply chain, thereby positively affecting inventory levels, cycle time, processes, and customer service. All these contribute to increased profitability and competitiveness.

The benefits of supply chain management were recognized long ago not only in business but also in the military. In today's competitive environment, efficient and effective supply chains are critical for the survival of most organizations and are greatly dependent on the supporting information systems.

THE COMPONENTS OF THE SUPPLY CHAIN

The term *supply chain* comes from a picture of how partnering organizations in a specific supply chain are linked together. As shown in Figure 8.2, a simple supply chain links a company that manufactures or assembles a product (in the middle of the chain) with its suppliers (on the left) and its distributors and customers (on the right). The upper part of the picture shows a generic supply chain, while the bottom part shows the specific example of making wine.

Note that the supply chain has three parts:

1. **Upstream. This part includes the suppliers (they can be manufacturers and/or assemblers) and their suppliers. Such relationships can be extended to the left in several tiers, all the way to the origin of the material (e.g., mining ores or growing crops).**
2. **Internal supply chain. This part includes all the processes used in transforming the inputs from suppliers to outputs, from the time materials enter an organization to the time the product(s) goes to distribution outside the organization.**

DSS IN ACTION 8.15

SCM IS STRAIGHT AS AN ARROW

Arrow Electronics utilizes good supply chain management practices and systems to produce new revenue to help insulate the firm during the sharp downturns in the electronics industry. It includes Arrow Collaborator, an interactive Web application (part of the suite of SCM tools of Arrow's Connectivity Dashboard) that helps customers monitor and control their own supply chains.

Source: Adapted from H. Green and P. Katz, "Arrow Takes Aim at Supply Chain," *Optimize*, September 2002.

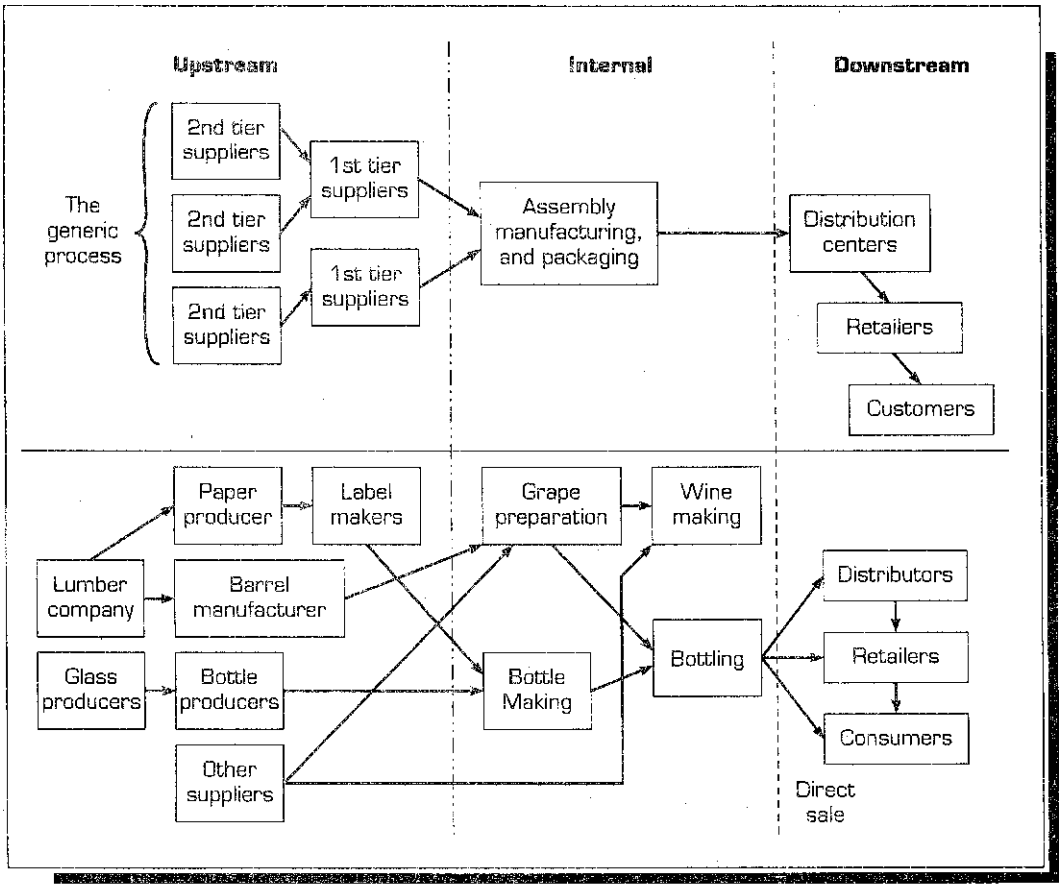

FIGURE 8.2 SUPPLY CHAINS OF WINE MAKING

3. Downstream. **This part** includes **all the** processes **involved in** delivering the **product to the** final customers. The **supply chain actually ends** when **the product** reaches its after-use disposal**—presumably back to Mother Earth** somewhere.

A supply **chain** involves activities that **take place during a product life cycle, from "dirt** to **dust" (see** Section **8.14 for** details **on product** life-cycle **management** systems) **However, a supply chain is more than that,** because **it also** involves **the movement of information and money and the procedures that support the movement of** a **product or a** service. The organizations **and individuals involved are part of the chain as well** (see Poirier, 1999).

Supply chains come in all shapes and sizes and can be fairly complex, as shown in Figure 8.3. As the figure demonstrates, the supply chain for a car manufacturer includes hundreds of suppliers, dozens of manufacturing plants (parts) and assembly plants (cars), dealers, direct business customers (fleets), wholesalers (some of which are virtual, e.g., **www**.cardirect.com), customers, and support functions such as product engineering and purchasing. The automobile industry is an extremely interesting case in point. The automobile industry in North **America** has developed the **Covisint** extranet to coordinate the supply chains of its members, from all the many parts and raw materials vendors to the dealers who sell the cars (*Portals Magazine,* 2003). Auto

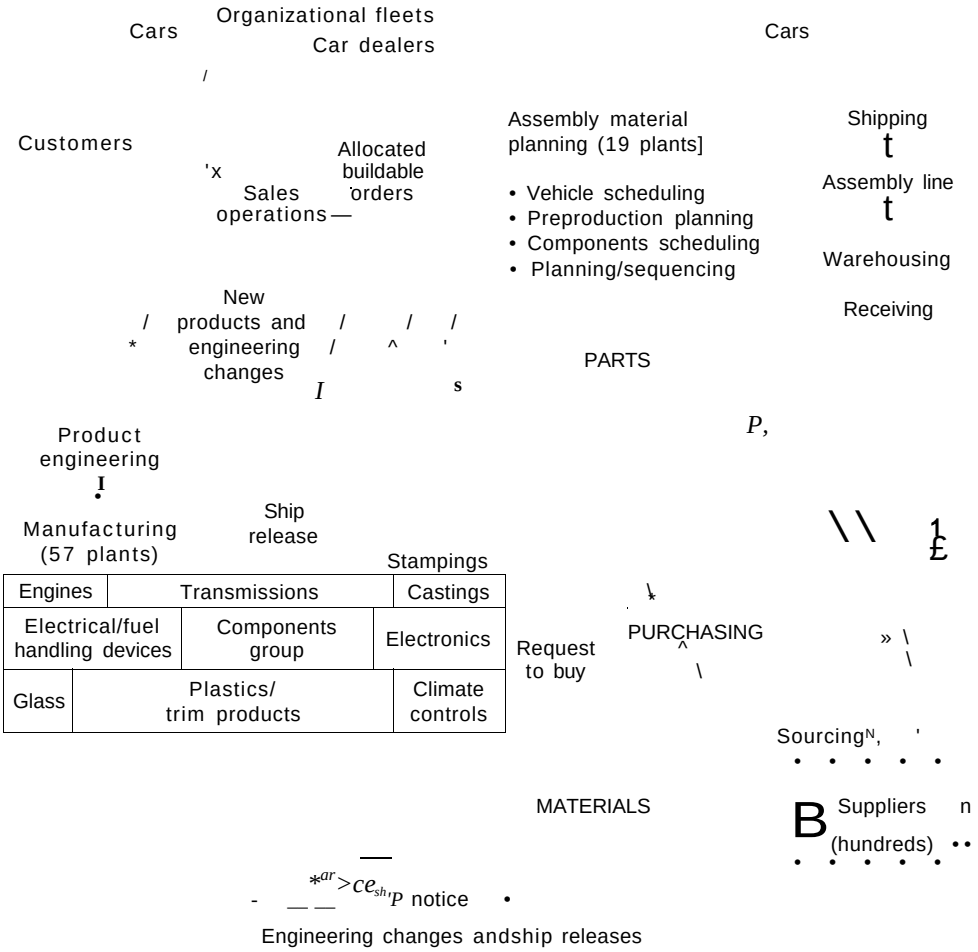

FIGURE 8.3 AN AUTOMOTIVE SUPPLY CHAIN

Source: **Modified from Introduction to Supply Chain Management by Handfield/Nichols, ©1998. Reprinted by permission of Prentice-Hall, Inc., Upper Saddle River, NJ. Handfield, R.B., and E.L. Nichols, Jr. (1999).** *Introduction to Supply Chain Management.* **Upper Saddle River, NJ: Prentice Hall.**

manufacturers ean link seamlessly with their suppliers in total security, offering more services, and making more and better decisions faster and at a lower cost. (Because of U.S. antitrust laws, an auto manufacturer may only collaborate and communicate with its own vendors and dealers, but not with other manufacturers.) See Evans (2003) and Koch (2002) for more on Covisint.

Note that in this case the chain is not strictly linear, as in Figure 8.2. Here there are some loops in the process. Sometimes the flow of information and even of goods can be

bidirectional. For example, not shown in this figure is the *return* of cars to dealers, known as reverse logistics, in the case of defects, a recall by the manufacturer or trade-ins.

Also note that a supply chain is much more than physical. It includes information and financial flows. The Chapter 2 Opening Vignette describes a situation where information flow was just as critical for the success of the work teams as moving products out the door. As a matter of fact, a supply chain of a digitizable product or service may not include any physical material.

The flow of goods, services, information, and so on, is usually designed not only to effectively transform raw items to finished products and services but to do so in an efficient manner. Specifically, the flow must end with the delivery of a product or service to the customer whenever it is needed, and it must be followed with an increase in value that can be determined by value-chain analysis, in which business analtyics methods are applied directly to SCM. As an example, Diageo pic implemented a supply chain planning system that significantly reduced inventory levels, resulting in a massive savings. See DSS in Action 8.16.

THE SUPPLY CHAIN AND THE VALUE CHAIN

The concept of the supply chain is related to the concepts of value chain and value system. According to the value chain model (Porter, 1985), the activities conducted in any organization can be divided into primary activities and support activities. The five *primary activities* are (1) inbound logistics (inputs), (2) operations (manufacturing and testing in a manufacturing firm), (3) outbound logistics (storage and distribution), (4) marketing and sales, and (5) service.

These activities are linked together. The output of the first is the input to the second, and so on. A value is added each time an input changes to an output. The primary activities are sequenced and work progressively in the manner shown below, and value is added at each activity.

Incoming materials are processed (in receiving, storage, etc.), and value is added to them in what is called inbound logistics. Then the materials are used in operations, where more value is added in making products. The products need to be prepared for delivery packaging, storing, and shipping, and so more value is added. Then marketing and sales deliver the products to customers. Finally, after-sales service is performed for the customer. All the value-adding activities result in profit (it is hoped). They are supported by the following *support activities:* (1) the firm's infrastructure (accounting, finance, management), (2) human resources management, (3) technology development

DSS IN ACTION 8.16

SCM PROVIDES INVENTORY REDUCTION

Diageo pic, a global beer (Guinness) and alcohol manufacturer (Johnnie Walker, Cuervo) has implemented Manugistics supply chain planning software to support its U.S. collaborative planning, forecasting, and replenishment processes. Ultimately, the software will be deployed to support its global manufacturing facilities. Diageo plans to save $1.1 million in inventory reduction and some $600,000 in logistics benefits over the next few years through more accurate forecasts. Sales should grow by 1 percent, or $3.3 million,

Source: AdaptedfromB.Bacheldor,"KeepSupply Chains Flowing," *InformationWeek,* April 14,2003.

(R&D), and (4) procurement. Each support activity can support any or all of the primary activities, which can also support each other.

Firms try to *optimize the total value* along the entire chain. There are many ways to increase the value, and many decisions need to be made for this purpose. It is important to note that *true* supply chain optimization must involve some of the models described in Chapter 4 along with methods for their solution and analysis. Very often, in this age of Web-based commerce, a manager will claim that a problem is far too complex to be modeled. Managers who make such claims do not understand their job and should be fired. Supply chain optimization is often interpreted simply as making some improvement in communication and collaboration along the supply chain. While such improvements are certainly good practice and often reduce overall costs, they do not mean that an organization is applying normative and/or descriptive models to the problem of managing the supply chain. True supply chain optimization is very effective. Consider the IMERYS Case Applications in Chapters 2, 4, and 6. By modeling and optimizing a portion of the supply chain, the firm increased its net profit by around 10 percent without utilizing additional resources.

Experts estimate that if the auto supply chain were optimized, vehicle makers and their suppliers could save somewhere between $1,700 and $3,000 per car. There is approximately $700 billion of inventory in the auto supply chain. Technology can easily cut this amount by one-third through supply chain optimization. See Wallace (2000). Keskinocak and Tayur (2001), Sodhi (2001), Quinn (2003), and Wallace (2000) describe how optimization efforts can impact the supply chain. Quinn (2003) describes how John Deere optimizes inventory throughout the supply chain, which is tricky because of its seasonal nature. See DSS in Action 8.17.

DSS IN ACTION 8.17

JOHN DEERE TRULY OPTIMIZES INVENTORY THROUGH SUPPLY CHAIN MANAGEMENT

One of the first scientific applications to business was the development of a calculus approach to optimizing inventory (economic order quantity or EOQ). John Deere, a 166-year-old lawn mowing, tractor, and other vehicle firm, with annual sales of about $3 billion, has taken its distribution supply chain to a new level of efficiency, utilizing specialized software from SmartOps Corp. In 2001, management wanted to reduce the finished-goods inventory both in company warehouses and at dealers. But customer service was not to suffer. The critical question asked how low inventory could go before it affected customer sales. Excess inventory and sales losses due to stockouts are expensive. Balance is important. Many of Deere's products are seasonal; demand forecasting is complicated by the fact that they are often impulse purchases,.

To maintain a leading position in the industry, John Deere adopted three basic supply chain goals: (1) improve service levels from dealers to customers; (2) reduce finished-goods inventory to target levels by 2005; and (3) improve factory and supplier flexibility to accommodate seasonal demand. However, some managers felt that inventory would have to increase for many products.

Fortunately, SmartOps Multistage Inventory Planning & Optimization (MIPO) software determines optimal inventory placement plans for the customer's supply chain by product, location, and time. It helps identify the optimal mix of inventories throughout the supply chain from raw materials to finished products. After a successful five-month pilot test, the software was adjusted, tested for seasonality in a second pilot test, and then deployed to cover all 2,500 dealers. The system has significantly reduced finished-product inventories without negatively impacting customer service.

Source: Adapted from Paul Quinn, "Inventory Optimization: Lean But Not Mean." *SCS Magazine,* May 2003, pp. 32-34.

Seasonal demand is also faced by Just **Born, which manufactures 600 million Peeps (gooey pink and yellow marshmallow chicks) annually. Eighty percent are sold during** the **Easter** season. **Uncertain seasonal demand,** though **difficult to model, can be handled** by **the** firm's optimizing SCM and forecasting efforts. **This** should save **it millions in** excess inventory of Peeps and **raw** materials. See Kaplan (2001) for **details.**

A firm's value chain is part of a larger stream of **activities** that **Porter calls a value system. A value** system consists of the suppliers **that provide the inputs necessary to the** firm and, as well, their value chains, which **include suppliers to the suppliers (possibly** in several tiers). Once the firm **creates products, they pass through the value chains of distributors (who also have** their **own value chains), all the way to the buyers (customers), who also have their own** value **chains. Gaining and sustaining a competitive advantage and supporting this advantage by means of IT require an understanding of the** entire value **system.** The concepts **of value chain and value system** concepts apply both to products and services and **to** any **organization, private or public.**

A close examination of the value chain and value system **concepts** shows **that they** are closely related to the supply chain. The primary activities of the **value chain correspond** to the generic model in Figure 8.2. Some of the support **activities** of **value** chains can be identified in Figure 8.3. Note, too, that the value system **concept corresponds** to the concept of an **extended supply** chain, which includes **suppliers and other** business partners. Wal-Mart Corporation is extremely effective **at** using **information** technology to integrate its supply chain heavily **with** the supply **chains of their vendors and** customers.

One of the **major** goals of SCM is to maximize the **value** added along **the supply** chain, and **this** is where computerized decision support enters **the picture. The** Web/Internet has extended the ability of organizations to implement **supply chain** management systems. For example, it has simplified the ability to **exchange purchase** orders, track shipments, and determine inventory levels.

DECISION-MAKING AND THE SOPPLY CHAIN

To **maximize the value added** along **the supply chain, it is necessary to make decisions and evaluate their potential impact. For example, in inbound logistics one must decide where, when,** and how much to buy. **Inbound materials can be transported in various ways; the question is which one to select. In each link of the chain, decisions** must **be** made on **how to** move **materia!, information, and money so as to most** increase the value.

Supply chain management **methods** are **even affecting nonmanufacturing operations.** For example, **the** Public Broadcasting Service **in** the **United States has adapted** SCM concepts to reinvent the way it distributes its **programming. See DSS in Action** 8.18 for how this is done. **And** see **Anthes** (2003) for some **details and a diagram of the** PBS supply chain.

Supply chain management software is available for decision **support for both primary** and secondary activities, including optimization **of manufacturing processes (see** www.manugistics.com), scheduling, inventory management, **and procurement. These** activities and others are described in Section 8.12.

Spccial DSS BIBA models can determine the costs **and benefits of investing in** information technologies in an attempt to create value **along the supply chain. The** implementation of DSS in **the** supply chain environment is **complex because of the difficulties** and uncertainties along the way. Let us explain.

DSS IN ACTION 8.18

PBS TELEVISION S BRAVE NEW SCM

The U.S. Public Broadcasting Service (PBS) is leading the television industry in adapting supply chain management methods in how it manages and distributes programs. By 2006, its overhaul will fundamentally change the dynamics and economics of TV broadcasting. In 2003, PBS distributed programs to its 177 member stations as real-time video streams from satellites. A single show might be sent a dozen times depending upon time zones, scheduling, and weather conditions. Someone at the receiving end generally had to be there to *catch* the transmission. This programming *chain* was fraught with labor-intensive activities that created problems. And the equipment needed to make it work could cost more than $10 million. PBS's new approach involves PCs, store-and-forward IP-based file transmissions, no videotape, and software (including metadata) to replace the manual operations.

The new system allows member stations to pull content into their schedules, as opposed to PBS pushing the content to them. Pilot testing took place in 2003, and by mid-2004 the first production operations were online.

The new system has increased broadcast reliability and will save member stations more than $100 million annually. The industry will probably adopt these concepts worldwide because of the savings and quality improvements.

Source: **Adapted from Gary H. Anthes, "TV for the 21st Century,"** *ComputerWorld,* **July 21,2003, p. 32.**

8.11 SUPPLY CHAIN PROBLEMS AND SOLUTIONS

INTRODUCTION

Adding value along the supply chain is essential for competitiveness or even survival. Unfortunately, such additions are limited by many problems along the chain.

Supply chain problems have been recognized both in the military and in business operations for generations. Some of them have caused armies to lose wars and companies to go out of business. These problems are most evident in a complex or long supply chain and in cases where many business partners are involved.

There are hundreds of examples of companies that were unable to meet demands or had inventories too large and too expensive to maintain. Several other problems are typical in a supply chain; for example, lack of overall supply chain strategy and failure to recognize the full range of organizational implications. Many companies erroneously think that good SCM can be attained only through an ERP (ERM is also used for ERP) system.

Companies that experience such problems sometimes pay substantial penalties or even end up going out of business. On the other hand, some world-class companies, such as Wal-Mart, Federal Express, and Dell, have superb supply chains with innovative applications.

An interesting supply chain decision-making problem involved the difficulty of fulfilling orders received electronically for toys during the holiday season of 1999-2000. During the last months of 1999, online toy retailers, including eToys, Amazon.com, and Toys.'R'Us, conducted a massive advertising campaign for Internet orders featuring $20- to $30-discount vouchers. Customer response was overwhelming, but some retailers had underestimated the demand and as a result made incorrect ordering, inventory, and shipment decisions. In consequence they were unable to obtain the necessary toys from manufacturing plants and warehouses and deliver them to customers by Christmas Eve. Hershey's Chocolate experienced a similar problem

DSS IN ACTION 8.19

AV1ALLS WEB-BASED LOGISTICS SCM HITS THE SPOT

Aviall Inc. was saved from financial disaster by a controversial $40 million IT project that included developing a marketing Web site as a key element. This transformed Aviall from a catalog business into a full-scale logistics business (SCM) that hundreds of aviation parts manufacturers and airlines depend on for ordering, inventory control, and demand forecasting. Aviall is now the logistics back-end for the aviation firms. The Aviall systems-integration work took place despite the shrinking of the airline industry.

The $3 million Web logistics system has reduced the cost of ordering from $9 per order to $0.39. The Web site generates $60 million (7.5%) of the company's $800 million annual revenue. Over three to five years, the firm expects this to rise to 30 percent of total revenue.

Source: **Adapted from Steve Alexander, "Web Site Adds Inventory Control and Forecasting,"** *ComputerWorld,* **February 24,2003, p. 45.**

when the foundation of its ERP for SCM was built on low data quality and accuracy (see DSS in Action 6.15 and Carr, 2002). This almost bankrupted the firm. Hershey's finally got it right through a new ERP implementation. On the other hand, proper implementation of an SCM systems, along with accurate and timely data, can streamline operations and lead to business opportunities. Aviall invested heavily in a Web-based SCM system that saved it from going under and created new business opportunities, including a major contract from Rolls-Royce PLC (see DSS in Action 8.19 and DSS in Action 5.11).

In the remaining portion of this section we will look closely at some specific problems in managing the supply chain and some proposed solutions, many of which are supported by information systems.

TYPICAL PROBLEMS ALONG THE SUPPLY CHAIN

Problems along the supply chain stem mainly from *uncertainties* **and the need to coordinate several activities and/or internal units and business partners.**

The major source of uncertainties is the *demand forecast,* **which can be influenced by several factors, such as competition, prices, weather conditions, and technological developments. Similar problems occur in forecasting the costs of marketing, raw materials which may be commodities, and transportation. Other uncertainties exist in** *delivery times,* **which depend on many factors ranging from machine failures to road conditions. Quality problems with materials and parts can also create production time delays, and traffic jams can interfere with shipments. Worthen (2003) describes some major issues in demand forecasting and how such systems must be integrated with SCM. Also see DSS in Action 8.20.**

Many other factors can cause supply chain problems (for details, see Jacobs and Whybark, 2000). A major symptom of poor SCM is poor customer service—meaning that people do not get the product or service when and where it is needed, or that they get poor-quality goods and services. Other symptoms are high inventory costs, loss of revenue, and extra costs for special shipments and for expediting shipments.

Other problems in SCM involve obtaining and maintaining accurate real-time data on the supply-chain status, and integrating supply chain information into other enterprise information systems. Access to accurate SCM data is critical for the system

DSS IN ACTION 8.20

NIKE'S FORECASTING SYSTEM RUNS INTO OBLIVION

Nike, the sneaker giant, spent some $400 million in developing state-of-the-art forecasting software. Nike deployed its i2 forecasting system in June 2000, and nine months later Nike executives acknowledged that they would be taking a major inventory write-off because the forecasts from the automated system were very inaccurate. With this announcement in February 2001, Nike's stock value plummeted, along with its reputation as an innovative user of technology. Court documents from shareholder lawsuits indicate some of the inherent limitations of demand-forecasting software. The i2 forecasting system did not communicate with Nike's existing systems, impairing its ability to analyze large amounts of product information. Some data were entered manually, greatly increasing the likelihood of mistakes. Most important, the forecasts were very inaccurate. Relying exclusively on the automated projections, Nike ordered $90 million worth of shoes, such as the Air Garnett II, that became very poor sellers. The company also had a shortfall of $80 million to $100 million on popular models like the Air Force One.

Source: Adapted from Ben Worthen. "Future Results Not Guaranteed," *CIO,* July 15,2003.

to succeed. Although many firms claim they now have a better view into their.supply chains, a more realistic picture has emerged. **Supply chains are often poorly understood, filled with data** that **are poorly** or **inadequately mined or used, and create opportunities for** competitors. According **to** the **Bain and Company survey "Why Companies Flunk Supply Chain** 101," 85 **percent** of 162 senior **executives placed a top priority on improving supply chain performance, but only 10 percent of them properly tracked it, while only 7 percent** collected **the** right **information to report correct metrics on their progress. Only one-third of them tracked performance beyond their own enterprise (see** Zipperer, 2002). Part **of the** problem **is cultural,** and **part derives from not being able to track the data.** It **is crucial to** *gather* **accurate and timely data throughout the supply** chain to enable better decision-making. **"Ibis** presents **an opportunity for software vendors,** and especially for organizations using **SCM tools to obtain real-time supply chain information. Vendors like i2 Technologies, Manugistics Group, Oracle, SAP, and PeopleSoft are** rising to the **occasion** (see **Bacheldor, 2003a; Zimmermann, 2003). RFID (radio-frequency identification tag) technology promises to improve SCM efficiency** by **more accurately tracking pallet and other cargo movement. For more on RFID technology and its potential impacts in SCM, see Bacheldor (2003a), Edwards (2003), Kimball (2003), Ewalt (2002,2003), and Chapter 5.**

There are a number of ways to integrate SCM systems into other enterprise information systems. Database vendors (e.g., IBM, Oracle) that sell large data warehouse technology, and other business intelligence vendors (e.g., Cognos, Hyperion) provide integrated SCM (see Songini, 2003a). The most typical blends are with ERP, EIS, and CRM. The critical issue is getting accurate data shared among the applications. Even artificial intelligence approaches can be integrated (see Nissen, 2001).

SOLUTIONS TO SUPPLY CHASM PROBLEMS

Over the years organizations have developed many solutions to supply **chain problems. One** of the earliest was vertical integration. For example, Henry **Ford purchased** rubber plantations **in** South America **in** order to control tire production. **Undoubtedly, the most** common solution used **by** companies **is** building *inventories* **as insurance**

against uncertainties. With this approach,, products and parts flow smoothly. The main problem is that it is very difficult to determine inventory levels correctly, which must be done for each product and part. When inventory levels are set too high, the cost of keeping the inventory is very high. When the inventory is too low, there is no insurance against high demand or slow delivery (lead) times, and revenues (and customers) may be lost. In either event, the total penalty cost, including opportunities lost and bad reputation gained, can be very high. Thus, major attempts are made to properly control inventory, as shown in DSS in Action 8.2,1.

Proper SCM and inventory management require making decisions and coordinating the different activities and links of the supply chain so that goods can move smoothly and on time from suppliers to customers. This practice keeps inventories low and costs down. Coordination is needed because companies depend on each other but do not always work together toward the same- goal.

Effective SCM requires that suppliers and customers work together in a coordinated manner by sharing and communicating the information necessary for decision-making. For example, Wal-Mart allows its major suppliers to enter its intranet and retrieve sales data on a daily basis. Thus, the suppliers can make better production-

DSS IN ACTION 8.21

HOW LITTLEWOODS STORES IMPROVED ITS SCM

Littlewoods Stores is one of Britain's largest retailers of high-quality clothing, with 136 stores throughout the United Kingdom. The retail clothing business is very competitive, and so in the late 1990s the company embarked on an IT-supported initiative to improve its supply chain efficiency. A serious SCM problem was overstocking.

In order to get better SCM, the company reengineered its supply chain processes. It first introduced a Web-based performance-reporting system. Using DSS models, the system analyzes marketing and finance data, space planning, merchandizing, and purchasing data on a daily basis. For example, merchandizing can now perform sophisticated sales, stock, and supplier analyses to make key operational decisions on pricing and inventory.

Using the Web, analysts can view sales and stock data in veritably any grouping of levels and categories, even at SKU (merchandise part number) and day levels. Furthermore, users can easily drill down to detailed sales and other data. The system uses a data warehouse, DSS/BI/BA, and other end-user-oriented software to make better decisions. Here are some *other* examples of decisions made and their results:

- The ability to strategically price merchandise differently in different stores saved $1.2 million in 1997 alone.
- Better inventory management eliminated $17 million of overstocked inventory and saved a margin of roughly $4 million.
- ® Better inventory management reduced the need for stock liquidations saving $1.4 million a year in inventory operating costs.
- The average stock-to-store lead time of 48 days was reduced to five days, improving overall responsiveness to customer demand.
- ° Marketing distribution expenses were cut by $7 million a year.
- ® Strategically pricing merchandise differently according to location, accounting for regional variation, and encouraging sales saves $1.2 million per year.
- ® Reduction in logistic employees from 84 to 49 people saves about $1 million annually.
- Reducing backup inventory expenses by about $4 million a year. For example, because of quick replenishment, stock levels went down by 80 percent.

'Within a year there were more than 600 Web-based users, and the data warehouse grew to over 1 gigabyte.

Source: Adapted from "Customers' Success Stories," and press releases at the MicroStrategy Corporation's Web site, www.microstrategy.com, January 2000.

scheduling decisions. Wal-Mart Stores Inc. built an intelligence-sharing inventory and supply chain management system that changed the face of business. See Johnson (2002) for a history of the Wal-Mart experience; some details appear in Chapter 5. A rapid flow of information along the supply chain makes suppliers very efficient. Therefore, suppliers and buyers must participate together in the design of supply chains to achieve their shared goals. In fact, Wal-Mart does not officially take ownership of certain classes of merchandise until sold.

Collaboration along the supply chain is critical, but not sufficient for SCM success. Though optimization is also necessary (see the preceding section). Konicki (2002) describes how better collaboration along the retailing supply chain could save the industry $40 billion annually. In 2002, Sears, Roebuck ran supply chain collaboration tests with Michelin North America tires. Sears successfully avoided a catastrophe by opening up its supply chain data to Michelin, which boosted production to avoid a forecasted shortfall due to a major sale. See Konicki (2002) for details. See Lee-Young and Barnett (2001) for details on the need for real-time collaboration and communication along the retail-fashion supply chain.

To properly control the uncertainties mentioned earlier, it is necessary to understand what causes the uncertainties, determine how the uncertainties will affect other activities up and down the supply chain, and formulate ways to reduce or eliminate the uncertainties. The problem is exacerbated by insufficient utilization of optimization and descriptive (typically simulation) models in SCM. Combined with these issues is the need for an effective, efficient communication environment for all business partners. For example, computerized POS information can be transmitted once a day, or even in real-time, to distribution centers, suppliers, and shippers. This enables optimal inventory levels.

The following are some other solutions to SCM problems:

- Use outsourcing rather than do it yourself during demand peaks.
- Similarly, "buy" rather than "make" whenever appropriate.
- Configure optimal shipping plans.
- Optimize purchasing.
- Create strategic partnerships with suppliers.
- Use a just-in-time approach to purchasing so that suppliers quickly deliver small quantities whenever supplies, materials, and parts are needed.
- Reduce the number of intermediaries, which usually add to supply chain costs, by using electronic commerce for direct marketing.
- Reduce the lead time for buying and/or selling by automatic processing using EDI or extranets.
- Use fewer suppliers.
- Improve the supplier-buyer relationship.
- Manufacture only after orders are in, as Dell does with its custom-made computers.
- Achieve accurate demand by working closely with suppliers.
- Apply true optimization and descriptive models to SCM.

Most of the above solutions are enhanced by IT support, especially in the form of enterprise resource planning (ERP) systems. But it is important to note that even in the e-commerce arena, products and services *must be delivered.* Aksoy and Derbez (2003) present a supply chain management systems product review. Check the *OR/MS Today* Web site for updates.

8.12 MATERIALS REQUIREMENT PLANNING (MRP), ENTERPRISE RESOURCE PLANNING/ENTERPRISE RESOURCE MANAGEMENT (ERP/ERM), AND SUPPLY CHAIN MANAGEMENT (SCM) SYSTEMS

The concept of the supply chain is interrelated with the computerization of its activities as they have evolved over the last 50 years. See Hugos (2003) and Sheikh (2003) for background details.

THE EVOLUTION OF COMPUTERIZED SUPPLY CHAIN AIDS

Historically, many supply chain activities were managed with inefficient and ineffective paper transactions. Since the early business utilization of computers, attention has been given to the automation of processes along the supply chain. The first software programs appeared in the 1950s and the early 1960s and supported short segments along the supply chain. Typical examples are inventory-management systems, scheduling, and billing. The major objective was to reduce costs, expedite processing, and decrease errors. Such applications were developed in the functional areas independently of each other.

It soon became clear that there were interdependencies between some supply chain activities. Early on, for instance, it was realized that production schedules are directly related to inventory management and purchasing plans. The material requirements planning (MRP) model was devised in the 1960s. Since this model often required daily updating, the need for computer support was obvious. This resulted in commercial MRP software packages.

MRP systems involve inventory models with lead times, a master production schedule of all final products (which may be demand forecast-driven), and bills of materials for every assembly. The bills of materials are a list of all the components of an assembly or final product. They form a tree structure of interrelated parts from the tiniest parts to the major assemblies that form each final product. The MRP system takes a proposed production schedule of final products and, using lead times and existing inventory records, backtracks through the records to create a parts explosion, which is a list of batches of parts that must be produced, and when, to meet the lead-time requirements of the parts and final products. Ideally a smooth production plan is generated, utilizing a factory's overall capacity at as close to 100 per cent as possible. Capacity requirements planning (CRP) was developed to smooth out the MRP plan based on a factory's specific and overall machine center capacities.

While MRP packages were useful in many cases, helping to drive inventory levels down and streamlining portions of the supply chain, they often failed. One of the major reasons for their failure was the realization that schedule/inventory/purchasing operations are closely related to both financial and labor resources. This realization resulted in an enhanced MRP methodology and software called manufacturing requirements planning, or MRP II.

During this evolution, information systems became more and more integrated. This led to the concept of enterprise resource planning (ERP), which concentrated on integrating enterprise transaction-processing activities. Later, ERP was expanded to include internal suppliers and customers, and then external suppliers and customers, in what is known as extended ERP/SCM software.

WHY INTEGRATION?

Creating a twenty-first-century enterprise cannot be done effectively with functionally oriented twentieth-century computer technology. Different departments using functional systems may be unable to communicate with each other in the same language. Worse yet, crucial sales, inventory, and production data often have to be painstakingly entered manually into separate computer systems each time a person who is not a member of a specific department needs ad hoc information related to the specific department. In many cases employees simply do not get the information they need, or they get it when it is too late.

Sandoe and Saharia (2001) list the following major benefits of integration (in order of importance):

- *Tangible benefits:* inventory reduction, personnel reduction, productivity improvement, order-management improvement, financial close-cycle improvements, IT cost reduction, procurement-cost reduction, cash-management improvements, revenue and profit increases, transportation logistics-cost reduction, maintenance reduction, and on-time delivery improvement.
- *Intangible benefits:* information visibility, new and/or improved processes, customer responsiveness, standardization, flexibility, globalization, and business performance.

Note that in both types of benefits, many items are directly related to improved SCM. For a further discussion of the improvements integration has provided to SCM, see the white paper "Competition's New Battleground: The Integrated Value Chain" at www.cambridgetechnology.com.

INTEGRATING THE SUPPLY CHAIN

For generations the various links of company supply chains were managed independently of each other. However, since the 1950s, and thanks to the introduction of computer-based information systems, companies have started to integrate these links. Integration was facilitated by the need to streamline operations in order to meet customer demands in the areas of product and service costs, quality, delivery, technology, and cycle time brought about by increased global competition. Furthermore, the new forms of organizational relationships and the information revolution, especially the Internet and electronic commerce, brought SCM to the forefront of attention. See DSS in Action 8.22.

ENTERPRISE RESOURCE PLANNING/ENTERPRISE RESOURCE MANAGEMENT (ERP/ERM)

With the advance of enterprise-wide client/server computing comes a new challenge: how to control all major business processes with a single software architecture in real-time. The integration solution, known as enterprise resource planning (ERP) (sometimes called enterprise resource management, ERM), promises benefits from increased efficiency to improved quality, productivity, and profitability (for details, see Umble and Umble, 2002). The name ERP is somewhat misleading because the software does not concentrate on either planning or resources. A major objective of ERP is to *integrate* all departments and functions across a company into a single computer system that can serve the entire enterprise's needs. For example, improved order entry allows immediate access to inventory, product data, customer credit history, and prior order information. This raises productivity and increases customer satisfaction. One

DSS IN ACTION 8.22

HOW WARNER-LAMBERT APPLIES AN INTEGRATED SUPPLY CHAIN

It all begins on eucalyptus farms in Australia, where the fast-growing trees produce some of the materials used in Listerine antiseptic mouthwash, one of the major products of Warner-Lambert (WL). The materials collected from eucalyptus trees are shipped from Australia to the WL manufacturing plant in the United States. WL's major problem is to determine how much Listerine to produce. Listerine is purchased by thousands of retail stores, some of which are giants, such as Wal-Mart, and many of which are small. The problem that the manufacturing plant faces is how to forecast the overall demand. A wrong forecast will confront WL either with excessive inventories or with shortages. Maintaining inventories is expensive, and shortages may result in loss of business and reputation.

WL forecasts demand with the help of Manugistic's Demand Planning DSS. (Manugistics is an SCM software vendor). Used with other products in the Manugistics Supply Chain Planning Suite, the system analyzes manufacturing, distribution, and sales data against expected demand and business-climate information to help WL decide how much Listerine (and other products) to make and distribute, and how much of each raw ingredient is needed. For example, the model can anticipate the impact of promotions or of a production line being down. The sales and marketing groups at WL meet monthly with employees in finance. procurement, and other departments. The groups enter the expected demand for Listerine into a Marcam Corporation Prism Capacity Planning DSS that schedules the production of Listerine in the amounts needed and generates electronic purchase orders for WL's suppliers.

WL's supply chain excellence stems from its innovative collaborative planning, forecasting, and replenishment (CPFR) program. WL launched CPFR a few years ago when it started sharing strategic plans, performance data, and market insight with Wal-Mart Inc. over private networks. The company realized that it could benefit from WL's market knowledge just as Wal-Mart could benefit from its product knowledge. During the CPFR pilot, WL increased its products' shell-fill rate—the extent to which a store's shelves are fully stocked—from 87 percent to 98 percent, earning the company about $8 million a year in additional sales, or the equivalent of a new-product launch. WL now uses the Internet to expand the CPFR program to all its suppliers and retail partners.

Source: Compiled and adapted from *Store,* June 15,1998; *CIO,* August 15,1998; Manugistics' Logistics Management and Distribution Reports, November 1999.

option is to self-develop an integrated system by using existing best-of-the-breed functional commercial packages or by programming your own systems. The other option is to use commercially available integrated software known as ERP. The leading software for ERP is SAP R/3. Oracle, ID. Edwards, Computer Associates, PeopleSoft, and Baan Company provide similar products. All include Web modules designed to be easily accessible from a company's enterprise portal. (SAP AG includes J2EE compliance in its application server: see Taft, 2003.) These software packages have been widely adopted and have been extended to include decision support tools designed to increase their integration with organizational EIS systems. Several takeovers and mergers of major ERP and CRM providers were in progress in 2003 (see Ferguson and Vaas, 2003). This obviously leads to consolidation of products and services, and the creation of software with, hopefully, the best features of each. For details, see Ferguson and Vaas (2003), McCright (2003a), and Songini (2003d, 2003e), among others.

ERP systems are based on a value-chain view of the organization in which functional departments coordinate their work. ERP systems integrate an organization's business activities by storing data about those activities in a centralized database. Enterprise resource planning systems are designed to enhance competitiveness by upgrading an organization's ability to generate timely, accurate information throughout the enterprise and its supply chain. Commercially available software packages

promise seamless integration of all information flows: financial and accounting, human resource, operations, supply chain, and customer information, providing a unified view of the business, encompassing all functions and departments by establishing a single enterprise-wide database in which all business transactions are entered, recorded, processed, monitored, and reported (see Umble and Umble, 2002).

A successful ERP implementation can shorten production cycles, increase the accuracy of demand forecasts, improve customer service, and trim excess operating expenses; it may lead to a reduction in overall information technology costs by eliminating redundant information and computer systems (see Umble and Umble, 2002). It may also lead to better inventory control and use. Flextronics International, a $1.1 billion Singapore-based firm, deployed an ERP to its 26 locations worldwide. The company improved its inventory turnover immediately. Its own managers shop online in their internal store. The consolidated supply inventory helps Flextronics purchasing managers negotiate better terms with suppliers (see Legare, 2002).

See Koch (2002) for an ERP primer and the "ERP Life Cycle Focus Guide: Planning, Execution and Post-Implementation" (available from www.cio.com), which examines best practices and decision-making needed to successfully harness ERP during its life cycle. For additional background on ERP, see Buchanan, Daunais, and Micelli (2000), Langenwalter (2000), and Ptak and Schragenheim (2000).

ERP software crosses functional departments and can be extended along the supply chain to suppliers and customers. Companies have successfully integrated hundreds of applications using ERP software, saving millions of dollars and significantly increasing customer satisfaction. For example, Mobil Oil consolidated 300 different information systems by implementing SAP R/3 in its U.S. petrochemical operations. ERP forces discipline and organization around business processes, making the alignment of IT and business goals more likely. Moreover, by using ERP a company discovers all the "dusty corners" of its business. Hershey's Chocolates learned this lesson (DSS in Action 6.15) when, in its first ERP implementation, it neglected to indicate to the ERP where its inventory was stored (this was always done informally in anticipation of a major demand spike). The ERP was unaware of the inventory, and consequently the firm was unable to meet demand during its busiest season (see Carr, 2002). Mobile Oil also experienced a major failure in implementing an ERP for SCM.

An ERP suite provides a single interface for managing all the routine activities performed in manufacturing—from entering sales orders to coordinating shipping, as well as after-sales customer service. This collaboration is extremely important in manufacturing. For example, Dow Corning extended its ERP (SAP R/3) with some of the best collaboration and electronic document management (EDM) tools available. The EDM manages critical content that includes over 2 million active materials-based data sheets for developers, customers, and partners. The collaboration tools provide e-mail services and Web collaboration tools (see Ericson, 2003). And Herman Miller extended the capabilities of its ERP system to include real-time communication and decision-making for all users in its MySIGN portal. Along with 150 internal users are 400 supplier users. More recently, ERP systems have begun to incorporate functionality for customer interaction and managing relationships with suppliers and vendors, making the systems less inward-looking.

ERP has played a critical role in getting small- and medium-sized manufacturers focused, which facilitates business-process changes across the enterprise. Vendors continue to create products to meet their needs. These include the SAP Business One Suite, the PowerEasy Corp. ERP suite for the Mac OS X, and ERP systems from Best Software and Microsoft (see Ferguson, 2003; Vizard and Darrow, 2003). Integrating multiple plants and distribution facilities results in better supply chain management.

The cost of a modest ERP implementation can range from $2 million to $4 million, depending on the size of the organization and the specific products and services purchased from vendors. The cost of a full-blown implementation in a large organization can easily exceed $100 million. A recent survey of 63 companies with annual revenues ranging from $12 million to $63 billion indicated that the average implementation cost $10.6 million and took 23 months to complete (see Umble and Umble, 2002). An important financial issue is when and how much to spend to upgrade an ERP. According to AMR Research (see Low and Goldberg, 2002), most companies that are upgrading their ERP systems spend their money in the following categories: professional services (23-28%), hardware (20-24%), employee labor and training (16-23%), software for upgrades (8-15%), additional software (9-15%), and networks (7-10%).

Despite the expense, the returns can be staggering when ERP succeeds, Owens Corning saved $50 million in logistics, materials management, and sourcing through its ERP. The system also led to inventory reductions because material planners had access to more up-to-date and accurate data that improved the company's ability to track and control system-wide inventory and forecast future demand (see Umble and Umble, 2002). For a comprehensive treatment of the costs, implementation problems, and payback of ERP, see Koch et al. (2002).

SECOND-GENERATION ERP

First-generation ERP aimed at automating key business office processes. During the 1990s, it provided an additional benefit. Companies that were using home-grown ERP systems were faced with the expensive task of expanding to support a four-digit year as a result of the then upcoming year 2000. ERP package system implementation provided the additional benefit of compliance (a benefit now taken for granted). And indeed, ERP projects saved companies millions of dollars. By the late 1990s the major benefits of ERP had been exploited, but the ERP movement was far from over. A second, more powerful generation of ERP development started with the objective of leveraging existing systems to increase efficiency in handling transactions, improve decision-making, and further transform ways of doing business.

As you may recall, in Chapter 5 OLTP and OLAP were treated as two different but complementary activities. First-generation ERP basically supported OLTP and other routine transactional activities. For example, an ERP system has the functionality of electron'c ordering, or the best way to bill the customer—all it does is automate the transactions.

The reports generated by ERP systems provided planners with statistics about what happened in the company, costs, and financial performance. However, with ERP the planning systems were rudimentary. Reports from ERP systems provided a snapshot of time, but they did not support the continuous planning activities central to supply chain planning, a system that Continues to refine and enhance the plan as changes and events occur, up to the very last minute before the plan is executed.

This deficiency created a need for decision-making-oriented systems, and this is what SCM and business intelligence software vendors provided. These products offer DSS/BI/BA capabilities in short segments of the supply chain. As an illustration, we look at the ERP and SCM approaches to the planning problem. There is a fundamental difference between the two; in SCM the question becomes, "Should I take your order?" instead of the ERP approach, "How can I best take or fulfill your order?"

Thus, SCM systems have emerged as a *complement* to ERP systems to provide intelligent decision support capabilities. An SCM system can be designed to overlay existing ERP systems and to extract data from every step of the supply chain, provid-

ing a clear global picture of where the enterprise is heading. Creating a plan from an SCM system allows companies to quickly assess the impact of their actions on the entire supply chain, including customer demand. Therefore, it makes sense to integrate ERP and SCM. ERP implementations are also integrating with capacity planning, CRM, and real-time performance analysis systems (see Ferris, 1999). ERP integration with e-commerce efforts is also important (see Siau and Messersmith, 2002).

How Is SUCH INTEGRATION DONE?

One approach to achieving such integration is to work with different software from different vendors for example, using SAP as an ERP, and adding Manugistics manufacturing-oriented software, as shown earlier in the Warner-Lambert case. Such an approach calls for integrating and fitting together different software, which may be a complex issue unless special interfaces exist. A suboption is to use advanced planning and scheduling (APS) packages, which are modules that can be integrated with ERP or total SCM. APS helps in optimizing production and ensuring that the right materials are in the right warehouse at the right time to meet customers' demands.

The second approach is for ERP vendors to add decision support and business intelligence capabilities, which solves the integration problem. But, as in the integration of DBMS and spreadsheets in Excel or Lotus 1-2-3, you get a product with some weaker functionalities. Most ERP vendors add such functionalities for another reason: because it is cheaper and easier for the customer. The added functionalities, which create the second-generation ERP, include not only decision support but also CRM, electronic commerce, and data warehousing and mining. Companies were eager to use post-ERP systems, as shown in DSS in Action 8.23.

The third option is to rent applications rather than build systems. When applications are rented, the ERP vendor (or other rentee) takes care of the functionalities and the integration problems. This relatively new approach is known as the ASP alternative.

APPLICATION SERVICE PROVIDERS AND ERP OUTSOURCING

An application service provider (ASP) is a software vendor who leases ERP-based applications, including those with DSS capabilities, to organizations. The basic concept is the same as old-fashioned time-sharing. The outsourcers set up the systems and run them for you. Use of ASP is considered a risk management strategy and it best fits small- to middle-sized companies.

The ASP concept is especially useful in ERP projects that are expensive to install, take a long time to implement, and are hard to staff. However, an ASP offering is also evident in ERP-added functions such as DSS/BI/BA, EC, CRM, data marts, desktop productivity, and other supply chain-related applications.

The use of an ASP has some downsides. First, ERP vendors demand a five-year commitment, but in five years ERP software may change drastically and purchase prices may fall dramatically. Second, flexibility is lost. Rented systems are fairly standard and may not fit your needs. Transition from a rented system can be expensive and time-consuming.

ERP PROBLEMS AND FAILURES

An ERP can help organize and manage a firm's supply chain, thereby leading to dramatic overall savings in production and management costs. Despite their strategic importance, ERP implementations report an unusually high failure rate, sometimes jeopardizing the core operations of the implementing organization (Hong and Kim,

HOW U.S. COMPANIES ARE SUCCEEDING WITH ERP C ^ x ® ^

Here is how **several** U.S. companies are succeeding with. **ERP installations.**

- *Owens Corning,* a maker of building materials, **changed its** business **model** and corporate thinking **in 1999. For example, instead** of selling shingles and **roofing vents separately, it started to sell complete roofing systems that include parts, installation, delivery, and other services. To do this economically, the company uses business intelligence (data warehouse and mining) to analyze the data generated by** the ERP **system (from SAP). The** data **warehouse provides** valuable **information** on customer **profitability, product line profitability, sales performance, and** SCM **activities.** The ERP **is also integrated with shop-floor** process **control that uses SCM software.**
- *General **Instruments,*** **a telecommunications equipment** maker, **and** SCM **software vendor, pushes parts data into Metaphase's product** management **tool. From there data** enter Oracle's ERP **system. Previously product data** were **entered manually into each system, resulting in high costs and many errors. The company** also **uses product configuration tools that** assist **the sales force and manufacturing department to ensure that certain product configurations are possible before orders are placed on the** ERP. **More than 3,000 component suppliers have direct access to product data over the Web using Metaphase's technology.**
- *Mollerblade Inc.,* an **in-line skate maker, uses an** ERP **(from** J. D. Edward) as **the platform for the company's forecasting, sales-force automation, and** data warehousing systems. **With the ERP integrated** platform, decision **support activities were** ineffective. Now a **profitability and sales analysis** by product, region, and time **is done regularly and** effectively.
- ® *Motfs North **America*** **installed ERP and found** that it **did not address its marketing and customer** service problems **properly. Using SAP's advanced** features, **the company added production planning and shipment Scheduling optimization. Integration** with electronic commerce **was also achieved. Now, for example, distributors can use the Web to check their order status by themselves with the R/3 system.**

2002).There **have been many dramatic** and **expensive** ERP **failures (see DSS in Action 8.24). We have mentioned** the **Hershey Chocolates ERP failure several times. Hershey rushed to deploy the system without carefully considering what it actually did. Data** inaccuracies plagued the system and created massive disruptions in operations. **See** DSS in Action 8.25.

In 1998, the **city** of Atlanta, Georgia, implemented **a PeopleSoft ERP system that cost over $10** million. The **system** worked **so poorly that the city eventually had to discard it.** The **intention of the deployment was to handle Y2K issues in a rush. Instead of evaluating and improving** existing **business** processes, **the city pushed** its **consultants to** modify the program to handle the existing ones. **Paper** methods were **not abandoned, and** there was **a** serious **lack of** training **and** skill in the IS group **responsible for the** ERP. See Bennett (2002). Also see Case Application 8.2 on **McDonald's major disaster** when implementing **a** major enterprise information system.

A successful ERP can be the backbone of business **intelligence for an organization,** giving management a unified view of its processes. **But** in **June 2000, Frank Gillett,** then a senior analyst with Forrester Research, Inc., stated, "It**'s been our experience that** most of the ERP [vendors] don't understand **decision support and when they try** to implement **it,** don't do it well" (Menezes, 2000). When used **appropriately, ERP software** integrates information used by the accounting, **manufacturing, distribution, and** human resources departments into a seamless computing **system. However, there are** challenges that come with implementing an ERP system. ERP **implementations fail** more often than not **(Legare,** 2002). **When** ERP implementation **fails, it** is **usually**

DSS IN ACTION 8.24

NOTABLE ERP IMPLEMENTATION FAILURES

In the September 30, 2002 issue of *ComputerWorld* (Anonymous, 2002) appears a list of the top 10 corporate IT failures in the 1990s. Several of them were major ERP implementations. These include the

- **SAP ERP system for drug distributor FoxMeyer Corp. The system's deficiencies allegedly helped drive the firm into bankruptcy.**
- **SAP ERP system for W.W. Grainger, Inc. Grainger spent at least $9 million on SAP software and services in 1998 and 1999. During the worst six months, Grainger lost $19 million in sales and $23 million in profits.**
- **IBM-led installation and integration of SAP for Hershey Foods Corp. Hershey lost 12 percent of sales in its busiest 1999 Halloween and Christmas candy season.**
- **Oracle ERP and application integration for the agricultural cooperative Tri Valley Growers. Tri Valley bought over $6 million in ERP software and services in 1996. It eventually stopped using the software and stopped paying the vendor. Oracle denied all claims. The case was settled in January** 2002.

because the organization did not dedicate enough time or money to training, and to managing culture-change issues. See Gale (2002). In fact, training is often last-minute and weak (Gale, 2002).

The successful implementation of an enterprise resource planning (ERP) system is a massive task. For an organization to reap the benefits of ERP, it must first develop a plan for success. But the organization must be prepared to be reengineered, with its staff disrupted and a drop in productivity, before the payoff is realized (see Umble and Umble, 2002).

ERP systems take a lot of time and money to implement. ERP system implementations disrupt a company's culture, create extensive training requirements, and lead to

DSS IN ACTION 8.25

HERSHEY S EVENTUAL SWEET SUCCESS IN ERP

Hershey Foods Corp. ran into major problems when it deployed SAP AG's R/3 ERP software and other business applications in 1999. In September 1999, Hershey's former CEO and chairman, Kenneth L. Wolfe, announced that problems with the ERP were going to prevent the company from delivering $100 million worth of Kisses and Jolly Ranchers for Halloween that year. Hershey's stock price fell more than 8 percent that day. Analysts did not fully trust Hershey's ability to deliver candy until the following fall, when things had long gone back to normal. Hershey's experience is pretty average. Studies have shown that most companies that install enterprise software are late, their business processes suffer temporarily, and their revenue can take a hit for as long as six months. One ERP expert has quipped that implementing ERP is like pouring cement on your business processes.

Fortunately, the candy maker had better luck with its upgrade to the Web-based version of R/3, started in July 2001 and completed in May 2002. The cost of the upgrade was 20 percent below budget, with none of the order-processing and product-shipment disruptions caused by the $112 million system in 1999. In addition, Hershey's made more than 30 improvements to its core business processes within 60 days of deploying the new system. Costs have been reduced, as have processing times. The system has achieved a near-zero defect production environment and, using SAP's business analysis tools, can measure the impact of sales and marketing programs instantaneously.

Source: **Adapted from Lave Low and Michael Goldberg, "Hershey's Bittersweet Lesson," *CIO,* November 15,2002, pp. 22-24; Todd R. Weiss, "Hershey Upgrades R/3 ERP System Without Hitches," *ComputerWorld*, September 9,2002, p. 25.**

productivity dips and mishandled customer orders that can temporarily damage the bottom line. Between 50 percent and 75 percent of U.S. firms have experienced some level of failure when implementing advanced manufacturing or information technology (see Umble and Umble, 2002).

ERP implementation is a transformation in the way an organization does business, and should be viewed as such by top management. There are a number of reasons why an ERP fails. Many failures are predictable, but overzealous CEOs and/or CIOs push the system to perform in ways for which it is not designed. Often data are simply unavailable, or cost excessive amounts to obtain. ERP definitely forces a *formalization* of business processes, which some firms are reluctant to do. Enterprise software is difficult to work with and expensive. Implementations take a long time. It is hard to get people to change the ways they work so that the system will function correctly. But they eventually adapt. And there will be problems at first because enterprise software is not just software. It requires changing the way business is done.

Some of the biggest ERP system implementation failures occur because the new software's capabilities and needs are mismatched with the organization's existing business processes and procedures. An ERP system that is not designed to meet the specific business needs of the company can cause major problems. A significant mismatch between the technological capabilities of the system and the existing structure, processes, or business needs of the organization will generate major disruptions. Less severe mismatches between business processes and software requirements will create significant problems for implementers and users (see Umble and Umble, 2002). In DSS in Focus 8.26, we describe some ways to avoid ERP implementation failure and critical success factors. Also see Umble, Haft, and Umble (2003), who investigate critical success factors, software selection steps, and implementation procedures critical to a successful ERP implementation, and Akkermans and van Helden (2002), who look into how ERP critical success factors interrelate. Hong and Kim (2002) investigate the organizational *fit* of ERP. Their results, from a field survey of 34 organizations, show that ERP implementation success significantly depends on the organizational fit of ERP and certain implementation contingencies.

Probably the *most critical factor* **in ERP failure is that** *the organization's business processes do not match those modeled in the ERP.* **For example, early ERP systems** were designed for the discrete parts industry. Many flow process firms (chemical, pharmaceutical, mining, etc.) met with dismal and very expensive failures when they attempted to get an ERP package to work. If the actual business processes do not match those modeled in the ERP, one or both of two things must be done for the implementation to proceed: (1) the actual business processes must be changed to match the model of the ERP system; and/or (2) additional, generally expensive software must be written, by the organization or its consultants, to accommodate the differences. Typically, some of each must be done. Regardless, there will be problems. The former generally hits organizational culture roadblocks and creates ill-will toward the system. And the ERP modeled processes may be inappropriate for the organization. The la Iter creates the usual set of problems that accompany the development of any new software. However, if the ERP software is upgraded by the vendor, there is no guarantee that the additional software will work. So the millions of dollars spent in developing add-on software may go to waste, as the home-grown software must be modified or completely rewritten. Consequently, there have been many problems and additional expenses in ERP deployment. For example, a large manufacturer of earth-moving equipment (each piece of equipment sells for several million dollars) "successfully" installed an ERP to handle its operations. When a client wanted to make a change in one of the options in the five tractors it ordered (e.g., a CD player instead of

DSS IN FOCUS 8.26

AVOIDING ERP IMPLEMENTATION FAILURE

The three primary reasons for the failure of all IT-related projects (see Chapter 6) are

- **Poor planning or poor management (77%)**
- **Change in business goals during the project (75%)**
- **Lack of business management support (73%).**

Specifically, ERP implementation failures fall into 10 categories:

- **Poor leadership from top management.**
- **Automating existing redundant or non-value-added processes in the new system.**
- **Unrealistic expectations. ERP implementations are expensive, require a lot of time to implement, and often lose money while being fine tuned.**
- **Poor project management.**
- **Inadequate user education and training.**
- **Trying to maintain the status quo.**
- **A bad match between the ERP business model and actual business processes.**
- **Inaccurate data. As in any enterprise system, inaccurate data can lead to disaster.**
- **ERP implementation is viewed as an IT project. It is a set of business processes, not a project. It continues to evolve as the organization's environment and business processes change.**
- **Significant technical difficulties.**

The following six basic building blocks are required to implement an ERP system successfully:

- **Organizational commitment. This is true for all large-scale, enterprise information systems. ERP affects all business processes.**
- **Clear communication of strategic goals.**
- **View ERP as an enterprise-wide venture.**
- **Select a compatible ERP system.**
- **Ensure data accuracy.**
- **Resolve multi-site issues (e.g., whether to standardize across the enterprise or not; whether to implement all sites simultaneously or phase in).**

In light of all this, we can establish the following critical success factors for ERP implementations:

- **Strong leadership provided by an executive management planning committee.**
- **The implementation is viewed as an ongoing process.**
- **Implementation teams are composed of the company's best workers representing all functions.**
- **Mid-level management is totally involved in the implementation.**
- **Excellent project management techniques are used.**
- **» The old systems, including all informal systems, are eliminated.**
- **Proper measurements are implemented and closely monitored.**
- **An aggressive but achievable implementation schedule is established.**
- **Successful change management techniques are applied.**
- **Extensive education and training is provided.**

Source: **Adapted and condensed from Elisabeth J. Umble and Michael M. Umble, "Avoiding ERP Implementation Failure," *Industrial Management,* Vol. 44, No. 1, January/February 2002, pp. 25-34.**

a cassette deck in the cabs), the production manager indicated that it could not be done. A multimillion dollar contract was in jeopardy because, in order to make the change, the company had to cancel the order for the tractors and create a new one. For the client, the problem was solved by the CEO walking out and bringing the CD player directly to the plant foreman and telling him to override the production requirements. Then additional software costing several million dollars was written to allow changes in the production order while the tractor was being built. Clearly, the ERP system was inflexible in that it did not anticipate long construction times in its internal model. Such ERP problems can cripple or even bankrupt an organization.

In addition, ERP generally does not include normative or descriptive models. It is great at processing data into usable information, but typically does so at the transaction level. A good dose of optimization and/or simulation models, depending on the situation, could definitely improve its performance.

8.13 CUSTOMER RELATIONSHIP (RESOURCE) MANAGEMENT (CRM) SYSTEMS

INTRODUCTION

Customer relationship management (CRM) is an enterprise approach to understanding and influencing customer behavior through meaningful communications in order to improve customer acquisition, customer retention, customer loyalty, and customer profitability (Swift, 2001). A customer relationship management (CRM) system (also known as a customer resource management system) provides the technology to do so. Corporations that achieve high customer retention and high customer profitability aim for *the right product (or service), to the right customer, at the right price, at the right time, through the right channel, to satisfy the customer's need or desire* (Swift, 2001). This is the main goal of CRM. Though it has the same goal as revenue management (see Chapter 4), CRM generally puts a major focus on the selling side. A broader definition of CRM includes all activities that turn casual (seemingly one-time) consumers into loyal customers by satisfying or exceeding their requirements so that they will buy again. E-commerce influence impacts the need for quality and accurate CRM (see Berkowitz, 2001; Kohli, 2001).

CRM is an interactive process that turns customer information into positive customer relationships. It empowers many more customer contact personnel, information workers, marketing and sales functions, and management employees with significantly better and more informative business intelligence about their customers. CRM should be integrated into everything a company does, everyone it employs, and everywhere it transacts. When a firm states that excellent customer service is its goal, this means that it is the goal of the *entire* organization, not just the people who connect directly with customers (see Swift, 2001). CRM is fundamentally an enterprise-level DSS. And CRM efforts are not restricted to companies. Government agencies use it to improve customer service (Scalet, 2000), and nonprofit organizations for fund-raising efforts (see Cohen, 2002).

Customer loyalty is important. In competitive markets, if you do not maintain customers' loyalty, another firm will take them away. In the mobile phone industry, between 20 and 30 percent of customers change their provider every year. Identifying who is likely to *churn* and maintaining even a small percentage can generate millions of dollars in maintained revenue (Swift, 2001). Loyal customers are typically more profitable customers. If an organization can accurately predict future sales based on customer behavior, it will lead to cross selling. CRM enables customer retention and higher profits by knowing the customer and using cross selling. It enables accurate target marketing by helping identify customers and their needs via customer segmentation.

For decades, airlines have recognized the importance of retention. They recognized early that incentives generate further purchases and positive contacts with cus-

tomers, leading to long-term growth and customer retention. Airlines pioneered customer retention programs and revenue management (sometimes called yield management) efforts to provide the right product to the right customer at the right price in the right manner, and utilized technology to apply optimization methods to manage price, supply, and demand. Superior and personalized customer service to their best customers and special privileges (free flights) have created brand loyalty. Hotels, rental car agencies, passenger railroads, and other travel industry firms soon adopted these methods. Now they are being adopted by the mainstream, including industry segments such as retail, insurance, and service.

CRM gathers data on and tracks customers. The point is to use data better to manage relationships with customers. The Chicago White Sox, a U.S. major league baseball team, uses CRM to increase fan loyalty (winning is better for building loyalty, but winning better with technology is even better) and increases sales. See DSS in Action 8.27.

MARKETING

Marketing has moved through the phases of (1) mass marketing, (2) target marketing, (3) customer marketing, and (4) 1-to-1 marketing. Each phase has used technology to boost sales. Now CRM is enabling the concept of 1-to-1 marketing. In 1-to-1 market-

DSS IN ACTION 8.27

THE CHICAGO WHITE SOX BAT 1000 WITH CRM

In 1997, the White Sox organization realized that getting a better handle on its fan base, particularly season ticket holders and those looking for group tickets, would lead to more sales and better customer retention. The team draws millions of fans every year and already had a prospecting base of hundreds of thousands of potential ticket buyers, but was still using paper and file folders to manage the information. Each account executive was responsible for nearly 600 accounts and 600 seats in group accounts. Tom Sheridan, manager of ticket sales for the Chicago White Sox, says that it was hard to keep on top of all the information, especially since the team was receiving 50 to 75 calls per day from season ticket holders.

The White Sox deployed a GoldMine (FrontRange Solutions) CRM. Its databases track people who have called and expressed interest in purchasing tickets, purchased leads and names obtained from contests (for telemarketing), and customers who have purchased tickets. In 2003, there were more than 30,000 records in the main ticket sales database, and more than 100,000 in the direct mail database. The Sox's inbound- and outbound call teams use these databases to solicit season tickets, group sales, company outings, suites, and events for the party areas.

The Sox use GoldMine to do more than just track leads. The CRM is used for marketing, suite-holder relations, and community relations. The team tracks season ticket holders' seat locations, create dates (to locate people by the year they purchased tickets), and records birthdays (to send out birthday cards). It also tracks whether ticket holders have purchased memberships to the Stadium Club. In addition, the Sox keep track of demographic information like the number of customers who take the Chicago Transit Authority instead of driving cars. This information was critical in helping the Sox in its efforts to track traffic. The CRM has also been instrumental in improving returning lost articles to their owners (by around 50%), since the software maintains data on customer seat locations.

GoldMine gives the Sox the ability to be more service-oriented toward season ticket holders instead of sending them impersonal mass mailings. The Sox are better able to target customers' needs, since every conversation with every season ticket holder is tracked. Account executives can focus on new sales and better customer service.

Source: Adapted from Lisa Picarille, "Batting 1,000." *Customer Relationship Management,* May 2003.

ing, there is a shift from product focus to customer focus. Customer loyalty is critical for success (see Reichheld et al., 1997).

COMMUNICATION WITH THE CUSTOMER

Part of CRM's goal is to increase opportunities by improving the process so as to communicate with the *right customer,* providing the *right offer* (product and price), through the *right channel,* and at the *right time* (Swift, 2001). CRM attempts to identify, or segment, existing and potential customers, so that the right products-and services reach them at the right price in the right way at the right time. How a firm communicates is an issue. Cass and Lauer (2002) evaluated the use of language specifically appropriate to personal relationships to describe what transpires in an information-mediated CRM.

Companies that understand the importance of customer contacts and can provide solutions for multichannel contact centers as well as voice-only call centers will improve customer service and increase profitability. These seven powerful strategies work (Aspect Communications, 2003):

1. Make self-service an attractive option.
2. Conduct interactions in real-time.
3. Exploit the value of voice over IP.
4. Integrate the Web into your contacts.
5. Keep your best agents on board.
6. Make extraordinary service ordinary.
7. Integrate everything.

THE VALUE OF A CUSTOMER

The high-value, loyal, returning, satisfied, profitable customer is the key focal point for profitable and growth organizations globally. So it is important for organizations to *know their customers.* See DSS in Focus 8.28. The Hard Rock Cafe learned how to *know* its customers, leading to greater revenue. See DSS in Action 8.29. Also see Deck (2001).

DSS IN FOCUS 8.28

KNOW YOUR CUSTOMER

v

To increase a firm's return on investment, the right culture, information, and relationship technologies are critical for effective CRM. With CRM, it is possible to

1. Know who your customers are, and who your best customers are.
2. Stimulate what your customers buy, know what they won't buy, and why.
3. Time when and how your customers buy.
4. Learn customers' preferences and make them loyal.
5. Define the characteristics of your best/profitable customers.
6. Identify and model channels that best meet the needs of specific customer classes.
7. Predict what customers may or will buy in the future.
8. Retain your best customers for many years.

Source: Adapted partly from Swift (2001).

DSS IN ACTION 8,29

BETWEEN A ROCK AND A HARD PLACE

Worthen (2001) describes how the Hard Rock Cafe has used its Web e-commerce initiative to capture demographic data about its customers. The Hard Rock utilizes CRM to target promotions accurately to its customers. It knows that the system is working because promotions are yielding return visits in "substantial" double-digits as compared to the standard 2 to 3 percent response rate of direct mail promotions. Second, 70 percent of the people who get their picture taken at the cafe claim their photos online. Finally, sales were over $200 million for the first half of 2000, whereas the total sales for 1999 were $388 million. And this was so with an initial decline in sales before the CRM Web effort began. The Hard Rock is building a *community* of its customers.

No company can afford to offer the highest level of service to all its customers. Only by calculating your customers' value to your firm can you properly allocate your valuable resources (see Gupta and Lehmann, 2002). And being a truly customer-centric organization requires that the information be shared firm-wide and used effectively (LoFrumento, 2003). The customers must be segmented into classes, and each class approached with appropriate products at appropriate prices (see Swift, 2001; LeVinson, 2000).

In fact, there may be several classes of customers that your organization simply cannot afford to meet. For example, no automobile manufacturer has developed a car that sells for under $1,000 new. If a product is not profitable, then every customer who buys one reduces overall profitability. A firm should know when to *fire a customer.* Certain groups of customers are not profitable. They should be identified, and carefully examined before dropping them (because there may be ties to other family members who are profitable customers; for an excellent example, see Swift, 2001).

LoFrumento (2003) describes how a bank identified its most profitable customers—surprisingly, small businesses, not the large businesses and college students. The impact to the bottom line was staggering. The bank turned an $18 million loss into a $4 million profit. This is similar to what Harrah's (Chapter 1 Opening Vignette) and Mohegan Sun (Case Application 8.2) learned. Their most profitable customers were not the casino high-rollers, but the low-rollers. The Royal Bank of Canada (Toronto) has just 17 percent of its customers providing 93 percent of its profits (Selden and Colvin, 2002).

For e-commerce, the best authority for what customers want may be the customers themselves. Using clickstream analysis, though, cross selling opportunities can be identified. See Fickel (2000).

Some studies show that the average customer retention rate in the United States is about 80 percent. Thus 20 percent of a firm's customers *leak out* every year, which means that the firm must replenish them with profitable customers or lose them all in five years (Gupta and Lehmann, 2002). It is important to recognize that keeping existing customers is generally easier and more profitable than finding new ones. It can cost up to 10 times as much to sell to a new customer than to an existing one. Loyalty is important. Companies can boost profits by 100 percent by retaining just 5 percent more of their customers. And an organization should be able to determine the value to its bottom line of increasing customer satisfaction 1 percent (Gupta and Lehmann, 2002).

Determining the lifetime value of a customer, including influence on attracting new customers is critical. For example, the estimated life-time value (LTV) for a super-

market/grocery store of a customer with a family of four is about $250,000. And this amount appears to be only half of the expenditures that the family will make on food-related purchases (Swift, 2001). Every CRM initiative should include a determination of the lifetime value of a customer, including his or her influence on the family, and other factors.

CRM TECHNOLOGIES

Early CRM efforts were simply sales-force automation tools. They included contact information in a database, along with some personal information to be used by salespeople. Relationship technologies now include massive, active data warehouses, which are the foundation of modern CRM (see Chapter 5). Today CRM includes business intelligence/business analytics through *data mining* and *OLAP* (see Cippola, 2001). These integrate CRM with other tools, such as ERP and other EIS.

Once data are gathered in a data warehouse for a CRM effort, data mining and OLAP/BI/BA tools (Chapter 5) are utilized to analyze them. These powerful tools can derive the relationships among customer behavior, demographics, products, and other factors. The term *predictive analytics* is sometimes used to describe these activities. Compton (2003) identifies the best things you can do with your data. These are almost all customer-oriented, and thus apply to CRM. See DSS in Focus 8.30. Customer segmentation is often handled by data mining (see Case Application 5.3). Many classes of customers can be readily identified by data mining tools (see the examples in Chapter 5, and Levinson, 2000).

CRM systems are being integrated with other enterprise information systems, including ERP, EIS, SCM, PLM, BPM, and BAM. Though the integration often leads to problems, the benefits of doing so can be enormous. See Maselli (2002) and Targowski (2001) for some details.

The potential for mining revenue-generating and cost-saving relationships from data is increasing as companies build bigger data warehouses, applications become more integrated, computers become more powerful, and vendors of analytic software introduce products that are easier to use. It is important to be able to predict which customers are likely to leave, which ones will probably respond to the next promotion,

DSS IN FOCUS 8.30

THE 10 BEST THINGS YOU CAN DO WITH YOUR DATA

Follow these 10 steps and you will have information that really means something:

1. Ensure data quality.
2. Measure success on metrics that matter.
3. Enable users to get the insight they need.
4. Unify data across channels. Eliminate stovepipes.
5. Establish meaningful customer segments.
6. Encourage customer growth.
7. Take the bad with the good. Study customer losses and bad experiences.
8. Model and predict profitable loyalty and motivations. Understand your customers.
9. Make the right call. Contact each customer, potential customer, and lost customer in appropriate ways.
10. Keep the data secure from harm, misuse, and theft.

Source: Adapted from Jason Compton, "The 10 Best Things to Do With Your Data," *Customer Relationship Management,* April 2003, pp. 44^7.

which ones are ripe for cross selling and what will happen if prices change. Predictive modeling can identify the range of products and services that best suit particular customers (Sabri, 2003). Data mining methods (Chapter 5) are often used (see Anthes, 2003; Betts, 2003). Of course, real-time data analysis and reporting applications require accurate data (see Reimers, 2003).

BankFinancial Corp. (Chicago) uses the SPSS Clementine data mining *workbench* to predict customer behavior so as to accurately target promotions to existing and potential customers. Analytical frameworks are discussed by Anthes (2003). Also see Betts (2003).

Using data mining tools integrated with GIS, one can establish customers' geographical preferences. For example, Betts (2003) describes how Cognos business intelligence tools identified national preferences for chicken burgers versus beef burgers at Red Robin Gourmet Burgers franchises in the United States.

Revenue (management) optimization software automates the process of calculating the prices businesses need to charge to maximize profits. It adjusts prices using optimization algorithms (see Chapter 4) that factor in variables like demand forecasts, inventory, and the economic elasticity of supply and demand. Harrah's uses a Manugistics revenue management application to adjust room prices in its casino hotels (see Songini, 2003c).

CRM SOFTWARE

On average, firms spend 2.5 percent of their annual revenue on customer technologies, half of their overall IT spending (see Guptill, 2003). Myron (2003) indicates that the CRM software and services market share in 2003 was a $6.7 billion global market. Siebel, SAP, and Oracle are the big three, capturing 59 percent of the global market. Customer relationship management systems are proliferating around the world. Global market estimates range from about $10 billion to $30 billion by 2006, with compound annual growths of up to 9 percent. The largest market penetration is in the United States, which will continue to lead the global CRM market in overall revenue and market size. Analysts expect other regions to have higher percentage growth rates than the United States. See Picarille (2003) for details.

The three major CRM software vendors are Siebel Systems Inc., SAP AG, and Oracle. Others include ACCPAC International, Inc., Amdocs, Broadvision, Aspect Communications, E.piphany, GoldMine Software Corp., i2 Technologies, Interact Commerce, Kana Software, Microsoft Corp., Nortel Networks, Onyx, PeopleSoft Inc., Pivotal Corp., Salesforce.com Inc., Salesnet Inc., and SupportWizard Inc. CRM tools for small- to medium-sized businesses are provided by Pivotal Corp., Salesnet Inc., and SupportWizard Inc. (see Callaghan, 2003a). For information about specific products, see the CRM Buyers Guide at www.destinationcrm.com, and CRMguru.com (2002a). See Dyche (2002) for methods of choosing appropriate CRM technologies for an organization. Some firms, rather than make major modifications to vendors' products, have opted to develop their CRM systems in-house. See Pender (2000) for details.

CRM BENEFITS

CRM has always been easy for small organizations. Representatives of a small organization can readily apply the personal touch. But now large companies are attempting to succeed at CRM. CRM benefits include (Swift, 2001):

1. Lower cost of recruiting customers.
2. No need to recruit so many customers to maintain a steady business volume.
3. Reduced sales costs. Existing customers are generally more responsive.
4. Higher customer profitability through segmentation and targeting products and services.
5. Increased customer retention and loyalty. Customers stay longer, buy more, and contact you more.
6. Improved customer service.
7. Evaluation of customer profitability leads to identifying the most profitable classes of customers and how to create new profitable classes.
8. Migration from a product focus to a *customer focus.*

Here are some details that underlie the benefits. Mass mailings are wasteful. Some 98 percent of promotional coupons are discarded. It costs up to 10 times more to generate revenue from a new customer than from an existing one. A 5 percent increase in the retention rate can increase company profits by 60 to 100 percent. Servicing a customer through a call center is six times more expensive than via the Internet. Loyal customers who refer another one generate business at little or no cost. Referred customers generally stay longer, use more products, and become profitable customers faster.

CRM PROBLEMS AND ISSUES

Most problems and issues with CRM are due to organizational factors. They crop up during an attempted implementation. One-third of all CRM projects generate great results, one-third create minor improvements, and the final third produce nothing (CRMguru.com, 2002b). According to a study by Gartner Inc., 42 percent of the CRM end-user licenses bought in 2002 were not being used (see Songini, 2003d). Levinson (2002) indicates that a failure to rethink business processes, not technology trouble, kills most CRM implementations. Most salespeople view the technology that was "imposed" on them in 2001 as a failure. Many firms did not involve the users in the selection or development of the CRM. CRM experts believe that 80 percent of the benefits of CRM come from new business processes, while only 20 percent are due to technology. See Close (2002) for details.

According to an *InfoWorld-CTO* Network Survey (see April and Harreld, 2002), CRM problems are due to difficult integration (39%), high cost/low ROI (27), resistance from staff or customers (24), other (5), and solutions do not meet needs (5).

Integration presents a whole new set of problems. The problem is acute in that many organizations have legacy systems that work perfectly but just do not readily integrate with new tools. For example, the Minnesota Department of Vehicle Services (DVS) had a two-week delay in renewing a driver's license. There was a month delay in obtaining a car title. Moving to the Web was difficult because most of the data were only available on paper via fax. The major difficulty organizations face is integrating the CRM into the data sources (see April and Harreld, 2002). Further difficulties occur in integrating CRM with other enterprise systems.

A CRM solution aimed at sales force productivity improvements must consider the overall aspects of sales management, especially the organizational culture and user involvement (see Thoreson, 2003).

CRM projects are big and costly. Like most large-scale IT projects, they often do not meet their objectives (see Boslet, 2001). CRM is hard work. Corporations often rush into CRM projects, spending millions without making the necessary preparations.

CRM efforts are plagued by all the problems involved in large-scale IT developments (see Boslet, 2001):

- Necessary preparations include allocating enough time and money, establishing realistic goals, and getting firm commitments from top managers
- Adapting business processes
- Retraining employees
- Finding the right system integrators

Cigna HealthCare's failure, illustrated in DSS in Action 8.31, identifies many factors to consider when developing a large-scale CRM system.

There is a *dark side* to CRM due to people and society issues. A key issue is that CRM can make an organization seem impersonal (see Scofield, 2002). Customers like the *personal touch,* and many organizations, from Marriott International (DSS in Action 8.32) to the Chicago White Sox (DSS in Action 8.27), recognize and capitalize on this. It is important to use the CRM to capture customer knowledge to improve the personal touch. If the personal touch is lost, an organization can cease to be a positive force in the community, which leads to lost revenue. Hollowell and Verma (2002) indicate that the goals of personalization are simple: learn and understand what the customer really wants, then ensure that the customer gets the same look-and-feel, and message across any channel. The businesses that have the most successful CRM strategies learn to create solutions for their customers instead of finding customers for their products. Waltner describes how Art Technology Group Inc. provides CRM software that drives the automated personalization of Web site content for individual shoppers. IExplore Inc., a Chicago-based travel company, uses ATG's Dynamo Suite to target online information for individuals. This is an extremely important issue, because Web sites are growing to unwieldy size and customers often cannot find what they want. It also enables cross selling, an important CRM feature, by providing items that its projections show a customer may want.

DSS IN ACTION 8.31

CIGNA HEALTHCARE INSURES FAILURE

Cigna HealthCare attempted a $1 billion IT overhaul that included a CRM initiative. It failed. Disruptions produced major problems in customer service. The firm went from 13.3 million members to 12.5 million. Its stock plunged 40 percent in value. Cigna's transformation was hobbled not only by the insurance giant's haste to get its new systems up and running, but by its eagerness to cash in on technology's promise of reduced costs and increased productivity. As soon as the new system went online, the company eliminated its customer service reps. The lessons Cigna learned include (also see Chapter 6):

1. Keep the project management in-house, even if using consultants.
2. Test in a real environment and end-to-end before going live. Migrate in stages.
3. Make sure your back-end data are cleansed and filtered.
4. Bring in a focus group of customers (involve, them) after testing the system. Then use their comments to redesign the front end for them.
5. Train and retrain the customer service reps on the new systems.
6. Do not expect productivity gains for months after going live, and do not make business decisions based on anticipated projected savings or gains. Wait until they occur.

Source: Adapted from A. Bass, "Cigna's Self-inflicted Wounds," *CIO,* March 15,2003.

MEASURING CRM SUCCESS

A critical issue when developing a CRM is determining appropriate metrics by which to measure success. Specific bottom line measurements are difficult but not impossible to obtain. In a recent study of CIOs (see Patton, 2002), they were asked how their organization would measure the ROI or value of its CRM implementation. They responded with reduced reporting cycle (53%), reduced expenses/costs of doing business (44%), improved external customer satisfaction (36%), improved internal customer satisfaction (35%), reduced sales cycle (32%), increased productivity (25%), increased sales (18%), and other (6%).

Strategic benefits are intangible and often difficult to measure. CRM capabilities can impact other value-added activities (along the value chain), thereby enhancing customer experience and *gaining competitive advantage* (Swift, 2001).The financial contribution CRM makes often comes from new business practices without clear precedents. CRM depends on changing the behavior of customers whose purchasing patterns are motivated by many external factors (see Swift, 2001). For example, DSS in Action 8.32 describes how Marriott International utilizes a CRM and how it plans to evaluate the results. The Marriott experience led to a set of keys to success, outlined in DSS in Focus 8.33. Also see Case Application 8.3.

Signs of CRM system success include: (1) companies use the system to meet *key* customer needs; (2) they derive in-depth analysis of customer costs and potential profit; (3) they link information from disparate business units or eliminate information silos; and (4) they redesign organizational incentives and structure to empower those employees who are closest to the customers (see Sviokla and Wong, 2003).

Swift (2001) provides a set of many questions to ask, issues, and rules to estimate your likelihood of CRM success. These questions are broken down into the following categories: (1) rules for discussions with CRM solution providers; (2) business (internal) questions and issues; (3) information technology questions; (4) business users' questions; and (5) red flags. Each should be considered carefully in determining an organization's readiness for CRM. See Swift (2001) for details.

For additional information about CRM, see Swift (2001), Berkowitz (2001), Berson (2000), Cippola (2001), CRMguru.com (2002a, 2002b), Dyche (2001, 2002), Fayyad (2003), Hayes (2001), Linoff and Berry (2002), Newman (2002), Staekpole (2001),Tillett (2000), and Tourniaire (2003).

8.14 EMERGING ENTERPRISE INFORMATION SYSTEMS: PRODUCT LIFECYCLE MANAGEMENT (PLM), BUSINESS-PROCESS MANAGEMENT (BPM) AND BUSINESS ACTIVITY MONITORING (BAM)

In this section, we describe several, relatively new enterprise information systems that have begun to have major impacts on organizations. These include product lifecycle management (PLM), business process management (BPM), and business activity monitoring (BAM). Each *system* is really a methodology that affects the entire enterprise. Each one has essentially become a Web-based *enterprise information portal* (dashboard) that gathers information from many disparate sources, integrates them, and provides them to the user for a specific purpose. Product lifecycle management systems have grown from the manufacturing and design engineering disciplines, while business process management and business activity monitoring systems have evolved from

DSS IN ACTION 8.32

MARRIOTT'S SUITE RETURNS

Traditionally, hotels measure performance by how much money is made from each room. But Marriott International has started to account for itself differently, using customer relationship management (CRM) systems to assemble an income stream based on how much each guest spends, not just on one room in a single stay, but over time, in different cities, at a wide range of hotels, resorts, and conference centers. Though Marriott will not be able to measure the bottom line on the efforts for some time, it has deployed the mechanisms to do so. Marriott executives believe that these changes will ultimately lead to greater profitability.

There is not much growth potential in the lodging industry from building and renting more rooms. Consequently, hotels must find ways to get customers to spend more when they visit. Non-room income accounted for 34 percent of hotel company revenues across the industry in 1999. Income from these sources, which include restaurants, grew faster than revenue from room rentals. This is critical for Marriott, because there are not many markets left where there is not an existing Marriott hotel.

Marriott uses CRM data from its loyalty program for cross selling to guests and meeting planners and smoothing transactions with the franchisees that run its hotels. It also personalizes service to both its corporate and individual clients. These efforts should increase revenue from happier, and more loyal, customers.

Marriott tracks how much more money guests spend at its resorts if they participate in a new vacation-planning program called Personal Planning Service. Marriott executives believe that the Personal Planning Service, which helps generate more revenues from each guest's visit, will also result in repeat business because guests have better vacations. The program's database helps hotel employees set up golf tee times, dinner reservations, or other activities for guests before they start their vacations. Guests who sign up for the program work with a concierge who arranges an itinerary for the trip and records it in the database. The next time a traveler vacations at a Marriott resort, concierges there can use the information to set up a similar set of activities, if the guest wants them. *Guests who particu pate in the program spend an average of $100 more per day at hotel golf courses, restaurants, and activities like guided tours for which Marriott gets commissions,* **These efforts create** *brand loyalty* **leading to repeat business. The new sales-force database also provides salespeople with a companywide view of customer accounts to help better understand what each customer wants to buy, right down to what they like to serve for breakfast meetings.**

The system has made a difference because Marriott captured $55 million in cross-chain sales last year, a measurement it could not to track before. Overall, Marriott earned $8.7 billion in sales in 1999, beating its top rivals Hilton, Hyatt, and Starwood.

Source: **Adapted from Elena Varon, "Suite Returns,"** *CIO,* **August 15,2000.**

DSS IN FOCUS 8.33

THE KEYS TO CRM SUCCESS

Here are some quick guidelines to help you in creating a successful CRM implementation.

Do:

- **Look for ways to measure how customer behavior should change once CRM systems are deployed.**
- **Take the long view. It may take up to a year before a firm starts accruing benefits.**
- **Focus on which of the problems CRM is supposed to fix.**

Don't:

Rely on cost savings to deliver value. Like revenue management, the focus is on revenue generation, not cost containment.

Equate past customer satisfaction with future customer value.

Source: **Partially adapted from Elena Varon, "Suite Returns."** *CIO,* **August 15,2000, p. 122.**

executive and enterprise information management systems concepts. All of the functionality of these systems was previously provided by sets of separate software tools, but now they are available as application suites that integrate the tools directly. They can be viewed as sitting on top of the tool set that comprises them. All of them are becoming integrated with the systems that provide data to them, as well as some capabilities. They include executive and enterprise information systems (EIS), CRM, ERP, and SCM. We discuss these in detail next.

PRODUCT LIFECYCLE MANAGEMENT SYSTEMS

Product lifecycle management (PLM) is an integrated, information-driven approach to all aspects of a product's life, from its design through manufacture, deployment, and maintenance, culminating in the product's removal from service and final disposal. PLM software suites enable accessing, updating, manipulating, and reasoning about product information produced in a fragmented and distributed environment. Another definition of PLM is the integration of business systems to manage a product's life cycle. (University of Michigan PLM; Staekpole, 2003).

PLM's goal is to streamline product development and boost innovation in manufacturing. PLM has the potential to vastly improve a company's ability to innovate, get products to market, and reduce errors. PLM applications hold the promise of seamlessly flowing *all* of the information produced throughout *all* phases of a product's life cycle to *everyone* in an organization, along with key suppliers and customers. An automotive company or aerospace manufacturer, for example, can shrink the time it takes to introduce new models in a number of ways. Product engineers can dramatically shorten the cycle of implementing and approving engineering changes across an extended design chain. Purchasing agents can work more effectively with suppliers to reuse parts. And executives can take a high-level,view of all important product information, from details of the manufacturing line to parts failure rates culled from warranty data and information collected in the field (Staekpole, 2003).

Unlike ERP packages, PLM requires integrating many independent databases and getting people from different business functions to work together better. PLM is more a strategy than a system. It is a strategy to integrate and share information about products between applications and among different constituencies, such as engineering, purchasing, manufacturing, marketing, sales, and after-market support (Staekpole, 2003).

The goal of PLM software is to help corporations track and share product data inside and outside of the enterprise. Information contained in these systems often includes hefty CAD files on products ranging from computer parts to aircraft engines (Jones, 2001).

PLM evolved out of product design engineering software. Typically, PLM is utilized in manufacturing. PLM is even being applied to the retail fashion industry to improve sales and reduce inventory. It has also been applied to the construction industry.

A PLM system tracks all the electronic information about the life of a product. A PLM system links together all of the processes required to design, build, deploy, and maintain the product (Gallagher, 2003). As with the other enterprise information systems described in this section, there are many tools that perform most of the main functions of PLM. PLM integrates them into one application suite. Through the suite, PLM enhances communication and collaboration in product design and manufacturing.

By digitizing not just the design of a product but also the processes that go into creating it, companies have been able to avoid mistakes in engineering and conflicts in different versions of product information, saving millions, sometimes over than 30 percent of operational costs (see Gallagher, 2003).

Like ERP, PLM is a set of interconnected modules, each of which addresses a specific function. But whereas ERP is designed to handle primarily transactional data, PLM manages all the unstructured data associated with product design and manufacture (Bartholomew, 2003).

Product data is the central component of an enterprise PLM system. PLM can be broken down into six distinct segments: innovation and portfolio management, project and program management, collaborative design, product data management, manufacturing process planning, and services and support management (D'Amico, 2003). Improving each leads directly to improvements in different aspects of design and manufacturing. See DSS in Action 8.34 for how Lear has improved its design and manufacturing processes.

PLM AND KNOWLEDGE MANAGEMENT SYSTEMS

PLM can be viewed in terms of a knowledge management system (Chapter 9) for manufacturing and product-version control. PLM is concerned with integrating requirement specifications, design documents, manufacturing plans, and post-release product support and evolution documents into a common *repository.* Making these critical documents available in all phases of the project to all of the stakeholders should enhance collaboration, reduce communication costs and delays, reduce redundant reengineering time, and improve how early-stage designers and engineers understand the real-world performance and challenges of the products they create. This should result in the development of more generalized, reusable assembly platforms, shorter development cycles, more frugal component counts, and possibly lower warranty-service charges. (Compton, 2002).

PLM BENEFITS

PLM offers many benefits when properly implemented. These include:

- Flexibility in engineering job roles
- Reduced engineering change order (ECO) times and quantities because PLM requires completeness
- More interchangeable parts because changes are correct and consistent

DSS IN ACTION 8.34

PLM FLIES AT LEAR

Lear, a $14.4 billion automotive supplier, has invested heavily in PLM because executives see it as a way to manage Lear's product-development efforts more effectively for its customers, leading car manufacturers. Previously, project information was conveyed in an ad hoc manner through spreadsheets and e-mail. The information was typically inconsistent. Using EDS PLM Solutions, Lear built the foundation of a system to give car-makers a constant flow of information about their projects, from engineering schedules to parts changes to quality statistics.

- Improved product designs
- Faster product development times
- Better and faster design and manufacturing decisions (like standardized vs. customized parts)
- Greater overall design and manufacturing efficiency
- Reduced time-to-market of products
- Improved quality control
- Integrated manufacturing and design systems
- Enhanced collaboration in design and engineering, and with suppliers, partners, and customers
- A centralized product repository with content management capabilities for all product-design information, accessed via a portal

Efficiencies in design reduce the time it takes to get a product to market. For example, through a PLM system, Flextronics reduced week-long ECO delays to less than a day. Overall, PLM reduces costs and improve efficiencies. For example, PLM has enabled Air International Group Ltd. to source components more competitively from a larger pool of suppliers, making the firm more competitive. It passes along a 5 to 10 percent savings when it puts its own projects out to bid (see Trommer, 2003). GEIS experienced many benefits from its PLM implementation, as is described in DSS in Action 8.35.

PLM ISSUES

PLM systems exhibit many of the common problems of enterprise information systems.

A successful implementation requires a focus on business need. It must deliver business value. PLM requires the requisite senior executive champion, and appropriate user involvement and training. Developing a complete PLM solution can be nearly as complex as developing a complete ERP (Vijayan, 2003a).

PLM systems must integrate with existing MRP, ERP, and SCM software to be effective. They typically exhibit few immediate benefits and are very difficult to implement. Like ERP, a PLM system can fail, but when it succeeds, the payoff can be very high.

PLM requires a corporate strategy. It must be supported at the highest level in the organization, and change must be managed as it affects many manufacturing and design processes. PLM should be viewed as a change management issue, not an engineering drawing control issue (Staekpole, 2003). It involves changes in organizational

DSS IN ACTION 8.35

THE GEIS PLM SYSTEM

GE Industrial Systems (GEIS), a $5 billion subsidiary of General Electric Co., is implementing a major product life-cycle management (PLM) project to reduce product-development time, improve supply chain efficiency, and reduce costs. GEIS is developing the PLM to create a collaborative environment for planning, development, sourcing, and program management. GEIS is migrating nearly 15 million product-related documents into the new system. By 2005, there will be more than 10,000 employees accessing the completed system (see Vijayan, 2003a).

DSS IN ACTION 8.36

GENERAL MOTORS DRIVES FAST WITH PLM

Kirk Gutman, global product development officer at General Motors, offered a compelling real-world example of an aggressive and successful PLM strategy. GM has been working since 1996 to create and use a global PLM environment that comprises a common geometry foundation—the "math highway," as GM calls it—and a massively collaborative PDM layer built on the EDS PLM that supports 18,000 users and 1,800 supplier Teamcenter connections across North America, Europe, and Asia. The business results to date are compelling: System simplification—1,500 product development applications alive in 1995 have been reduced to 500, with systems savings of $1 billion. GM obtained a 35 percent reduction in its overall global product development budget while expanding from 19 to 30 development programs. GM was able to reduce the cycle time from styling freeze to production from 60 months in the early 1990s to 18 months in 2002.

Source: Adapted from Kevin O'Marah, "The Roadmap to PLM Starts with Corporate Strategy." *CIO,* December 4,2002.

culture because it affects many business processes. General Motors recognized this, and through its PLM obtained substantial savings. See DSS in Action 8.36.

PLM VENDORS

Manufacturing companies spent $2.3 billion on PLM application suites in just the first half of 2003 (Staekpole, 2003). The market for product life-cycle management (PLM) software is expected to reach some $7.5 billion in 2006, and $14 billion in 2008. Growth drivers include the software's ability to help manufacturers lower product development and support costs, and to protect a company's intellectual capital. Key drivers include a major push from technology vendors, which offer PLM software that runs in conjunction with ERP systems or manufacturing management software (D'Amico, 2003). Based on 2001 revenue, the leading PLM vendors are EDS, SAP, Parametric Technology Corp, IBM/Dassault, Telelogic, MatrixOne, Aspen Technology, and Agile Software. They command 69 percent of the market. EDS commands only 13 percent of the market. There are a lot of smaller players commanding the remaining 31 percent of the market. They include Agile Software, Arena Solutions Inc., PeopleSoft, Baan, CoCreate Software Inc., Omnify Software Inc., Oracle, OSI Software Inc., and Optiva (for details, see D'Amico, 2003; Weinberger, 2003).

BUSINESS PROCESS MANAGEMENT (BPM) SYSTEMS

A business process management (BPM) system integrates data, applications and people together through a common business process. It aims to streamline and automate business processes thus offsetting the administrative burden of the organization and creating an environment where processes can be leveraged for strategic value (see Datz, 2002; and CKB, 2003).

BPM software can graphically map business processes, such as issuing or collecting a bill; transform that visual map into an application or set of applications; and manage the electronic workflow to monitor that the work gets done and allow changes and improvements to the workflow (see Scheier, 2003).

BPM provides a comprehensive framework for automating people-intensive processes, and integrating legacy and packaged applications into everyday operations. Most importantly, BPM institutes process control and policies that allow organizations

to manage risk and comply with external mandates and regulations. BPM systems allow businesses to take full ownership of their processes and make adjustments in real-time as conditions change (CKB,2003).

Essentially BPM is an enterprise information portal into all business processes. It integrates ERP, EIS, CRM and SCM systems to let managers see every relevant factor to the organization's health and progress. BPM enables the real-time access of relevant information about business processes. Essentially, BPM delivers the promise of executive information systems in real-time. BPM attempts to capture and monitor best practices that lead to productivity improvements as is evident by the iUniverse situation in DSS in Action 8.37.

Business performance management unifies methodolpgies, processes, rules, and collaboration workflows among all managers, at all levels, across the enterprise. The attributes of the management process, a unified approach, and collaboration support are essential to proactively managing and improving financial and operational performance (Hyperion, 2003). These improvements can lead to new opportunities. See DSS in Action 8.38.

Business intelligence (BI) provides managers with information that enables them to understand their business for a given moment in time. Business performance management, in contrast, provides managers with applications that support a process for managing their business as well as information from BI applications (Hyperion, 2003).

DSS IN ACTION 8 37

(UNIVERSE AUTOMATES WITH BPM

Book-publisher iUniverse deployed Intalio's BPM software in part to automate catalog delivery to its dealers and other partners. Before the BPM was implemented, only one partner had an automated system in place to receive catalogs; the other partners' deliveries had to be entered manually into the system by an iUniverse employee, which took about 120 hours per month. The BPM system has enabled that employee to be diverted to another segment of the company and has permitted other iUniverse partners to automate their own catalog delivery systems.

Source: Condensed from Amy Rogers, "Intalio Banks on Business Processes," *CRN,* April 2003, No. 1040.

DSS IN ACTION 8.38

IJET TRAVEL'S BPM FLIES HIGH

iJet Travel Intelligence provides online, open-source intelligence information and crisis-management services to individuals and corporations. Initially, iJet knew that using some process-change management technology would be important in achieving its business objectives. After deploying a BPM system in 2001, iJet could create, optimize, change, and manage its business processes quickly, without costly and time-consuming intervention by the IT department. Analytics are utilized to perform impact analysis on various customer-travel scenarios, helping companies assess the legal liabilities of sending workers abroad. The system lets analysts create job requirements, tap the appropriate intelligence sources, and review existing information residing in iJet's repositories. The BPM environment provides continuous value, letting iJet quickly generate accurat€ and objective alerts. Most significant, iJet has grown by revamping business models and processes to adapt to new market conditions and strategies.

Source: Adapted from Greg Meyer, "Case Study: Jet-Fueled," *Optimize,* February 2003, p. 32.

However, vendors routinely include BI/BA capabilities in BPM to enhance their products' capabilities. For example, Hyperion's business performance management software includes business intelligence and business analytics features. As with PLM, the software tools for BPM have existed for some time, but now vendors are packaging them together.

BPM BENEFITS

Business process management (BPM) software can pay for itself within a year or two by linking expensive legacy applications to new, more streamlined workflows. Trimac Corp., a trucking company in Calgary, Alberta, expects a return on its $500,000 BPM investment within two years. This will come about through reduced paperwork and additional business from customers who find Trimac's BPM-based ordering system easier to use than those of competitors (Scheier, 2003). BPM results in improved workflow through redesign as it is automated. Firms should measure their returns from BPM efforts not only on cost reduction but also on process improvement.

The Wiltshire Constabulary (a police force in the U.K.) has adopted a BPM for its e-policing project. Officers feel that it should help reduce the time spent on non-operational matters and administrative work. This will enable them to spend more time on primary duties, such as patrolling their beats.

Process improvements indicating that a BPM implementation is underway can lead to dramatic cost savings. Shell Oil experienced this. See DSS in Action 8.39.

BPM ISSUES

BPM forces an organization to look carefully at its processes. If they are to be managed carefully, then they should be correct. So, like PLM and other enterprise information systems, notably ERP and SCM, BPM implementations require a careful look at business processes. Organizational culture change issues must be managed because processes will change as the implementation moves forward. As with any enterprise

WKKKm •.mi'UIJM'IMl

SHELL OIL QUICKLY DEPLOYS A BPM SYSTEM AND SAVES A MILLION CLAMS

Shell Oil's U.S. Tax Organization (Houston, Texas) was given a mandate to cut its monthly financial reporting time in half and provide a clear trail in case of audits. The core problem, which is common to large enterprises, was the heterogeneity of the systems involved, including geographically dispersed divisions running primarily SAP R/3 but also J.D. Edwards and Oracle Financials.

Shell adopted TeamWorks, Lombardi Software's BPM software, to handle the enterprise application integration. Fortunately, TeamWorks did not require extensive coding. It took only three months to deploy the application. Because the team could quickly prototype business processes with the tool, financial analysts and IT people focused more on evaluating how they worked, instead of on the technology. The key focus was the business process. It was important for Shell to decide which area of the business process to automate and identify bottlenecks that had the greatest challenges.

Shell recouped its $1 million investment in less than sixmonths and derived more value from its $1 billion SAP investment. Now the company plans, to develop BPM applications in other operations, including exploration, refineries, and financial services.

Source: Adapted from M. LaMonica, "Process Power," *CIO* , January 1,2003.

system, it is important not to track what exists, but to determine whether the process is the right one, or even if it should be done at all. As with CRM and PLM, integration problems occur during implementation (Scheier, 2003). BPM systems are large-scale, so they exhibit the same problems as other enterprise systems. They require a senior champion, user involvement, and have a high probability of failure. Essentially, the McDonald's enterprise system failure (Case Application 8.2) was a BPM effort.

BPM VENDORS

BPM vendors include Apriso Corp., BEA Systems, Business Objects SA, Computer Sciences Corp./Metastorm, FileNET, Fuego Inc., Fujitsu Software, HandySoft Corp., Hyperion Solutions Corp, IBM, IDS Scheer AG, Intalio Inc., J.D. Edwards & Co., Lombardi Software Inc., Metastorm, Microsoft Corp., Nobilis Software, Pegasystems Inc., PeopleSoft Inc., Q-Link Technologies, SAP AG, Savvion, SeeBeyond Technology Corp., Siebel Systems, Silas Technologies/Ultimus, Staffware PLC, Tibco Software, Unisys Corp., VitriaTechnology Inc., and WebMethods. Scheier (2003) provides a BPM vendor list with product descriptions. Vendors continue to integrate business intelligence/business analytics into BPM software, as well as integrate their BPM systems into others.

For further details on BPM, see CKB (2003), LaMonica (2003), Leahy (2003), Smith and Fingar (2003), and the BPM vendor sites.

BUSINESS ACTIVITY MONITORING (BAM) SYSTEMS

Business activity monitoring (BAM) systems consist of real-time systems that alert managers to potential opportunities, impending problems, and threats, and then empower them to react through models and collaboration. Situations are detected in real-time, quickly analyzed, and solved.

Business activity monitoring (BAM) software monitors the activities of a specific facility, such as a factory or a call center, or a specific business process, such as logistics or sales. BAM integrates data from different processes within the company and from outside partners, unstructured (soft) information, and provides collaboration capabilities for teams to make decisions (see Keating, 2003). Its two activities include detecting a developing situation as quickly as possible, and formulating a speedy response. Information technology can collect data from a variety of internal and external sources in real-time, analyze them to detect unexpected patterns that indicate an emerging situation, and then deliver the results to those responsible for reacting. This technically agile aspect of the *real-time enterprise* is often labeled business activity monitoring (see Keating, 2003).

As a technology layer, BAM sits on top of a BPM solution to capture and analyze business process data in real-time- Events are displayed in an enterprise information portal (dashboard). The display offers instant insight into business metrics like CRM call center success rates or supply chain inventory levels. Real-time alerting to breakdowns in processes such as shipping schedules lets users react to problems in real-time. BAM applications gather data from many disparate sources and present them as a unified whole (see April, 2003).

BAM evolved from the basic ideas of executive information systems. But now, mature integration and business-intelligence tools, real standards such as XML, and improved software development methods and tools make such real-time technology feasible (see Keating, 2003).

Monitoring an activity depends on the ability to recognize significant events that occur within the activity and respond appropriately based on the application of busi-

ness rules. The rules may be either predetermined or, in a more sophisticated BAM system, learned by the system over time via artificial intelligence methods like intelligent agents (McKie, 2003). BAM reports the business process flow directly. Filters can indicate when any important parameter is off, and an alert (as in an executive information system) tells the manager to look into why. Essentially, BAM systems deliver real-time executive information system capabilities to all decision-makers. General Electric uses its *CXO dashboards* to give executives their real-time organization's status (see Keating, 2003). A simple BAM can send e-mail alerts.

BAM BENEFITS

BAM helps not just in recognizing and responding to events, but also in enabling managers to resolve event occurrences quickly and review their impacts to make more timely and informed decisions (see McKie, 2003). Essentially the two most important benefits are real-time data access in a usable format, and access to tools to collaborate and model the problem, leading to a quick solution. So faster and presumably better decisions will be made.

A business activity has to be intelligently automated in order to be monitored. The monitoring must be intelligent, and the results must be easy to access, visualize, or act upon to derive value. Activity modeling is the first step in creating a successful BAM system. This involves finding activities worth monitoring, defining their steps and events, and tying those events to performance metrics to be monitored (see McKie, 2003). Analyzing activities leads to improved processes.

BAM ISSUES

BAM systems suffer from many of the shortcomings of all enterprise information systems. Often executives fail to consider the readiness of technology or of the business processes that they want to monitor. This was one reason for the failure of the McDonald's enterprise system (Case Application 8.2). Enterprise Systems require a senior management champion, and proper involvement and training of users. Integration issues can plague a BAM effort. Data must be extracted from many different sources and provided to many users.

Change management issues are paramount. As with most EIS, adopting the model and method requires not only technology, but also a *change in business processes*, that is, change management. In the case of BAM, delays built into information flows to allow lower-level managers to respond to them are eliminated. This has caused problems in executive information systems, and higher-level managers must learn to leave some problems in the hands of those responsible, at least for a time, to allow them the opportunity to respond. Executives must not undermine the authority of their employees.

As with any EIS, effective BAM requires working closely with the business units to identify the key indicators (critical success factors) and analytical techniques that provide reliable early warnings of impending issues *{alerts).* Also, again as for any EIS, a good way to start with real-time BAM is to focus on a well-defined business problem with a demonstrable return (Keating, 2003).

BAM has the capacity to get the right information to the people who need it faster. Simultaneously, the information is reported higher in management. Executives must let the responsible managers on the front lines deal with their problems and issues in a timely manner before reacting (see the next section). The key to success is to provide those closest to the situation with the information they need for decision-making, and at the same time help higher levels of management to more effectively monitor the effects of the decisions (see Keating, 2003).

DSS IN FOCUS 8.40

ANATOMY OF CELEQUEST'S BAM SOFTWARE

The Celequest 2.0 BAM software monitors business events, relates them to historical or contextual information from data warehouses or operational systems, and then alerts users to exception conditions as they occur.

Celequest 2.0 has four integrated components. Among them is the Activity Server, that provides streaming database technology to cache temporal views of events and integrate historical context data. The Activity Server utilizes an Adaptive Modeling Engine that executes business rules, manages exception conditions, and enables dynamic event modeling, including time-series analysis.

With the Scenario Modeler component, users model complex analytical scenarios and evaluate them as they happen within a spreadsheet-type interface. Alerts are presented through the Activity Dashboard, while the Application Workbench component creates baseline business views and data models to represent ongoing business activity. This information is correlated with contextual information to provide a meaningful picture of the activity.

The BAM software can monitor business events like an increase in call volume in a call center, changes in investment positions, inventory levels falling below a certain threshold, a demand forecast drop, and an increase in product returns. The target markets are financial services, retail, manufacturing and Homeland Security contractors.

Source: Adapted from Dennis Callaghan, "Celequest Releases BAM Application," *eWeek,* June 30,2003.

BAM VENDORS

BAM vendors continue to improve their products by increasing functionality and by integrating them with other enterprise information systems and business intelligence/business analytics products (see Havenstein, 2003). Integrated BAM suites help configure, track, and analyze performance metrics (Bednarz, 2003), sometimes called *business optimization.* Cognos, Information Builders, and some other firms have developed monitor and alert features into their business intelligence systems. (Cognos executive information systems had these capabilities in the 1990s.) Others, like Actimize Ltd. and SeeRun Corp., have developed predictive analytics for customer relationship management into their systems (see Smith, 2003).

BAM vendors include Actimize Ltd., Celequest Inc., Cognos, FirstRain Inc., Information Builders, Iteration Software, Microsoft, Quantive LLC, Savvion Inc., SeeBeyond, SeeRun Corp., Sybase, Tibco Software, Vitria Technology Inc., and WebMethods.

In DSS in Focus 8.40, we describe the capabilities of the Celequest BAM application, which contains extensive modeling capabilities, as a representative example. Also see Callaghan (2003b). See DSS in Action 8.41 to see how the software works in practice.

8.15 FRONTLINE DECISION SUPPORT SYSTEMS

Decisions at all levels in an organization contribute to its success. But decisions that maximize a sales opportunity or minimize the cost of customer service requests are made on the front lines by those closest to situations that arise during the course of daily business. Whether it is an order exception, an upselling opportunity, or a contract that hangs on a decision, a decision-maker must be able to make effective decisions rapidly based on context and according to strategies and guidelines set forth by senior management.

DSS IN ACTION 8.41

BROCADE'S CELESTE BAM SYSTEM

Brocade is testing the Celequest BAM application suite to build business models to analyze data in the familiar spreadsheet format. Formulas can be added, just like in Excel.

Brocade is using the Celequest BAM system to look at data from the manufacturing process. Managers need to know when the data fall outside acceptable limits. Managers can monitor everything from constantly changing prices to the quality of the components manufactured for Brocade by suppliers. They can then access static data from the data warehouse, compare them against historical trends, and automatically get results.

Source: Adapted from Ephraim Schwartz, "Is BAM a Scam or Score?" *InfoWorld,* July 3,2003.

Frontline decision-making is the process by which companies automate decision processes and push them down into the organization and sometimes out to partners. It includes **empowering employees** by letting them devise strategies, evaluate metrics, analyze impacts, and make operational changes.

Frontline decision-making serves business users, such as line managers, sales executives, and call center representatives, by incorporating decision-making into their daily work. These workers need applications to help them make good operational decisions that meet overall corporate objectives. Frontline decision-making provides users with the right questions to ask, the location of needed data, and metrics (e.g., for customer and product profitability) that translate data into corporate objectives and suggest actions that can improve performance. Some aspects of CRM function as frontline systems. For example, the Chicago White Sox CRM (DSS in Action 8.27) helps salespeople interact directly with their existing and potential customers. Real-time analytic application products have emerged to support these actions (see Section 5.12 for more on real-time analytics).

Today's transactional applications and decision support tools do not by themselves readily enable frontline users to make better decisions. Systems like those from SAP AG and Siebel Systems do not implement simple decision processes or present data in a way that can be analyzed in complex situations. Executives may obtain context from reports and systems created from them (e.g., financial or executive information systems), but these do not provide frontline workers with guidance on daily problems. At the same time, traditional decision support from vendors like Pilot Software, Cognos, and Business Objects SA is intended for experts who can access data, slice-and-dice it, and give it business meaning, but are unlikely to be at the front lines. So organizations need a new generation of enterprise analytic applications to implement frontline decision-making.

FRONTLINE SYSTEMS

In frontline decision-making, every operational process has a corresponding decision process for evaluating choices and improving execution. For example, order management has cross sellcross selling suggestions, and a customer service representative can offer additional items to customers based on their specific needs.

Frontline decision-making automates simple decisions—like freezing the account of a customer who has failed to make payments—by predefining business rules and the events that trigger them. At more complex decision points, such as inventory allocation, frontline decision-making gives managers the necessary context—available

alternatives, business impacts, and success measurements—to make the right decision. In order for business users to take advantage of ordinary decision support, they have to know what questions to ask, where the information resides, and the components of any metric.

The frontline software that began to appear on the market in late 1999 can help solve standard problems, such as what to do if a specific bank customer withdraws 100 percent more than the average withdrawal, by packaging a self-service solution that requires business logic (including rules, algorithms, intelligent systems, etc.) in a single browser. Also provided are metrices such as lifecycle expectancy, decision workflow, and so on. Finally, to be successful, such systems must work hand in hand with transactional systems.

Real-time frontline systems are under development as executive information system capabilities have moved to the operational level of the organization. Look for new developments in conjunction with real-time analytics and active warehousing. According to Forrester Research Inc., such systems are essential for the survival of many companies, but it will take five years for the technology to mature. The major current vendors are Hyperion Solutions Corporation, NCR Corporation, SAS Institute Inc., and i2 Technology. However, almost all the SCM, ERP, and business intelligence vendors mentioned in this chapter may deploy such systems. For further details, see McCullough (1999) and Sheth and Sisodia (1999).

8.16 THE FUTURE OF EXECUTIVE AND ENTERPRISE INFORMATION SYSTEMS[2]

Executives and other managers place substantial requirements on computerized support. *First,* they often ask questions that require complex, real-time analyses for the answers. This is why many of today's EIS/ESS are linked to data warehouses and are developed with real-time OLAP in separate multidimensional databases along with organizational DSS, which provide the necessary analytical tools. But sometimes even these systems lack the ability to respond in real-time. Delay in the delivery of information can mean loss of competitive position, loss of sales, and loss of profits. This is changing as real-time (active) data warehousing and analytics are deployed. Various types of enterprise information systems and frontline systems are moving these capabilities to all decision-makers who need up-to-date information and analytic capabilities. *Second,* like other infrequent, untrained, or uncooperative users, executives (along with most users today) require systems that are easy to use, easy to learn, and easy to navigate. Current support systems generally possess these qualities through Web-based interfaces. However, ease of use can also mean that the system has enough intelligence to automatically determine which tasks need to be performed and either performs these tasks directly or guides the user through them. Although current systems enable executives to monitor the present state of affairs, they typically cannot automate the processes of interpreting or explaining information. Automation of these tasks requires integration of current executive support system capabilities with those of an intelligent

-Part of this section was condensed from unpublished work by D. King, Comshare Inc., 2000 (Courtesy of D. King).

system. *Third,* executives tend to have highly individualized work styles. Although the current generation of enterprise systems can be molded to the needs of an executive, it is very difficult to alter the look-and-feel of the system or to change the basic way in which the user interacts with it. Intelligent agents can learn how any user utilizes a system and create a "path" through the information that the user can automatically follow. *Finally,* any information system is essentially a social system. One of the key elements of an enterprise system is the communication and collaboration capabilities it provides for members of the (executive) team. Therefore, visualization, including multimedia documents, is becoming critical, as is the integration of collaborative computing tools into enterprise information systems.

The enterprise systems of the future will look substantially different from today's systems. Developers of decision support/business intelligence technology for executives must be alert to the needs of top executives. And developers of enterprise information systems must be alert to the needs of all decision-makers in the organization. Like most other systems, enterprise and standalone EIS/ESS have migrated to the networked world of the technical workstation (advanced PC clients with Web browser GUI interfaces) and intranets. Computing capacity continues to grow at almost astronomical rates, and memory, DASD, and network bandwidth cease to be impediments to highly complex decision support applications. In mid-2003, it was announced that research on magnetics will result in a thousand-fold increase in the capacity of PC hard drives for about the same cost as existing drives. (This will have a dramatic impact on data warehouse sizes, as well as on the amount of information available directly in portable devices.) Mobility, wireless connectivity, and the need to support multimedia integrated EIS on a variety of devices are just some of the challenges to be overcome in the next few years. Nobel (2003) indicates how some PDAs can already access enterprise information systems directly. Also see Brewin and Hablem (2001).

Enterprise information systems continue to evolve. New types of enterprise systems are continually developed and utilized, as is evident from the creation of CRM, PLM, BPM, and BAM. In summary, here are some major developments we expect to see in the next few years:

- ***Hardware and software advances.*** As hardware shrinks and speeds up, and software becomes more capable, more information can be made available to decision-makers anytime, anyplace. There will continue to be increased use of portable devices for information access and display. These include mobile PCs, PDAs, and cell telephones. Though scalability is an issue, data warehouses are at the petabyte range and will continue to increase in size.
- ***Virtual reality and three-dimensional image displays.*** The development of virtual reality standards (virtual reality mark-up language, VRML), the ability to examine terabytes of data in map form or on a landscape (Chapter 5) via three-dimensional visualization, and higher-quality display units are beginning to affect enterprise systems. There will be an increase in the utilization of spatial data, as supplied from geographic information systems and used in geophysical satellite systems (see Chapter 5). As these tools are deployed for general use, executives and managers are adopting them in data visualization for information evaluation and decision-making.
- ***Increased utilization of multimedia data.*** Many organizations thrive on soft information. Much of this can be textual, audio, or visual. Decision-makers, especially executives, typically use such information more frequently than hard infor-

mation in their work. As the capabilities of computing hardware and software increase, these types of information can be made readily available.

- ***Increased collaboration and communication throughout the enterprise.*** As collaborative computing technologies become integrated into the many types of EIS, the walls of the silos break down so that information flows to where it is needed. Although organizational culture issues must be dealt with, strong leadership at the highest levels will enable the use of such tools when the benefits are made clear. Knowledge-management systems (see Chapter 9) succeed because of increased collaboration and communication at the enterprise level.
- ***Automated support and intelligent assistance.*** Expert systems and other Al technologies (e.g., natural language) are currently being embedded in or integrated with existing enterprise and decision support systems. This clearly adds more automated support and assistance to the analytic engines underlying enterprise systems. However, we are also likely to see other forms of intelligent or automated assistance. One such form is the intelligent agent. Another example of currently deployed agent technology is news filtering. Thus, instead of thinking of an executive support system as a single system, we can think of it as a society of cooperating agents whose actions need to be coordinated. For example, Comshare's Detect and Alert agent, which is embedded in Decision Web, provides automatic surveillance of large databases and external news sources, with delivery of immediate personal alerts to users' desktops. Comshare's Decision Web uses intelligent component expansion (ICE) to identify the drill-down paths of exceptions (see DSS in Focus 8.4). Another agent tracks users' actions, learns how users use the system, and adopts appropriate screens in the user's preferred order. Other agents can be deployed in Web-enabled EIS. Expert systems, artificial neural networks, genetic algorithms, and fuzzy logic can play an active role in the decision-making process. These tools are utilized to provide advice and identify relationships in data. They can also be utilized to scan through large amounts of text and data to retrieve nuggets of information as part of data-mining efforts in seeking opportunities for or identifying threats to the organization.

• CHAPTER HIGHLIGHTS

- **Enterprise systems serve the whole organization and frequently business partners as well.**
- **The major enterprise systems are (1) for executive support, (2) for organizational decision support, and (3) for support along the supply chain.**
- **Executives' work can be divided into two major phases: finding problems (opportunities) and deciding what to do about them.**
- **EIS serves the information needs of top executives. It used to be an independent system, but today its capabilities are generally provided as part of a business intelligence/enterprise system.**
- **EIS provides rapid access to timely information at various levels of detail. It is very user-friendly.**
- **Drill-down and rollup are important EIS capabilities. They allow an executive to look at details (and details of details), and to reaggregate the details.**
- **EIS uses a management-by-exception approach. It centers on CSFs, key performance indicators, and highlighted charts.**
- **Data warehouses and client/server front-end environments make an EIS a useful tool.**
- **Organizational DSS (ODSS) deals with decision-making across functional areas and hierarchical organizational layers.**
- **ODSS is used by individuals and groups, and operates in a distributed environment.**
- **The effectiveness and efficiency of the supply chain are critical to the survival of organizations.**
- **The major components of the supply chain are upstream (suppliers), internal, and downstream (customers).**
- **The value chain is a concept that attempts to maximize the value added when moving along the supply chain.**

- Enterprise systems are becoming part of corporate portals for communication, collaboration, access, and dissimilation of information.
- Customer relationship management (CRM) systems enable customer loyalty, retention, and cross selling.
- Product life-cycle management (PLM) systems improve manufacturing processes by integrating design and manufacturing systems, essentially providing knowledge management capabilities.
- Business performance management (BPM) systems integrate information from many sources to improve an organization's workflow performance
- Business activities monitoring (BAM) provides managers with real-time information and models and collaboration capabilities in order to respond to situations and make timely decisions.
- Frontline systems automate or facilitate decisions at the place where customers interface with organizations.

• KEY WORDS

- advanced planning and scheduling (APS)
- application service provider (ASP)
- business activity monitoring (BAM) systems
- business intelligence (BI)
- business process management (BPM) systems
- critical success factor (CSF)
- corporate (enterprise) portal
- customer relationship management (CRM) system
- demand chain
- drill down
- empowering employees
- enterprise information systems (EIS)
- enterprise (information) portal
- enterprise resource planning (ERP)
- environmental scanning
- exception reporting
- executive information system (EIS)
- executive support system (ESS)
- extended supply chain
- frontline decision-making
- intelligent agent (IA)
- key performance indicators (KPI)
- multidimensional analysis
- navigation of information
- news feeds
- organizational decision support system (ODSS)
- product life cycle
- product life-cycle management (PLM) system
- reverse logistics
- soft information (in EIS)
- supply chain
- supply chain management (SCM)
- value chain
- value chain model
- value system

• QUESTIONS FOR REVIEW

1. Define executive information system (EIS).
2. Define executive support system (ESS).
3. What are the key differences between an EIS and an ESS?
4. List the pressures for the creation of an EIS.
5. Define enterprise support system.
6. List the major benefits of an EIS.
7. Define drill down and roll up, and list their advantages.
8. Define status access.
9. Define exception reporting.
10. List the major differences between EIS and DSS.
11. Describe how soft information can help an executive in decision-making.
12. Define ODSS (give at least two definitions).
13. Define supply chain and list its major components.
14. Discuss supply chain management (SCM) and its benefits.
15. Define enterprise resource planning/enterprise resource management (ERP)/(ERM).
16. List the major characteristics of ERP.
17. List the major tangible and intangible benefits of system (and software) integration.
18. Describe an ASP.
19. Define a corporate (enterprise information) portal (dashboard).
20. Describe the benefits of customer relationship (resource) management (CRM) systems.
21. Define PLM. Describe how it enhances SCM and ERP.
22. Describe BPM. Explain how it integrates with enterprise information systems and data warehouses.
23. Describe BAM. How can an effective BAM interact with other decision support/business intelligence/ business analytic systems.
24. Explain how the Web has impacted all of the enterprise systems described in the chapter.
25. Describe frontline decision-making.

• QUESTIONS FOR DISCUSSION

1. If a DSS is used to find answers to management questions, what is an EIS used for?
2. Discuss how CSFs can be monitored and why they should be.
3. What are the major benefits of integrating EIS and DSS? What problems can occur?
4. It is said that drill down will be fully automated someday. What advantage will such automation give the executive? How can an intelligent agent be used to automate drill down in EIS?
5. What is soft information? Give four examples. Why is it important for an EIS to provide soft information?
6. Data mining (Chapter 5) is critical for enterprise information systems. Explain why.
7. Describe how multidimensional analysis, visualization, and OLAP are influencing EIS design and use.
8. Compare and contrast a value chain and a supply chain.
9. How can cooperation between a company and its suppliers reduce inventory costs?
10. Discuss the reasons for ERP's inability to support decision-making directly.
11. Discuss the major problems that could develop along the supply chain.
12. ERP software vendors have Web-based products. Discuss the benefits of Web-based ERP.
13. Discuss why EIS has moved toward the enterprise information (corporate) portal.
14. Business intelligence and ERP software as we know them today cannot support frontline decisions. Why not?
15. Describe in detail how a customer relationship management (CRM) system is an enterprise information system.
16. Compare and contrast the capabilities of PLM, BPM, BAM, SCM, and ERP.

• EXERCISES

1. Prepare a diagram showing the supply chains of (a) a toy manufacturer, (b) a PC manufacturer, and (c) a university. Clearly show the major components.
2. A. Paller described an EIS as being like the displays in an airplane cockpit. Because most of us are not airplane pilots, we can use the analogy of the gauges and indicator lights on a car dashboard. Explain the analogy between an airplane cockpit or an automobile dashboard and EIS or OLAP in terms of its use and effect on an organization.
3. Three surprising benefits ensue as an organization develops an enterprise system: the organization settles on a common terminology for its information, a common format is used, and a common depository of data is developed (now called a data warehouse). How might this happen otherwise? Consider several organizations with which you are affiliated. How might common terminology and a data warehouse be helpful to you? What disadvantages might there be? Explain.
4. Choose a real-world information scanning and reporting problem for which Temtec Executive Viewer might be appropriate. Develop a prototype EIS in Executive Viewer.
5. Choose a real-world information scanning and reporting problem for which Pilot Decision Support Suite might be appropriate. Develop a prototype EIS in Pilot Decision Support Suite.
6. There are documented cases in the literature of EIS development strictly in spreadsheet packages. Develop a small EIS in Excel (or another spreadsheet). Use publicly available Cencus data.
7. Why are EIS diffusing down to lower levels of management? How does this affect an organization's ability to provide the same level of support to all levels of management using an EIS? Explain.
8. Consider the supply chain for a textbook. Explain how ERP could help Prentice Hall, the publisher of this book. Identify some major decisions that need to be made with respect to textbook production and distribution, and explain what type of DSS could be useful and how it could be integrated with an ERP.
9. Investigate ways that CRM can be used to optimize the relationship between an organization and its customers. Describe how this can be done at your organization or, if you are not working, at your college or university. Write up your findings in a five-page report.
10. Describe in detail how PLM, BPM, and BAM relate to other enterprise information systems.

• GROUP EXERCISES

1. Develop an EIS in a Windows-based database system (e.g., Access) to access critical census data (assume that it changes regularly). Highlight exceptional cases in color. Use regression and forecasting models. Link the data to a spreadsheet (e.g., Excel) containing the models. Describe the system in a report and highlight the difficulties encountered.
2. Divide the class into groups and assign each group to an ERP vendor (Oracle, SAP, Peoplesoft, etc.). Each group will investigate what business intelligence capabilities, including EIS, are incorporated into the core ERP (e.g., SAP R/3). Have the groups compare results and prepare a unified report.

• INTERNET EXERCISES

1. Access the Web sites of sap.com, oracle.com, baan.com, and www.peoplesoft.com, and find out how they incorporate business intelligence and EIS in their offerings.
2. EIS is tightly related to data warehousing and OLAP. Find recent articles on this relationship (try cio.com for the search). Also, check vendor Web sites, such as sas.com. Contact the SAS Institute and identify its product strategy regarding EIS, data warehousing, and OLAP. Access the Cognos Web site (cognos.com), download a demo of one of its EIS products, and try it. Report your experience to the class.
3. Access the Data Warehousing Institute's Web site (dw-institute.org) and identify current database trends, data warehousing, data mining, multitiered architectures, client/server architecture, and OLAP specifically as they relate to EIS. Report your findings.
4. Repeat Internet Exercise 3 for the Teradata University Network Web site. (teradatauniversitynetwork.com)
5. Access the Web sites of several EIS software vendors. Compare their products. What are their latest product offerings? What hardware platforms do they promote for their products? Which companies provide products that are Web-ready? Describe their capabilities. Which companies provide collaborative computing (GSS) capabilities?
6. Access the BusinessObjects Web site (businessobjects.com) and download and try BusinessQuery for Excel. Describe your experience. Do the same for the currently available downloadable demo version of BusinessObjects.
7. Access www.supplychain.com, cio.com, and other sources, and find the recent developments that relate to SCM and decision-making.
8. Prepare a presentation of state-of-the-art corporate portals. Start with www.microstrategy.com and www.oracle.com, and point out the capabilities and benefits.
9. Access the Web sites of several CRM software vendors. Compare their products. What are their latest product offerings? What hardware platforms do they promote for their products? Describe their capabilities. Which companies provide collaborative computing (GSS) capabilities?
10. Access the Web sites of several PLM (e.g., ptc.com), BPM, and BAM software vendors. Compare their products. What are their latest product offerings? What hardware platforms do they promote for their products? Describe their capabilities. How do they integrate into other enterprise information systems? Which companies provide collaborative computing (GSS) capabilities?
11. Access acxiom.com, epiphany.com, ncr.com, hyperion.com, and ptc.com. Identify their frontline system initiatives.

CASf APPLICATION 8.1

HOW LEVI S GOT ITS JEANS INTO WAL-MART

Years ago, Levi's and blue jeans were synonymous. By the mid-1990s, Levi's had missed the baggy pants craze that had overtaken American high schools. In 1996, Levi's sales peaked at $7.1 billion. In 2002, they fell to $4.1 billion, a six-year low. Levi's jeans market share fell to about 12 percent from 18.7 percent in 1997. To survive, Levi's had to begin selling to mass-channel retailers such as Wal-Mart, which meant transforming the company's IT.

Wal-Mart, the world's largest retailer, is where moms go to stock up on jeans for their kids. So if you want to sell to the kids and their families, you must sell at Wal-Mart. Levi's introduced a new, less expensive Signature jeans line specifically for this market. And Wal-Mart, the largest clothing retailer in the world, wanted more affluent customers, so it needed major name brands. By partnering with Wal-Mart, Levi's expected to get the volume it needed to survive.

To a large extent, the success of the Levi's strategy depended on the performance of its technology. Wal-Mart requires its major vendors to utilize technology in their supply chains. The technology must link to Wal-Mart's systems. Selling to the mass market requires supply chain improvements. Globalization demands standardized enterprise systems.

CIO David Bergen joined Levi Strauss to get Levi's ready for Wal-Mart. Bergen had to rethink the supply chain, which included every detail of how Levi's jeans, jackets, and shirts would get from factories to new regional warehouses to Wal-Mart's 3,422 U.S. stores when they were needed, not before and certainly not after. This was much more complex than the demands placed on Levi's by smaller department store chains, such as Macy's (243 stores) or even J.C. Penney (1,049 stores). Complicating this challenge was the fact that Bergen would be going live with a completely upgraded supply chain system during the back-to-school rush, the worst time for a retailer to roll out a new technology.

In 2000, Bergen began working to make Levi's technology fit for the "mass channel," the big discount stores where 31 percent of all the jeans in the country are sold. When Bergen arrived, the company was in tentative discussions with Kmart, Target, Wal-Mart, and others. Bergen knew that without a technology overhaul, Levi's would fail. He was most concerned that the company's national distribution strategy did not match Wal-Mart's business processes. Levi's had a poor on-time delivery record, the result of manufacturing and logistics problems dating from its move to largely overseas manufacturing in the late 1990s.

During exploratory meetings, Bergen knew that, the Levi's supply chain would initially be unable to deliver the services Wal-Mart expected. Being a supplier to Wal-Mart demands a certain level of performance and cost control. Wal-Mart drives you to work with your supply chain to put the same requirements on your suppliers that Wal-Mart puts on you. If you can't make your supply chain work, you do not benefit from being a supplier. At Levi's, executives could not track where its product was moving in the pipeline: how many pairs of jeans were being manufactured in which factories, and how many were sitting in trucks or in distribution centers. That was unacceptable to Wal-Mart, a supply chain pioneer that moves products off its shelves faster than any retailer and expects replenishment on time to keep costs down. Levi's needed to both get a handle on how its products were doing in stores and accelerate the speed at which those products moved from import dock to warehouse to retail shelf.

The lack of information available to Levi's executives translated into poor performance even without Wal-Mart. Beforehand, Levi's was delivering 65 percent of its product on time to customers, a poor performance. After its supply chain management improved, the rate was $5 percent, which could improve sales by 10 percent to 15-percent. Much of the benefit was due to improved demand-replenishment systems and forecasting technology. Additions included a dashboard that executives use to shows how each line of jeans is doing with each store on a weekly, monthly, or annual basis. Executives can also click on a specific product to track how it moves from the factory to the distribution centers to the stores. It shows how many pairs of jeans are available at a given time, what the demand is from the stores, and whether the company is meeting that demand. Executives can drill down to the product level.

The new system connects employees working within the supply chain to salespeople all the way up to the corn-

Adapted from Kim Girard, "How Levi's Got Its Jeans into Wal-Mart," *CIO,* July 15,2003.

pany's financial office. Executives use the dashboard to track trends and prevent problems. For example, during the third quarter of 2002, when the company started shipping Dockers Stain Defender pants, it expected to sell about 2 million pairs. The dashboard, however, alerted Levi's to that fact that the pants were flying off the shelves and another 500,000 more would be needed to meet demand. Having this information at its fingertips helped the company plan in advance and meet the demand. The same sort of information would be crucial to replenish Wal-Mart's shelves during the back-to-school season.

As part of this network of facilities, Levi's also developed a scanning tool for its manufacturers to check the accuracy of cartons ready to ship. The company implemented technology to exchange information with Wal-Mart EDI transactions that support collaborative forecasting. And a set of Manugistics applications allows the company to collaborate with Wal-Mart on demand forecasting, product modifications, and ordeT planning. Levi's can plan, define, and ship prepackaged orders to the retailer.

By 2003, there were encouraging signs that Levi's was turning around. Sales for the company's third and fourth quarters grew for the first time since 1996. During the spring and fall of 2002, for the first time in a long time, Levi's started appearing on NPD Fashionworld's top-10 list of brands preferred by young women. Levi's plans to upgrade its business processes and its improved replenishment system had helped the company get the right sizes to the right stores. The next phase is to develop a global ERP for between $1 million and $5 million, plus consulting fees.

CASE QUESTIONS

1. Why was it so important to overhaul the Levi Strauss supply chain system?
2. What SCM features do you think the system utilized (hint: see the chapter)?
3. What benefits did the new system deliver?
4. How can analytics help Levi Strauss?
5. What advantages could Levi Strauss obtain by implementing an ERP system to integrate with this SCM system?

(AH APPLICATION 8.2

MCDONALD S ENTERPRISE INFORMATION EFFORT: MCBUSTED!

McDonald's planned to spend $1 billion over five years to tie all its operations in to a real-time digital network (enterprise information system). Eventually, executives at company headquarters would have been able to see every performance detail in every store, at any time, through this massive enterprise information system. After just two years, McDonald's cancelled the expensive program.

In early May 2003, McDonald's announced that it would write off a $170 million loss for the discontinuation in December 2002 of the global, real-time digital Innovate network, which represented the most expensive and extensive information technology project in the company's history. The $170 million was just part of the $1 billion that McDonald's planned to spend on Innovate starting in January 2001. Innovate was designed to let McDonald's management see how many billions of burger patties, buns, and chicken nuggets were being consumed at any or all stores at any time of the day. Every detail of every property was to be available in *real-time.* The billion-dollar project failed before it even got off the ground because of the difficulty of transforming even a simple business into a real-time enterprise.

Fast growth led McDonald's to want to create a means to control the key quality that makes a fast-food chain successful: *consistency.* McDonald's opened more than 1,700 new restaurants a year over 10 years, taxing its outdated data-collection systems. A Web-based network that sent information instantly around the world was needed so that executives could monitor, and possibly

Adapted from Larry Barrett and Sean Gallagher, "McBusted," *Baseline,* No. 20, July 2003.

affect on a minute-by-minute basis, the company's ability to get a consistent product to customers quickly. If connected to every key piece of equipment in every store, the real-time digital network would have allowed McDonald's to better serve customers by using information and communications technologies to monitor the quality of the oil used to make french fries, or to ensure that each bun was toasted to the proper level of crispiness. It would have given McDonald's executives a detailed view of the entire system in real-time. Sales, service time, staffing, supply chain data, vendor locations, equipment repair orders, and every other datum that McDonald's currently tracks with its aging internally developed system, which typically made the data available to decision-makers in a week or more, could be pulled up in seconds through a Web browser. In theory, by working closely with suppliers and store managers, the company could improve the consistency of the product.

Innovate was also supposed to streamline the delivery of employee training and benefit data. Using the Internet to convey training information, like how to clean fryers or use the point-of-sale system, McDonald's hoped to leverage its training system across this platform.

By instantaneously collecting and sending data to stores from the corporate office, executives could monitor performance and fix it on the fly. For example, if a particular store was not moving people through the lines or drive-through up to the standards, executives could ask the local manager to add another employee or two to improve service time. If certain products were not moving, executives could investigate whether the in-store advertising was in place.

The supply chain would also be monitored. Every item from warehouse to store could be tracked to the second. If there was a run on Big Mac's in a particular store, supplies could be diverted en-route. McDonald's could react to customer demand quickly, and draw substantial financial rewards from the resulting efficiency. On the other hand, monitored remotely and, eventually, managed remotely, the system would take a lot of responsibility away from individual store managers.

Eventually, the Internet-based network would have linked all of the company's 30,000-plus restaurants and 300-plus approved vendors 24 hours a day, seven days a week, to the back-office system at its corporate office in Oak Brook. This would have given McDonald's executives a complete, instant picture of the company's operations around the world, and, in theory, the ability to act quickly when necessary to adjust the deployment of promotions and supplies to meet demand.

Some $170 million was spent on the "research and development" of Innovate. McDonald's claims that the decision to terminate Innovate was based on the company's recent financial difficulties. On the other hand, had McDonald's made the $1 billion investment in Innovate to streamline its supply chain and improve its day-to-day operations, it would have needed to achieve at least a 1.5 percent improvement in sales, or roughly $231 million a year, to pay for the initial rollout. That is an additional 1.5 percent above the 3 to 5 percent in annual sales McDonald's was already projecting.

McDonald's first attempt at a large-scale, real-time enterprise data systems failed. This was no shock to some experts. McDonald's has a relative lack of experience in this area, spent too much money, and has little to show for it. McDonald's is not known for being at the cutting edge of technology or the executive-level appreciation and understanding of technology. Peter Abell, an analyst at AMR Research, says that "a real-time global network would tax even the most ambitious information technology organization. Configuring and integrating the software necessary to communicate back to Oak Brook from 30,000-plus locations including some in third-world locations where broadband connectivity is still just a dream—was more fantasy than reality." Abell continues, "The real challenge is determining whether or not there are enough cost benefits to make it worthwhile in the first place."

"The biggest problem a company like McDonald's would have is getting high-speed bandwidth in every location," Abell says. "Some parts of the U.S. still don't have reliable high-speed connectivity. And they're international. So that could definitely be problematic."

Though the company had shown little to no excitement or expertise in large-scale information systems implementations when Innovate was initiated, its executives thought they could do a Wal-Mart-like makeover of their core technology infrastructure. What they found out was that their expertise in developing and mass-producing fast food had little relevance to software integration and implementation.

CASE QUESTIONS

1. Investigate and describe the McDonald's supply chain. How do information flows follow it?
2. Why was the McDonald's enterprise information "McSystem" cancelled?
3. Would the system have been cost-effective had it survived?
4. What problems would the McDonald's enterprise information system have encountered?
5. Examine the ERP situation at Hershey's Chocolate described in this chapter and Chapter 6. Compare and contrast Hershey's ERP experiences to McDonald's. What lessons could McDonald's learn from Hershey's?

CASE APPLICATION 8.1
mmmmmmmmM

MOHEGAN SUN S CRM HITS THE JACKPOT

The Mohegan Sun Casino tracks the habits of its customers (gamblers), even low rollers, to build loyalty and get them to return. Mohegan Sun has 6,200 slot machines, 260 table games, and 36 poker tables.

Sue Vanwiggeren, 76, has for the past year taken a two-hour bus ride from Fall River, Massachusetts, to Uncasville, Connecticut, to visit the Mohegan Sun Casino. She usually comes three or four times a week, for the day, and has gotten to know many other senior citizens who do the same. Vanwiggeren likes slot machines, but especially likes blackjack. She does not just come for the gambling, but also for the "freebies." The $15 bus fare was paid in points earned through her frequent-gamer Player's Club card. Mohegan Sun also mailed her a coupon for a chance to spin a giant prize wheel and one for a free buffet dinner. Most people think about high rollers playing high-stakes games and dropping thousands of dollars a night when they think about gamblers. Even though there are such players, they are *not the core* of the casino business. People like Ms. Vanwiggeren are.

At Mohegan Sun, cardholders collect points like a checking account and can use them any way they want: to eat, drink, buy gifts or clothes, pay for hotel rooms or massages, or for hourly childcare services while gambling, or for gassing up the car on the way out.

Mohegan Sun works to get repeat business with a customer-loyalty program mixed with outside demographic data, surrounded by data mining and analysis software. Information technology helps marketing identify exactly who, in a six-state radius, it should try to attract. Mohegan Sun spent $77 million on promotional programs last year, up from $71 million in 2001. In 2003, the casino had the first full year of operating its expanded gaming floors and luxury hotel.

Promotions are definitely geared to certain age groups. For example, the casino targets senior citizens with coupons for bus rides and weekday meals. Other programs are broader, intended to appeal to as many Northeastern gamblers as possible. For example, with Swipe & Win, customers run a magnetic-striped Player's Club card that they got in the mail through a kiosk to try to win cash. There are five other major promotions that the casino rotates monthly to bring in customers, who can play once per day. In the summer of 2002, it gave away $500,000 to 25,000 people. Prizes ranged from $25 to $50,000.

But more important, Mohegan Sun can identify the gambling history of each of the casino's 2 million Player's Club members (as well as of anyone using a credit card, but not cash just yet). Using collected data, a customer relationship management (CRM) system is used to analyze gaming patterns with demographics to identify profitable customer segments. The casino can determine how popular each contest is and with whom. The casino also tracks when patrons use Player's Club cards on the property to play slot machines or table games, or to redeem points at stores or restaurants. This helps determine how much additional revenue the casino got from those customers after luring them in with promotions.

Direct mail campaigns across industries, on average, draw a 3 to 5 percent response rate. But 75 to 80 percent of the people who get Swipe & Win mail promotions visit the casino. When analysts noticed that Tuesdays were slow days on the gaming floors, marketing staff created *double-swipe Tuesdays*, which brought more people in.

An electronic item-tracking system inside the minibar monitors what has been taken so that housekeepers know what to cart to each room the next day. The system automatically charges room accounts for items pulled out for longer than a half minute.

Overall, the system is a success. It increases demand and enhances profitability.

CASE QUESTIONS

1. **Why is it important for an organization to use CRM to segment customers? What do organizations do with the information?**
2. **Examine data mining in Chapter 5. How can data mining be used to identify profitable customers?**
3. **How could credit card and Player's Club data be used to track additional spending on the property? Determine at least three categories of spending and explain how could this be effective in developing further comps for customers.**
4. **Identify similarities and differences between the Mohegan Sun case and the Harrah's situation in the Chapter 1 Opening Vignette.**

Adapted from Kim S. Nash, "Mohegan Sun: Play for Keeps," *Baseline,* No. 20, July 2003.