Part IV Operational and Enterprise Systems and Processes

Chapter 9

Operational Planning and Control Systems

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References

Learning Objectives

1. Describe how functional systems support managers and workers at the operational level.
2. Understand the support provided by manufacturing and production/operations systems.
3. Understand the support provided by marketing and sales systems.
4. Understand the support provided by accounting and finance systems.
5. Understand the support provided by human resources systems.

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QUICK LOOK at Chapter 9, Operational Planning and Control Systems

This section introduces you to the business issues, challenges, and IT solutions in Chapter 9. Topics and issues mentioned in the Quick Look are explained in the chapter.

Operational-level information systems (or simply **operational ISs**) capture and record all of the company's data from operations and perform the routine transactions needed to conduct business on an ongoing day-to-day basis. They are planning and control systems. At their best, operational ISs put the right information in the right hands at the right time, giving those on the front-line the ability to respond to customers and suppliers, resolve production issues, and react to changing conditions as quickly as possible. The support provided by operational ISs can be broken into two components:

- **Operational awareness:** The ability to see at any given time what's happening in the department or functional area. The business functions are manufacturing and production, accounting, finance, sales and marketing, and human resources (HR).
- **Operational responsiveness:** The ability to respond to unexpected changes in conditions and customer demands as they occur, enabling business units to take advantage of opportunities, to protect against threats, and/or to improve efficiency.

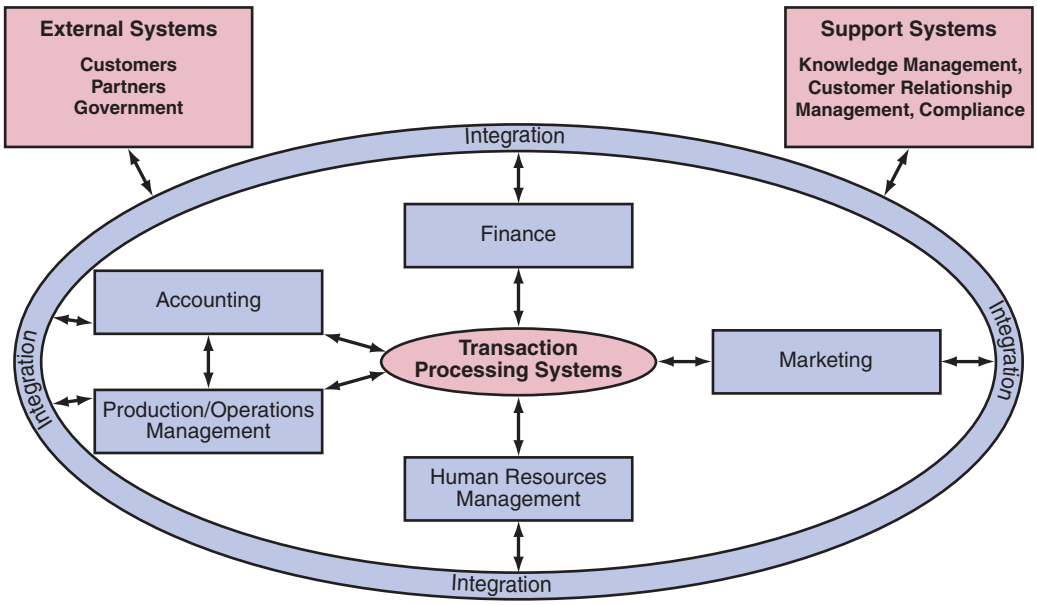

Figure 9.1 Functional areas, TPS, and integration connection. Note the flow of information from the TPS to the functional systems. Flow of information between and among functional systems is done via the integration component.

In this chapter, you learn more about functional information systems that support the operational level of the organization. Functional ISs get much of their data from transaction processing systems, TPSs, which you read about in Chapters 1 and 2. Most applications in business intelligence, e-commerce, and customer relationship management (CRM) use data from several functional ISs. As such, getting a complete view of what's going on requires integrating the functional systems with the TPS and with external business apps and support systems, as diagrammed in Figure 9.1.

The focus of this chapter is on information systems that support the operational level, or operations, and the benefits and issues of integrating functional ISs shown in Figure 9.1. These systems are critical to the organization's ability to conduct business and to its performance.

Scandinavian Food Retailer Axfood Integrates Operations

In 1999, over 1,300 Scandinavian (Sweden and Finland) food retailers merged, forming Axfood AB. The food retailers had merged to build brand recognition, respond better to increasing customer demands, improve efficiency, and achieve other synergistic effects. In 2006, the company had consolidated sales of 28.8 billion SEK (Sweden kronor; approximately 3 billion euros or US$3.7 billion) and over 7,000 employees. The Axfood Group owns 224 stores in Sweden, with more than 500 additional stores run by independent merchants tied to the company through franchise agreements. In Sweden, its market share is over 15 percent.

Axfood Integrated its Disparate IT to Integrate Operations

Axfood AB is one of the largest food retailers in Scandinavia to unite disparate IT infrastructures and to provide the strategic foundation for integrating partners in its delivery chain. Mats Munkhammar, Axfood's chief of IT architecture, explained: "As a direct consequence of this consolidation, we were left with a very diverse IT infrastructure with many different solutions. So we had to go and look for a central integration engine, a platform that would allow us to keep our existing solutions while adding on new components and removing old ones when the time came." Axfood invested approximately 200 million SEK (20.4 million euros or US$25.6 million) in a common IT platform for the Axfood Group's core businesses to fully integrate its wholesale and retail operations.

Integrated Scalable and Flexible Architecture

Axfood selected two Progress (*progress.com*) software products: Progress SonicMQ and Progress Sonic ESB (enterprise service bus). Progress Software Corporation is a global software company that enables enterprises to be operationally responsive to changing conditions and customer interactions as they occur. (Visit *progress.com* and click on the tab "What We Offer" to view their **tag cloud,** which is discussed in Chapter 8.)

These two software apps offer an Internet-ready messaging system that integrates disparate applications. Sonic ESB combines messaging, Web services, XML transformation, and intelligent routing—all of which enable managers and workers to reliably connect and coordinate the interaction of applications across the enterprises.

Figure 9.2 Supermarket POS terminal collecting operational data. (*Joshua Hodge Photography/iStockphoto*)

Axfood's integrated operational systems enable it to handle high-volume POS (point-of-sale) data (see Figure 9.2). Specifically, the integrated operational systems do the following:

- Coordinate the secure and reliable transmission of POS data from retail locations to a central data warehouse, enabling more efficient inventory management and business activity monitoring.
- Connect the company's network of wholesale suppliers and logistics operations, which cut the *order-to-delivery* time by 33 percent—from three days to two days. That is, the ordering process involves not just every department of the company, but also external parties such as suppliers and transportation companies.
- Enable the addition of new solutions for future business processes with minimal incremental investment.
- Help keep shelves stocked with the products consumers want, and that results in increased sales, satisfied customers, and eventually more stores.

For Class Discussion and Debate

1. ***Scenario for Brainstorming and Discussion:*** Supermarkets, food retailers, and others in the grocery industry operate on thin (low) profit margins. To maintain profits, they attempt to make up for thin margins with volume. Visit *data360.org* to compare the profit margins (shown as Data Graphs) of selected industries. The data graph shows that the profit margin of *grocery sales* in 2005 Q4 was .90% (less than 1.00%). In contrast, the profit margins of *Internet companies* were 21.30% and those of security software were 17.90%. You can see the detailed data by clicking "Generate CSV," which generates a spreadsheet.

a. Discuss why it makes sense for Axfood to invest approximately 200 million SEK (20.4 million euros or US$25.6 million) to integrate operations despite its thin profit margin.

b. Was it necessary for the food retailers to merge prior to investing in the IT to integrate operations? Explain.

2. ***Debate:*** Refer to Porter's five competitive forces that shape strategy model, which you read about in Chapter 1. You can also view Porter discussing that model on YouTube (*youtube.com/*).

a. Debate how and to what extent the increased use of IT to manage operations in the grocery industry and to connect to suppliers, as Axfood has done, impact each of those five forces.

b. Two possible outcomes are that the degree of competition in the grocery industry increases because of required IT investments or it decreases the degree of competition. Select one of those two positions and explain it. You may need to make reasonable assumptions to support your position.

9.1 Management Levels, Functions, and Operational Systems

Three levels of management and decision making are modeled as a pyramid to show their hierarchy. Starting at the bottom of the pyramid shown in Figure 9.3, the levels are operational, managerial or administrative, and strategic. Each level of management has its own data needs, decision-making responsibilities, and time horizons.

- At the **strategic level,** senior or top-level management plan and make decisions that set or impact the long-term direction of the entire organization. These decisions are visionary and future-oriented, defining the mission, objectives, and strategy. External data about the economy, competitors, and business trends is essential to management's SWOT (strengths, weaknesses, opportunities, and threats) analysis, planning, and decisions.
- At the **managerial or administrative level,** middle-level managers make tactical decisions that focus on intermediate-term issues to fulfill the organization's mission, objectives, and strategy. Control is important at this level. Middle-level managers set goals for their departments or business units that are consistent with organizational goals set by senior management. External and internal data are important for decision making, which often has a one- to three-year time horizon.
- At the **operational level,** lower-level managers, supervisors, and workers need detailed data, in real time or near real time, and the ability to respond to what they

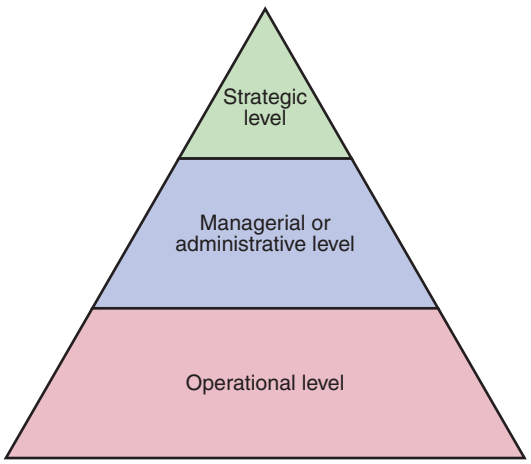

Figure 9.3 Robert Anthony's model of organizational levels, decision making, planning, and control.

learn from functional ISs. Decision making is for the immediate or short-term because decisions are made to control the day-to-day activities or operations. The purpose of control is to identify deviations from objectives and plans as soon as possible in order to take corrective action. Tracking sales, inventory levels, orders, and customer support are examples of control activities. Internal data is most important at this level.

TRADITIONAL FUNCTIONAL IS DESIGNS

Traditionally, ISs were designed within each functional area to support and increase its effectiveness and efficiency. However, the traditional functional structure may not be the best structure for some organizations, because certain business processes involve activities that are performed in several functional areas. Suppose, for example, a customer wants to buy a particular product. When the customer's order arrives at the marketing department, the customer's credit needs to be approved by finance. Someone in production/operations (see Figure 9.4) determines whether the product is in the warehouse. If it is there, then picking and shipping departments pack the product, print the mailing label, and arrange for delivery. Accounting prepares a bill for the customer, and finance may arrange for shipping insurance. The flow of work and information between the different departments may not work well, and coordination may be difficult, creating delays or poor customer service.

One solution is to integrate the functional departments via ISs that facilitate communication, coordination, and control.

OPERATIONAL SYSTEMS AND DATA QUALITY

The various operational functions interact, passing data from one to the other. For example, when products are produced and shipped, then production and shipping departments inform the accounting department to process and charge the buyer's credit card or issue an accounts payable (A/P). In the process, files are generated to record the details of the activity. The data requirements of the operational-level units are extensive and routine, rarely changing because they depend on fixed sources of input and **standard operating procedures (SOP).** As the term implies, a standard operating procedure, or SOP, is a clearly defined and mandatory procedure to be followed without deviation to complete a process or function, such as a quality control process or function. SOPs document the step-by-step ways in which activities are to be performed.

Data in a TPS has a different significance to many other systems. If data is lost, it has financial implications. As such, it is critical that businesses have procedures to ensure that data is secure and accurate and that data integrity is maintained.

- **Data security:** Data needs to be protected from malicious or unintentional corruption, unauthorized modification, theft, or natural hazards such as fire. Infosec is covered in greater detail in Chapter 5.
- **Data accuracy:** Every effort is needed to ensure that data is accurate and in standardized format. Data validation is used to detect and correct data entry errors as well as to standardize address data, names, and other data types.

Figure 9.4 Preparing factory orders for shipping. (© *API/Alamy*)

TABLE 9.1 Key Characteristics of a TPS

- Large volumes of data are processed.
- Data sources are mostly internal, and the output is intended mainly for internal users and trading partners.
- Data is processed on a regular basis: hourly, daily, weekly, biweekly, and so on.
- Processing is done at high speed due to the high volume.
- Current or past data is monitored and collected.
- Input and output data are structured. Processed data are fairly stable, so they are formatted in a standard fashion.
- There is a high level of detailed raw data.
- There is low computation complexity, such as basic math and statistical calculations.
- Accuracy, data integrity, and security are critical. Privacy of personal data is strongly related to TPSs.
- High reliability is required. The TPS is the lifeblood of the organization. Interruptions in the flow of TPS data can disrupt operations and damage the organization.
- Quick search and query processing capacities are a must, often in real time.

- **Data integrity:** The overall reliability of the data must be ensured. Data integrity with real-time systems involves the ACID test, which is short for atomicity, consistency, isolation, and durability:
  - *Atomicity:* If all steps in a transaction are not completed, then the entire transaction is canceled.
  - *Consistency:* Only operations that meet data validity standards are allowed. For instance, systems that record checking accounts only allow unique check numbers for each transaction. Any operation that repeated a check number would fail to ensure that the data in the database is correct and accurate. Network failures can also cause data consistency problems.
  - *Isolation:* Transactions must be isolated from each other. For example, bank deposits must be isolated from a concurrent transaction involving a withdrawal from the same account. Only when the withdrawal transaction is successfully completed will the new account balance be reported.
  - *Durability:* Backups by themselves do not provide durability. A system crash or other failure must not cause any loss of data in the database. Durability is achieved through separate transaction logs that can be used to re-create all transactions from a known checkpoint. Other ways include database mirrors that replicate the database on another server.

Other key characteristics of TPSs are summarized in Table 9.1.

OPERATIONAL SUBSYSTEMS

Functional systems are composed of subsystems, or modules, that support specific activities performed in the functional area. Examples of subsystems of the key functional areas are:

- **Manufacturing and production:** purchasing, quality control, scheduling, shipping, receiving
- **Accounting:** accounts receivable, accounts payable, general ledger, budgeting
- **Finance:** cash management, asset management, credit management, reporting
- **Sales and marketing:** order tracking, pricing, sales commissions, market research
- **HR:** payroll, employee benefits, training, compensation, employee relations, staffing, performance appraisal

TRANSACTION PROCESSING SYSTEMS AND CORE OPERATIONS

Core operations are supported by TPSs that monitor, collect, store, process, and disseminate information for all financial and nonfinancial (e.g., hiring) transactions. Transactions occur when a company produces a product or provides a service.

Figure 9.5 Server at a café uses a mobile scanner to process customers' credit card payment. (© *Chris Cooper-Smith/Alamy*)

For example, to produce cell phones, a manufacturer needs to order materials and parts, pay for labor and electricity, create a shipment order, and bill customers. The bank that maintains the cell phone company's checking account keeps the account balance up-to-date, disperses funds for the checks written, accepts deposits, and posts statements.

Every transaction generates additional transactions. Purchasing materials changes the inventory level; paying employees reduces cash-on-hand. Because the computations involved in most transactions are simple and the transaction volume is large and repetitive, such transactions are fairly easy to computerize.

Activities and Methods of TPS. Regardless of the specific data processed by a TPS, a fairly standard process occurs, whether in a manufacturer, in a service firm, or in a government organization. First, raw data is collected by people or sensors, and then the data is entered into the computer via input device, as shown in Figure 9.5.

Generally speaking, organizations try to automate the TPS data entry as much as possible to minimize errors and data entry time.

Next, the system processes data in one of two basic ways: *batch* or *online processing*. In **batch processing,** the firm collects data from transactions as they occur and stores it. The system then prepares and processes the collected data periodically, such as at the end of the workday. Batch processing is useful for operations that require processing for an extended period of time. Once a batch job begins, it continues until it is completed. Examples are payroll and billing.

In **online processing,** data is processed as soon as the transaction occurs, in *real time*.

Examples. When a component part is used, an order for a new one is placed. When you place an order online, your credit card authorization is done instantly.

To implement online transaction processing, master transaction files containing data about business entities are stored in an operational database (see Figure 9.6). In **online transaction processing (OLTP),** transactions are processed as soon as they occur. Data can be accessed directly from the operational database. The transaction files containing data about business activities, such as items ordered, are also stored in online files until they are no longer needed. This series of processes ensures that transaction data is available to all applications and that all data is kept updated. Data from the TPS can be further processed and stored in a data warehouse.

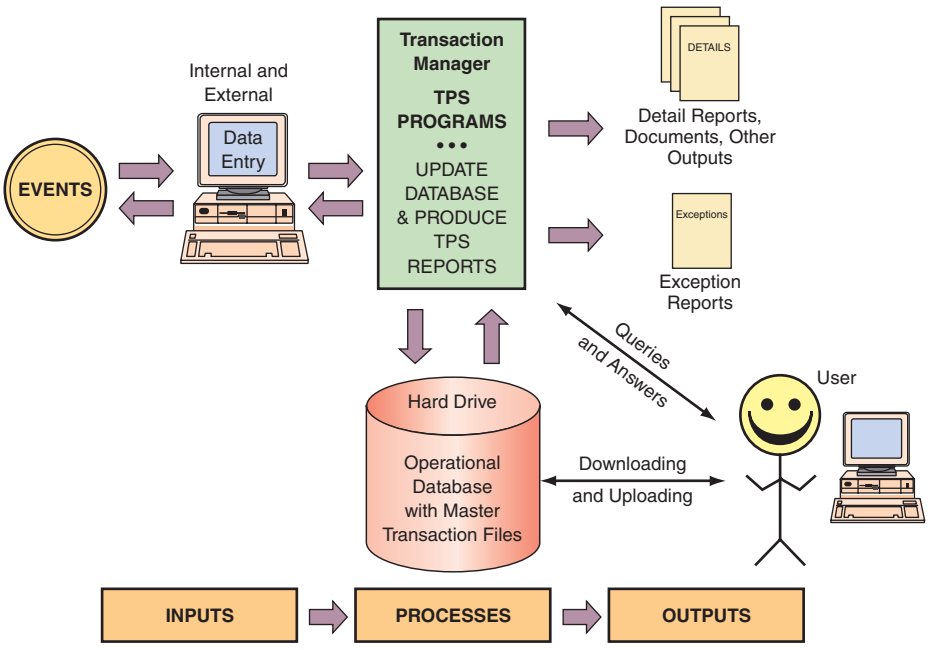

Figure 9.6 Flow of information in transaction processing.

IT at Work 9.1

TPS Cuts Delivery Time and Saves Money

Here are examples of how TPSs have saved time or money.

Domino's Pizza. Domino's uses Microsoft's Tellme service to route thousands of callers to its nearest outlet. The system is experimenting with automatic order taking. When a customer calls and says "delivery," the system checks to see if the customer has called before and reads back the address where the delivery is to be made. Voice technologies are popular in other customer service applications, including wireless ones.

FedEx-Kinko's. Each time you make a copy at Kinko's, both a copying transaction and a payment transaction occur. In the past you received a device (a card, the size of a credit card) and inserted it into a control device attached to the copy machine, and it recorded the number of copies that you made. Then you stood in line to pay: The cashier placed the device in a reader to see how many copies were made. Your bill was computed, with tax added. Kinko's cost was high with this system, and some customers were unhappy about standing in line to pay for only a few copies. With Kinko's new system, you insert your credit card into a control device, make the copies, print a receipt, and you're done.

Carnival Line. Carnival Line, the operator of cruise ships, needs to rapidly process up to 2,500 people leaving the ship at the ports of call and later returning to the ship. The company used to use printed name lists for manual checkmarks. Today, passengers place a smart card into a reader so the company knows who left the ship, when, and who returned. Each smart card reader can process over 1,000 people in 30 minutes. In the past, 10 to 15 employees processed passengers leaving and returning to the ship, which took almost an hour. Now, one person supervises two card readers.

UPS Store. Seconds after you enter an address and a zip code into a terminal at UPS delivery outlets at a UPS Store, a shipping label and a receipt are generated. Your shipping record stays in the database, so if you send another package to the same person, you do not need to repeat the address again.

Sprint Inc. Sprint Inc. has improved its order processing for new cell phones. In the past it took a few days for a customer to get a new telephone line. With its new system, Sprint can process an order in a few hours. The order application itself takes less than 10 minutes, experiences fewer errors, and can be executed on electronic forms on a salesperson's desktop or laptop computer.

Discussion Questions: Could Kinko's operate completely without employees at its outlets? What effect does Carnival's smart-card reader have on security? Whose time is being saved at UPS and Sprint?

The flow of data in a TPS is shown in Figure 9.6. An event, such as a customer purchase, is recorded by the TPS program via a barcode reader at a retail checkout. The processed data (output) can be in the form of a report. Users can query the TPS for information, such as "How many units of item A were sold each month of year 20XX?" The system will provide the appropriate answer by accessing a database containing transaction data, as shown with the bidirectional arrows in Figure 9.6.

Web-Based and Online Transaction Processing Systems. With OLTP and Web technologies such as portals and extranets, suppliers can look at the firm's inventory level or production schedule in *real time*. Suppliers are then able to assume responsibility for inventory management and ordering in what is known as **vendor-managed inventory (VMI).** Customers, too, can enter data into the TPS to track orders directly. Other Web-based applications are described in *IT at Work* 9.1.

TASKS IN TRANSACTION PROCESSING

Transaction processing exists in all functional areas. Here we describe in detail one application that crosses several functional areas—order processing.

Order Processing. Orders for goods or services may flow from customers to a company via a smart device, Web site, fax, or other electronic method. Fast and effective order processing is a key to customer satisfaction. Orders can also be internal—from

IT at Work 9.2

Yahoo! Web Analytics Helps First Choice Ski Triple Sales

First Choice Ski (*firstchoice-ski.co.uk/*) holds a 14 percent market share of the online U.K. ski market. TUI Travel, its parent company, is an international leisure travel group that operates in 180 countries and serves more than 30 million customers.

In the highly competitive tour operator industry, margins are tight. As a result, real-time reporting is key to maintaining a profitable business. By using Yahoo! Web Analytics (*web.analytics.yahoo.com/*), First Choice Ski was able to gain enough insight into its customers to respond in near real time to their online behaviors—by revamping its travel Web site.

First Choice Ski Tracks Customers' Behaviors. At First Choice Ski, customers spend a lot of time researching and selecting their vacation. Simon Rigglesworth, e-commerce manager, explained: "We see users return multiple times from multiple sources such as paid search, e-mail, and even social networking as they try to find the vacation that suits them the best. Capturing as much information as possible allows us to identify the best way to complete the sale and optimize for it."

After experimenting with fee-based analytics packages, First Choice Ski selected Yahoo! Web Analytics (YWA), which is free. Web analyst Penelope Bellegarde used the *Search Phrases Report* in YWA to leverage factors driving visitors to First Choice Ski. She said: "If we notice a specific destination is driving a lot of visits to the site, then it is very likely we will promote that destination on the homepage."

The *Internal Campaign Report* is valuable because of the numerous travel promotions on First Choice Ski. Bellegarde monitors the number of clicks and number of sales generated by the campaigns; when a low ratio of sales to clicks is noticed, she adjusts the campaign accordingly.

Performance Improvements. Using these different data sets and tools from YWA, TUI redesigned and changed the content of its First Choice Ski homepage. As a result, the homepage experienced an 18 percent decrease in bounce rate and a 13 percent decrease in exit rate—with more than two-thirds of the improvement directly attributed to the changes made. More importantly, the number of sales driven by the homepage increased 266 percent.

"We are now generating quantifiable, actionable, data-driven processes for prioritizing and reviewing website developments," says Rigglesworth.

Sources: Compiled from *firstchoice-ski.co.uk/* and *Yahoo.com/.*

Discussion Questions: How is being able to respond quickly to visitors' clickstream behavior related to the company's profit margin? Recall the principle: If you can't measure it, you can't manage it. Explain how this case illustrates this principle. Does Web analytics impact barriers to entry and rivalry among incumbents in this industry?

one department to another. Once orders arrive, an order processing system needs to receive, document, route, summarize, and store the orders.

Some companies spend millions of dollars reengineering their order processing as part of their transformation to e-business. IBM, for example, restructured its procurement system so its purchasing orders (POs) are generated quickly and inexpensively in its e-procurement system.

Web Analytics. **Web analytics** is the analysis of data generated by visitors' behavior on a company's Web site. That data is referred to as **clickstream data.** Web analytics begins by identifying the data that can be used to assess the effectiveness of the site's goals and objectives. For example, frequent visits to the site map may indicate navigation problems. Abandoning shopping carts repeatedly when the shipping charges are added indicates another problem.

Next, analytics data is collected, such as where site visitors are coming from, what pages they look at and for how long, and how they interact with the site's information. For example, the data can reveal the impact of an online advertising campaign, the effectiveness of Web site design and navigation, and, most important, visitor buying behavior. Because the goal of e-commerce sites is to sell a product or service, the most valuable Web analytics are those related to step-by-step conversion of a visitor to a customer.

Other typical TPS activities performed by managers in various functional areas are summarized in Table 9.2.

TABLE 9.2 Descriptions of TPS Activities

Activities	Description
General ledger	An organization's financial accounts. Contains all of the assets, liabilities, and owners' equity accounts.
Accounts payable (A/P) and accounts receivable (A/R)	Records of all accounts to be paid and those owed by customers. Automated systems send reminder notes about overdue accounts.
Receiving and shipping records	Records of all items sent or received, including returns.
Inventory-on-hand records	Records of inventory levels as required for inventory control and taxation. Use of barcodes and 2-D improves ability to track inventory.
Fixed-assets management	Records of the value of an organization's fixed assets, which include buildings and machines. Tracks depreciation rates and major improvements made in assets, for taxation purposes.
Payroll	Detailed and summary payroll records.
Personnel files and skills inventory	Files of employees' history, evaluations, and records of training and performance.
Sales reports	Reports on sales and for commissions on sales.
Reports to government	Reports on compliance with government regulations, taxes, and so on.

WHAT IF A TPS FAILS?

TPS failure can cause a disaster. The U.S. Social Security Administration had some major TPS failures, as did insurance companies, hospitals, and banks. One might think that a large financial institution should be immune from IT failure, but this was not the case with TIAA-CREF, as illustrated in *IT at Work* 9.3.

IT at Work 9.3

TIAA-CREF Reporting Failure

TIAA-CREF (*tiaa-cref.org/*) is a huge company serving the retirement, insurance, and other financial needs of teachers and professors. It is one of the largest financial institutions of its kind.

In September 2005, thousands of TIAA-CREF members were unable to withdraw funds from their pensions. The company assured clients that this was just a small delay due to the IT platform upgrade. However, the problems continued for months and expanded to interfere with deposits as well. The cause of the problem was the introduction of the powerful new IT platform, Open Plan Solutions. Open Plan Solutions was to integrate fixed annuities, variable annuities, mutual funds, and homegrown platforms onto a single, connected platform with:

- Flexible, state-of-the-art record keeping
- Streamlined enrollment process
- Comprehensive remittance services
- Improved Web-based institutional reporting on accumulations, transactions, and salary reduction agreements
- New and improved participant quarterly statements

The integrated platform did not synchronize the company's Web-access software and the recordkeeping system during the batch transaction processing. In other words, the new system was not in sync with the old one. By April 2006, the problem had become a disaster because of the inability to solve all of the IT integration problems fast enough. At that time, the company set up a new cross-functional team to catch issues before they escalated.

Sources: Compiled from Boucher-Ferguson (2006a, 2006b) and TIAA-CREF (2007).

Discussion Questions: What factors—technical and managerial—contributed to TIAA-CREF's data problems? How could each of these contributing factors be minimized? What lessons does this case teach other companies?

Review Questions

1. Explain Robert Anthony's management hierarchy (see Figure 9.3).
2. List the major characteristics of TPSs.
3. Describe the importance of high-quality (error-free) data entry.
4. List five typical TPS activities.
5. Describe the importance of Web analytics and show some of its applications.

9.2 Manufacturing and Production Systems

The production and operations management (POM) function in an organization is responsible for the processes that transform inputs into useful outputs, as shown in Figure 9.7. Compared to other functional areas, POM covers diverse activities. It also differs considerably among organizations. For example, manufacturers use completely different processes than service organizations, and a hospital operates much differently than a government agency.

Next, we present two IT-supported POM topics: in-house logistics and materials management and computer-integrated manufacturing (CIM).

IN-HOUSE LOGISTICS, AND INVENTORY CONTROL AND MANAGEMENT

Logistics management deals with ordering, purchasing, inbound logistics (receiving), and outbound logistics (shipping) activities. In-house logistics activities are processes that cross several functional departments. Both conventional purchasing and e-procurement result in incoming raw materials and parts, which constitute inventory or stock. Materials are tracked from the time they are received until they're distributed—or disposed of when they become obsolete or their quality becomes unacceptable.

Scanners, RFID, and voice technologies support inspection, and robots can perform distribution and materials handling. **Robots** are programmable machines. Large warehouses use robots to bring materials and parts from storage, when needed. Parts are stored in bins, and the bins are stacked one above the other similar to the way safe deposit boxes are organized in banks. Whenever a part is needed, the stockkeeper keys in the part number. The mobile robot travels to the part's location, takes the bin out of its location using magnetic force, and brings the bin to the stockkeeper. Once a part is taken out of the bin, the robot is instructed to return the bin to its permanent location.

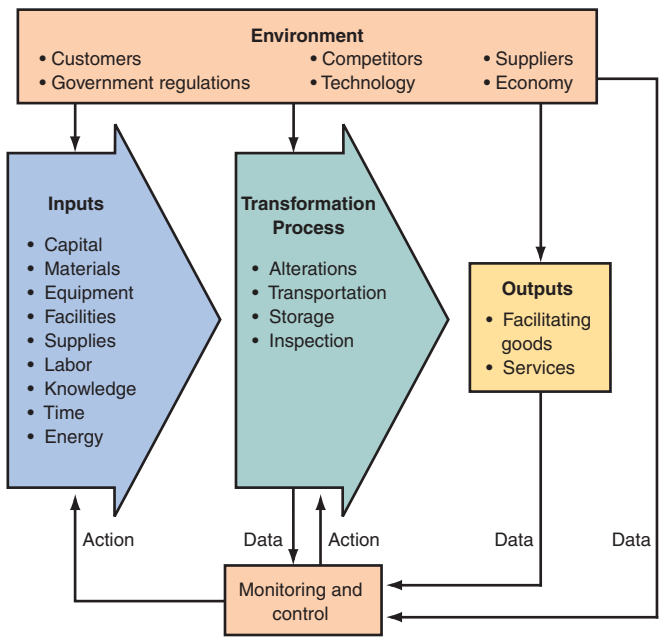

Figure 9.7 Production operations management (POM) functions transform inputs into useful outputs.

Figure 9.8 Industrial robot handles boxes of sugar. (© *David J. Green-industry/Alamy*)

Figure 9.8 is a photo of an industrial robot that's used to handle and transport inventory from storage. In intelligent buildings in Japan, robots bring files to employees and return them for storage. In some hospitals, robots dispense medications.

Inventory Control. The function of **inventory control** (also called stock control or inventory management) is to minimize the total cost of inventory. The objective is to maintain optimal inventory levels by reordering the correct quantity at the right time. POM departments may keep **safety stock** as a hedge against running out of inventory. Safety stock is extra inventory in case of unexpected events, such as spikes in demand or longer delivery times. It is often called **buffer stock.** The absence of inventory is called a **shortage.**

Managing inventory is important to profits because there are numerous costs associated with inventory. Inventory control systems minimize the following three categories of cost:

1. Cost of holding inventory: warehousing costs, security costs, insurance, losses due to theft or obsolescence, inventory financing costs based on the interest rate
2. Cost of ordering and shipping: employees' time ordering and receiving, shipping fees
3. Cost of inventory shortage: production delays and forgone revenues because of stockouts

Because of these costs, the POM department has two decisions to make:

- When to order
- How much to order

One inventory model that is used to answer both questions is the **economic order quantity (EOQ)** model. The EOQ model takes all of those costs into consideration. A tutorial on EOQ, including its assumptions and equations, is available at *scm.ncsu.edu/public/inventory/6eoq.html.*

Dozens of other inventory control models exist because inventory scenarios can be diverse and complex. A large number of commercial inventory software packages to automate the application of these models are available at low cost. Minimizing inventory costs is a major objective of supply chain management.

Just-in-Time Inventory Management and Lean Manufacturing. **Just-in-time (JIT)** inventory management is an alternative method whose objective is to minimize holding costs by not taking possession of inventory until it is needed in the production process. JIT was developed by Toyota and is used extensively in the auto manufacturing industry. For example, if parts and subassemblies arrive at a workstation exactly when needed, there is no need to hold inventory. There are no delays in production, and there are no idle production facilities or underutilized workers, provided that parts and subassemblies arrive on schedule and in usable condition. Many JIT systems are supported by software from vendors such as HP, IBM, CA, and Cincom Systems.

Oracle, Siemens, and other vendors offer demand-driven **lean manufacturing,** which is a derivative of JIT. The objective of lean manufacturing is to remove waste of any kind from production. Waste can be unnecessary labor, material space, energy, or rework due to poor quality control. Like any IS, JIT needs to be justified with a cost-benefit analysis. Also, all of the assumptions that the JIT model is based on must exist. For example, JIT is based on the assumption that inventory will arrive on schedule. For companies subject to bad weather or labor strikes, that assumption is not valid.

Quality Control. Manufacturing quality control (QC) systems can be stand-alone systems or can be part of an enterprise-wide total quality management (TQM) effort. QC systems provide data about the quality of incoming materials and parts, as well as the quality of in-process semifinished and finished products. Such systems record the results of all inspections and compare actual results to expected results.

QC data may be collected by Web-based sensors and interpreted in real time, or it can be stored in a database for future analysis. Also, RFID systems collect data.

Periodic reports are generated, such as percentage of defects or percentage of rework needed, and management can compare performance among departments on a regular basis or as needed. For example, KIA Motors introduced an intelligent QC system to analyze customer complaints so it could more quickly investigate and make corrections. The analysis was done with data mining tools.

Project Management. A **project** is a collection of tasks to achieve a result, such as implementing a new JIT inventory management system. Projects have a defined beginning and end as well as a scope, resources, and a budget. Projects are approved before they are allocated resources. *Projects* differ from *operations*, or *business as usual*, because of their uniqueness.

Projects have these characteristics:

- Are unique undertakings
- Have a high degree of uncertainty with respect to costs and completion times due to the generally long length
- Involve participation of outsiders, which is difficult to control
- Require extensive interaction among participants
- May compete and conflict with other business activities, making changes in planning and scheduling difficult
- Involve high risk of delay, failure, and costly changes, but also have high profit potential or benefit

The management of projects is enhanced by computerized project management tools such as the *program evaluation and review technique* (PERT) and the *critical path method* (CPM). For example, developing a social media campaign can be a major project, and several IT tools are available to support and help manage the tasks.

Other POM Areas. Many other areas of POM are improved by IT. Web-based production planning optimization tools, product routing and tracking systems, order management, factory layout planning and design, and other tasks can be supported by POM subsystems. For example, a Web-based system at Office Depot matches employee scheduling with store traffic patterns to increase customer satisfaction and reduce costs. Schurman Fine Papers, a manufacturer/retailer of greeting cards and specialty products, uses special warehouse management software to improve demand forecasting and inventory processes. Its two warehouses efficiently distribute products to over 30,000 retail stores.

COMPUTER-INTEGRATED MANUFACTURING

Computer-integrated manufacturing (CIM) is a concept promoting the integration of various computerized factory systems. CIM has three basic goals: (1) the *simplification* of all manufacturing technologies and techniques, (2) *automation* of as many of the manufacturing processes as possible, and (3) *integration and coordination* of all aspects of design, manufacturing, and related functions via computer hardware and software.

The major advantages of CIM are its comprehensiveness and flexibility. These are especially important in business processes that are being completely reengineered or eliminated. Without CIM, it may be necessary to make large investments to change existing ISs to fit the new processes.

Review Questions

1. What is the function of POM in an organization? How can it be enhanced with IT?
2. What is a robot? How does it differ from a machine?
3. What are the three categories of inventory costs?
4. Explain the difference between EOQ and JIT inventory models.
5. Explain the difference between a project and operations.
6. What is CIM?

9.3 Sales and Marketing Systems

In Chapters 1, 7, and 8, you read about marketing channels, interoperability, e-commerce, and social media—all are types of sales and marketing ISs. In this section, we describe marketing systems for best-in-class performance.

In general, sales and marketing systems support market research, getting products and services to customers, and responding to customers' needs. Many of these systems and subsystems are shown in Figure 9.9. As you notice, marketing ISs have numerous components—sales, research, intelligence, reporting, procurement, logistics, and delivery. Interoperability enhances market power and presence.

Chapters 7, 8, and 10 cover sales and marketing systems and strategies, including e-commerce and customer relationship management (CRM). This section will focus on data-driven marketing and components of marketing ISs.

DATA-DRIVEN MARKETING

Marketing ISs are more than a system of data collection or a set of information technologies. They consist of people, equipment, and procedures to gather, sort, analyze, evaluate, and distribute relevant, timely, complete, and accurate data for use by marketing decision makers to improve their marketing planning, implementation, and control. The focus is on data-driven, fact-based marketing. Data mining, discussed in Chapter 10, is the primary method for data-driven marketing.

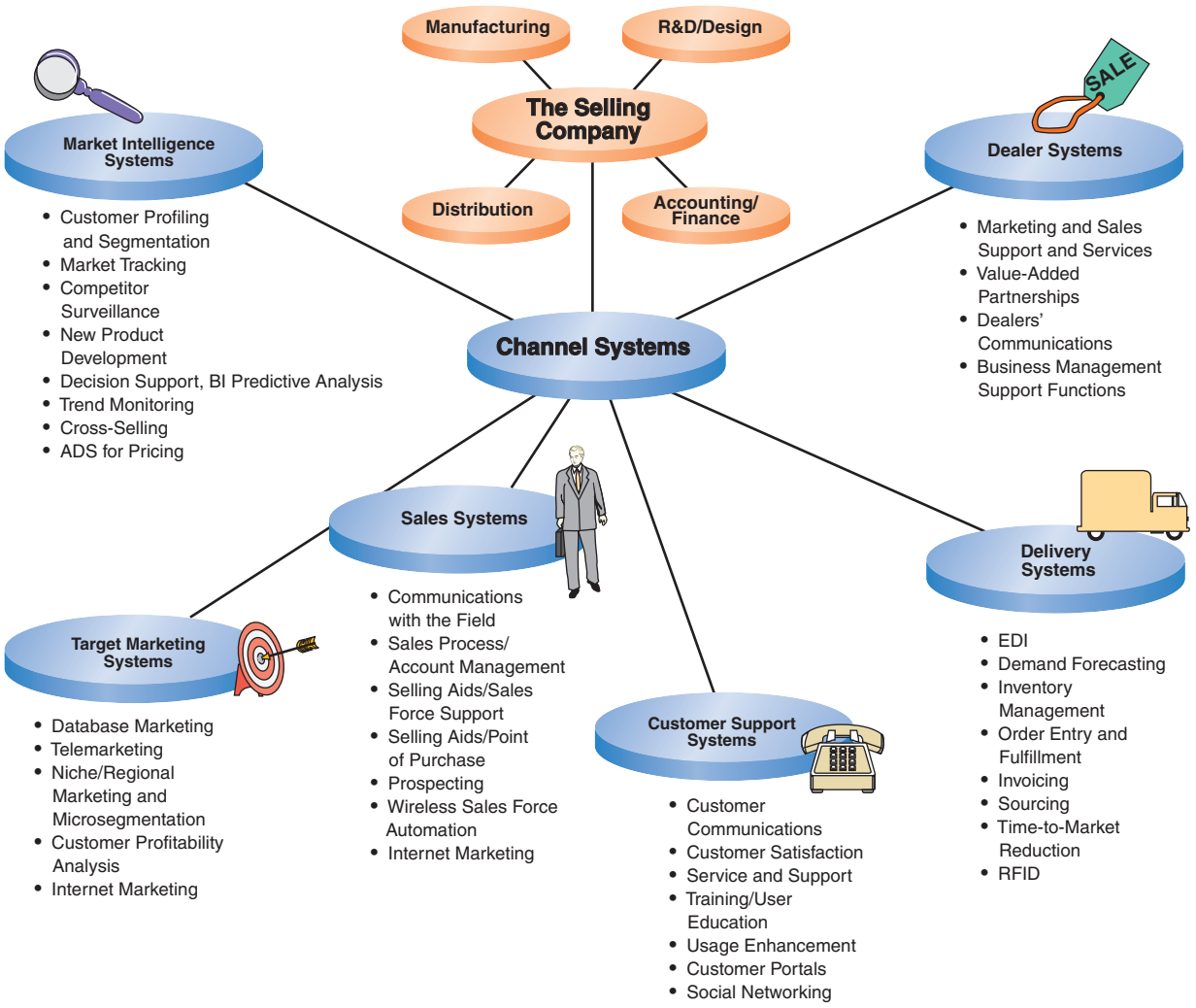

Figure 9.9 Marketing channel systems.

There is no shortage of customer and sales data, but there is a shortage of reliable, high-quality data and insight about how to use that data for better decisions that improve performance. In the August 2008 benchmark study, "Customer Analytics: Segmentation Beyond Demographics," all respondents identified that their top two data-related challenges were poor data quality (62 percent) and the inability to collect or access the data needed to calculate key performance metrics (31 percent) (Aberdeen Group, 2008).

DISTRIBUTION CHANNELS

Organizations distribute their products and services through a combination of electronic, mobile, and physical channels. Here are representative topics relating to distribution channels.

- Kiosks at 7-Eleven stores in some countries can be used to place orders on the Internet. In Macy's, you can check the current price on computerized screens with barcode readers.
- Some stores that have many customers who pay by check have installed check-writers. All you have to do is submit the blank check to the cashier, who runs it through a machine attached to the cash register. The machine prints the name of the store as the payee and the amount, you sign the check, and in seconds the check is validated, your bank account is debited, and you are out of the store with your merchandise.
- The Exxon Mobil Speedpass allows customers to fill their tanks by waving a token, embedded with an RFID device, at a gas-pump sensor. Then the RFID starts an authorization process, and the purchase is charged to your debit or credit card. Customers no longer need to carry their Mobil corporation credit cards.
- An increasing number of retailers are installing self-checkout machines. For example, Home Depot has self-checkouts in its stores. Not only does the retailer save the cost of employees' salaries, but customers are happier for saving time. And some enjoy "playing cashier" briefly. A major vendor is U-Scan, which is used in many supermarkets, shown in Figure 9.10. RFIDs are improving the process even further.

MARKETING MANAGEMENT

Here are some representative examples of how marketing management is being done.

Pricing of Products or Services. Sales volumes are largely determined by the prices of products or services. Price is also a major determinant of profit. Pricing is a difficult decision, and prices may need to be changed frequently, as is true for First Choice Ski, which is discussed in *IT at Work 9.2*. For example, in response to price changes made by competitors, a company may need to adjust its prices quickly or take other actions. Checking competitors' prices is commonly done by retailers, often using wireless price checkers, for example, PriceMaster Plus, from SoftwarePlus. These devices make data collection easy.

Figure 9.10 U-Scan kiosk. (*Sonda Dawes/The Image Works*)

Salesperson Productivity. Salespeople differ from each other; some excel in selling certain products while others excel in selling to a certain type of customer or in a certain geographic zone. This information, which is usually collected in the sales and marketing TPS, can be analyzed using a comparative performance system in which sales data categorized by salesperson, product, region, and even time of day is evaluated. Actual current sales can be compared to historical data and to standards. Multidimensional spreadsheet software facilitates this type of analysis. Assignment of salespeople to regions and/or products and the calculation of bonuses can also be supported by this system. Wireless systems are used extensively by salespeople.

In addition, sales productivity can be boosted by Web-based call centers. When a customer calls a sales rep, the rep can look at the customer's history of purchases, demographics, services available where the customer lives, and more. This information enables reps to work faster while providing better customer service.

Sales automation software is especially helpful to small businesses, enabling them to rapidly increase sales and growth. A leading software is *salesforce.com,* which is a CRM application that is offered as a software-as-a-service (SaaS). You will read about Salesforce.com in the CRM section of Chapter 10.

Profitability Analysis. In deciding on advertising and other marketing efforts, managers need to know the profit contribution of certain products and services. Profitability metrics for products and services can be derived from the cost-accounting system. For example, profit performance analysis software available from IBM, Oracle, SAS, and Microstrategy is designed to help managers assess and improve the profit performance of their line of business, products, distribution channels, sales regions, and other dimensions critical to managing the enterprise. Several airlines, for example, use automated decision systems to set prices based on profitability.

New Products, Services, and Market Planning. The introduction of new or improved products and services can be expensive and risky. An important question to ask about a new product or service is, "Will it sell?" An appropriate answer calls for careful analysis, planning, and forecasting. These can best be executed with the aid of IT because of the large number of determining factors and the uncertainties that may be involved; for example, see the discussion of using predictive analysis in Chapter 10. Market research also can be conducted on the Internet.

Marketing activities conclude the primary activities of the value chain. Next we look at the functional systems that are *support activities* (also called *secondary activities*) in the value chain: accounting/finance and human resources management.

Review Questions

1. Define *data-driven marketing.*
2. Identify several distribution channels.
3. How does IT support marketing and sales?
4. What marketing strategies can be enhanced by the Web?

9.4 Accounting and Finance Systems

Accounting and finance control and manage cash flows, assets, liabilities, and net income or profit as well as issue financial statements to regulatory agencies. Another critical responsibility is the prevention, detection, and investigation of fraud.

In companies with lax accounting systems, it is too easy for employees to misdirect purchase orders and payments, bribe a supplier, or manipulate accounting data. If senior managers are involved in the fraud, preventing fraud is extremely tough. Consider Bernie Madoff, who committed record-setting fraud for many years even after the Sarbanes-Oxley Act was passed to prevent financial fraud.

IT at Work 9.4

Lax Accounting Systems Enable Employee Fraud

Chris was a compulsive gambler, and she hid it well. Her problem began innocently at work when one day a casino Web site popped up on her computer as she surfed the Internet during lunch. She placed a few bets using the free credits offered by the site to entice first-time players. She won, and that gave her a thrilling feeling, she would later explain to fraud investigators.

Two years later, as the payroll manager of a medium-sized manufacturing firm, Chris had defrauded her employer of over $750,000. Why did she do it? To pay off her gambling losses, an average of $7,000 a week. How did she do it? By taking advantage of the lack of proper controls in her company's payroll and accounting information systems and controls.

Chris's Employment History and Deception. Chris had worked at the company for a decade. Her performance reviews described her as hardworking, reliable, and loyal but did not mention that she felt underpaid. Chris was bitter, thinking her employer didn't treat her fairly. When her gambling began to spiral out of control, she turned to fraud. "As far as I was concerned, they owed me," she told the forensic accountants.

The company's HR manager and comptroller were supposed to review Chris's work. But the HR manager focused on providing her with the correct data for employees' wages and benefits. The comptroller appeared not to have exercised control over payroll processing, which Chris knew.

Chris's primary deception was two phony employees she set up on the company's hourly payroll system as a new and separate cost center. As she processed and received the records sent to and from an external payroll provider (EPP) without effective oversight, she was able to control the scheme without detection. The phantom employees' checks were drawn up manually by EPP, sent to Chris, and deposited into an account she had in a bank near her home. Near the end of the year, she also had EPP make adjustments to the payroll register to eliminate the amounts paid to the phony employees. When she went on vacation, she deactivated the two phony names from the payroll.

Fraud Scheme. Chris started paying herself for unauthorized overtime. At first, this plan proved to be a great success—she paid herself for 1,500 hours of overtime over two years as opposed to the actual 50 she did work. Chris falsified records and increased the size of her theft until the HR manager finally noticed. When she was confronted with the evidence, she confessed that she had spent all the money on gambling and could not repay.

Discussion Questions: What role did trust play in Chris's ability to commit fraud for so long (that is, the employer's trust in Chris)? What role did weak accounting ISs play in her ability to commit fraud? In your opinion, if Chris knew that strong accounting ISs were in place, would that have deterred her from trying to steal from her company?

AUDITING INFORMATION SYSTEMS

Fraud is easy to commit and hard to detect. Just ask any auditor. There are countless ways to hide fiscal malfeasance. The problem may be exacerbated in government and nonprofit entities, which rarely have adequate accounting and internal control systems. The problem is so bad at the federal level that auditors are unable to express an opinion on the fairness of the consolidated financial statements of the United States. For example, NASA, the space agency, was unable to explain $565 billion in year-end adjustments to its books. It could have been the result of bad accounting, fraud, waste, or abuse. Without adequate records, no one really knows. This amount is astounding, especially when one considers that the combined cost of fraud in the Enron and WorldCom scandals was less than $100 billion in shareholder equity.

Because physical possession of stolen property is no longer required and it's just as easy to program a computer to misdirect $100,000 as it is $1,000, the size and number of frauds have increased tremendously. See *IT at Work 9.4*, which describes a real-life case.

FINANCIAL PLANNING AND BUDGETING

Management of financial assets is a major task in financial planning and budgeting. Managers must plan for both the acquisition of financial resources and their use. Financial planning, like any other functional planning, is tied to the overall organizational planning and to other functional areas. It is divided into short-, medium-, and long-term horizons, much like activities planning.

Financial and Economic Forecasting and Budgeting. Knowledge about the availability and cost of money is a key ingredient for successful financial planning.

Especially important is the projection of cash flows, which tells organizations what funds they need and when as well as how they will acquire them. In today's tough economic conditions with tight credit and limited availability of funds, this function has become critical to the company's survival.

Inaccurate cash flow projection is the number-one reason why many small businesses go bankrupt. The inability to access credit led to the demise of the investment bank Lehman Brothers in September 2008.

The best-known part of financial planning is the annual budget, which allocates the financial resources of an organization among participants, activities, and projects. The budget is the financial expression of the organization's plans. It allows management to allocate resources in the way that best supports the organization's mission and goals. IT enables the introduction of financial logic and efficiency into the budgeting process.

Several software packages, many of which are Web-based, are available to support budget preparation and control. Examples are budgeting modules from Oracle (*oracle.com*) and *Capterra.com*, which facilitate communication among participants in budget preparation. Software support for budgeting and forecasting is available from Prophix (*prophix.com*). The key benefits of the package are a familiar Windows Explorer interface, customizable flexibility that supports a variety of budgeting templates, a controlled database that secures data and allows for multiple user accessibility, and data manipulation tools for complex budgeting.

The major benefits of using budgeting software are that it can reduce the time and effort involved in the budget process, explore and analyze the implications of organizational and environmental changes, facilitate the integration of the corporate strategic objectives with operational plans, make planning an ongoing continuous process, and automatically monitor exceptions for patterns and trends.

Capital Budgeting. Capital budgeting is the process of identifying the financing of assets, including software, that need to be acquired or developed. It includes comparing alternatives or evaluating buy-versus-lease options.

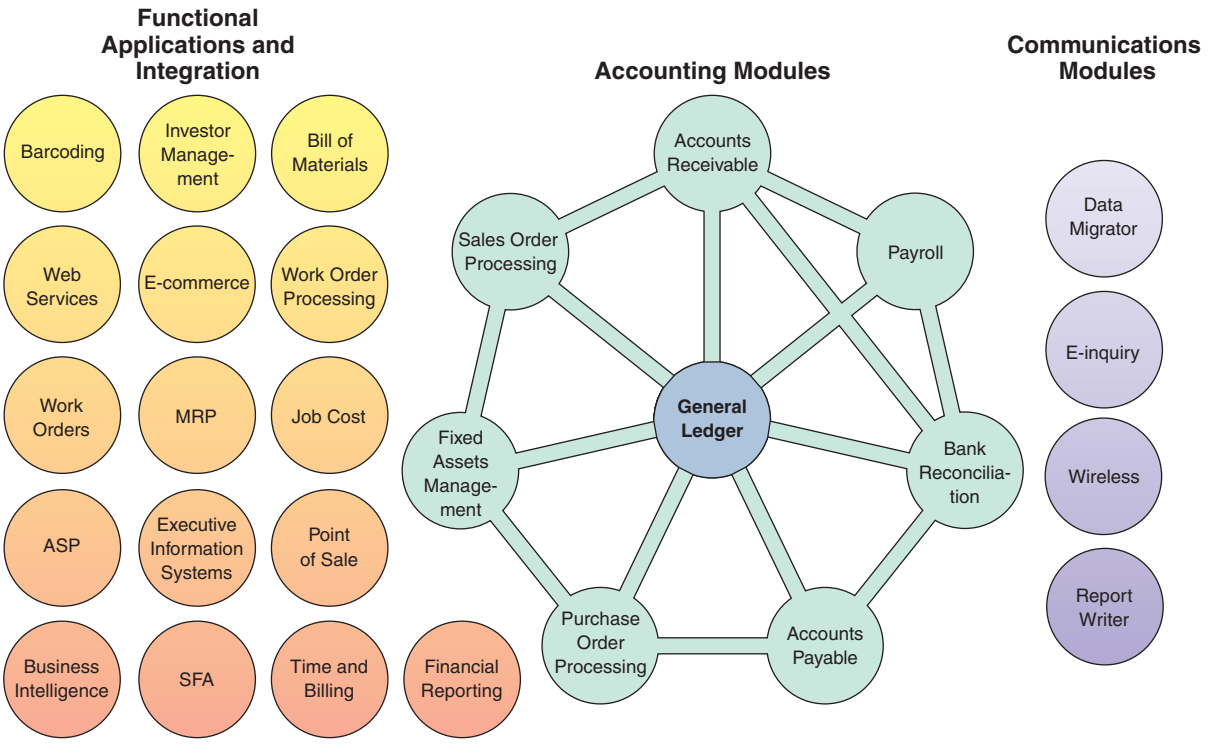

Figure 9.11 Integrated accounting/business software.

Capital budgeting analysis uses standard financial models, such as net present value (NPV), internal rate of return (IRR), and payback period to evaluate alternative investment decisions. Excel and other spreadsheet packages include built-in functions of these models.

Accounting/finance ISs are also responsible for gathering the raw data necessary for the accounting/finance TPS, transforming the data into information, and making the information available to users, whether aggregate information about payroll, the organization's internal reports, or external reports to stockholders or government agencies, which is illustrated in Figure 9.11.

The accounting/finance TPS also provides a complete, reliable audit trail of all routine transactions transmitted through the network. This feature is vital to accountants and auditors.

XBRL: eXtensible Business Reporting Language. As you read in Chapter 8, **XBRL** is a programming language and an international standard for electronic transmission of business and financial information. As of September 2005, it can be used to file financial reports electronically with the SEC and FDIC. With XBRL, all of the company's financial data is collected, consolidated, published, and consumed without the need to use Excel spreadsheets. Figure 9.12 illustrates how XBRL works. Such submission allows government analysts to validate information

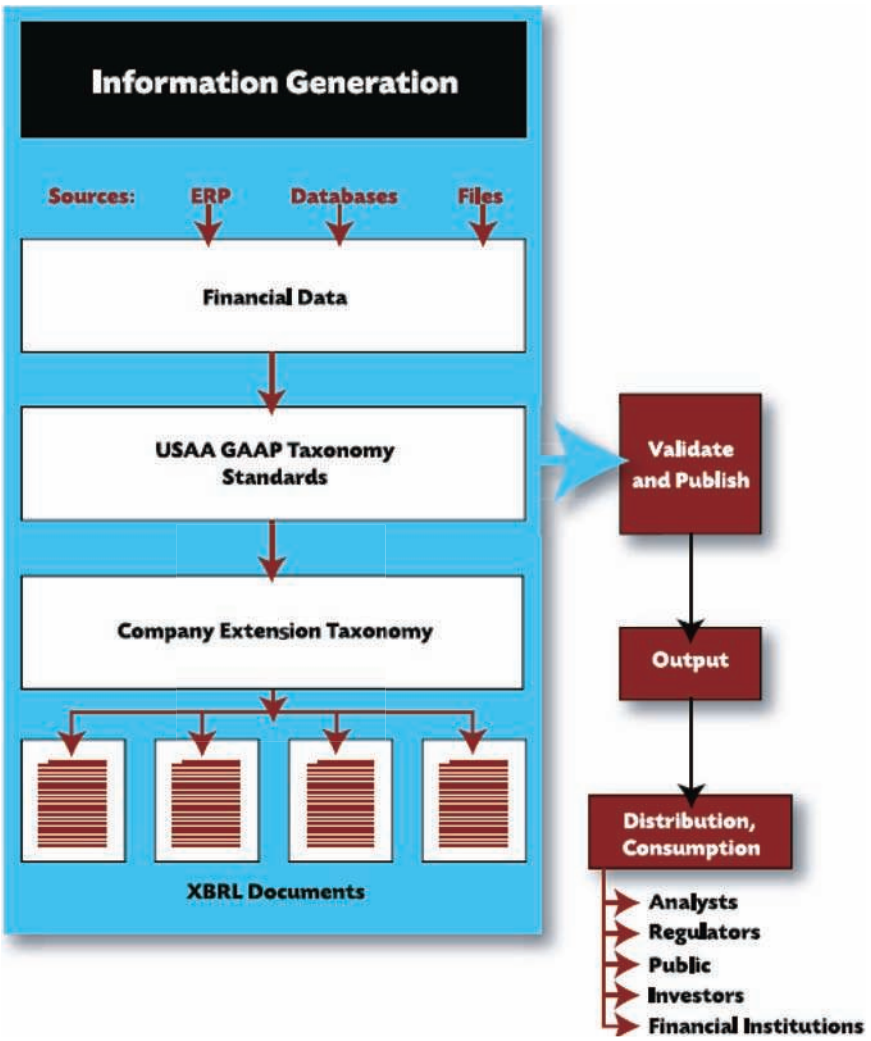

Figure 9.12 How XBRL works.

submitted in hours instead of two to three weeks. XBRL helps financial institutes do the following:

- Generate cleaner data, including written explanations and supporting notes
- Produce more accurate data with fewer errors that require follow-up by regulators
- Transmit data faster to regulators and meet deadlines
- Increase the number of cases and amount of information that staffers can handle
- Make information available faster to regulators and the public
- Address issues and concerns in their filings rather than after the fact
- Reduce report cycle time
- Lead to a more efficient capital market

CONTROL AND AUDITING

As you read, a major reason organizations fail is their inability to forecast and/or secure sufficient *cash flow*. Underestimated expenses, overspending, financial mismanagement, and fraud can lead to disaster. Good planning is necessary, but not sufficient, and must be supplemented by skillful control. Control activities in organizations take many forms, including control and auditing of the information systems themselves. Information systems play an extremely important role in supporting organizational control, as we show throughout the text. Specific forms of financial control are presented next.

Risk Analysis and Budget Control. Companies need to analyze the risk of doing business with partners or in other countries. Giving credit to customers can be risky, so one can use products such as FICO from *fairisaac.com* for calculating risk. Regulators mandate risk management.

Once the annual budget has been decided upon, it is divided into monthly allocations. Managers at various levels then monitor departmental expenditures and compare them against the budget and operational progress of the corporate plans. Simple reporting systems summarize the expenditures and provide *exception reports* by flagging any expenditure that exceeds the budget by a certain percent or that falls significantly below the budget. More sophisticated software attempts to tie expenditures to program accomplishment. Numerous software programs can be used to support budgetary control; most of them are combined with budget preparation packages from vendors such as *claritysystems.com* and *capterra.com*.

Auditing. The major purpose of **auditing** is to protect and defend the accuracy and condition of the financial health of an organization. Internal auditing is done by the organization's accounting/finance personnel, who also prepare for external auditing by CPA companies. IT facilitates auditing. For example, intelligent systems can uncover fraud by finding financial transactions that significantly deviate from previous payment profiles. Also, IT provides real-time data whenever needed.

Financial Ratio Analysis. A major task of the accounting/finance department is to watch the financial health of the company by monitoring and assessing a set of financial ratios. These ratios are also used by external parties when they are deciding whether to invest in an organization, extend credit, or buy it.

The collection of data for ratio analysis is done by the TPS, and computation of the ratios is done by financial analysis models. The interpretation of the ratios, and especially the prediction of their future behavior, requires expertise and is sometimes supported by intelligent systems.

Profitability Analysis and Cost Control. Many companies are concerned with the profitability of individual products or services as well as with the financial health of the entire organization. Profitability analysis DSS software allows accurate computation of profitability and allocation of overhead costs. One way to control cost is by properly

estimating it. This is done by using special software. Profitability Management from Hyperion, an Oracle Company, provides potent multidimensional and predictive analysis as well as proven query, reporting, and dashboard functionality with ease of use and deployment. The solution delivers powerful, insightful, activity-based cost analysis and what-if modeling capabilities to help create and test new business strategies. Sophisticated business rules are stored in one place, enabling analyses and strategies to be shared easily across an entire enterprise.

Review Questions

1. How are financial planning and budgeting facilitated by IT?
2. Explain how accounting ISs help deter fraud.
3. Define *capital budgeting*.
4. Why is XBRL important?
5. What is the purpose of auditing?

9.5 Human Resource Systems

Human Resources (HR) is a field that deals with policies, procedures, compliance requirements, and best practices. Developments in online systems increased the use of human resources information systems (HRISs) as of the late 1990s. HRISs have been moved to intranets and the cloud, where HR apps are leased in a software-as-a-service (SaaS) arrangement. This benefits companies by freeing HR staff from routine tasks by shifting them to employees (self-entry of an address change) so that they can focus on their legal and compliance responsibilities, employee development, hiring, and succession planning. In the following sections we describe in more detail how IT facilitates HR management.

To better understand how IT facilitates the work of the HR department, review Figure 9.13. The figure summarizes the role HR plays in acquiring and keeping people in organizations. Note that the activities are cyclical in nature.

Recruitment. Recruitment is finding employees, testing them, and deciding which ones to hire. Some companies are flooded with viable applicants, while others have difficulty finding the right people. With millions of résumés online, it is not surprising that companies are trying to find appropriate candidates on the Web, usually with

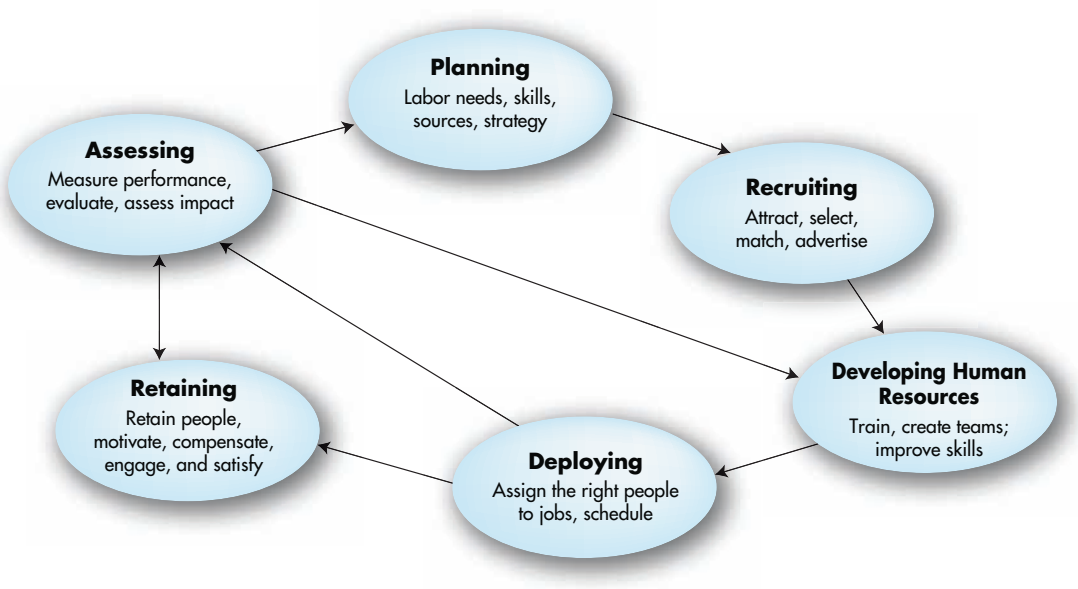

Figure 9.13 HR management activities.

IT at Work 9.5

Using Intelligent Software and Social Networks to Improve Recruiting Processes

A challenge for companies is how to cost-effectively manage the online recruiting process, because online ads are attracting large numbers of applicants. For example, Infosys now receives in excess of 1 million job applications each year to fill about 9,000 positions. It might sound like a good problem to have too many applicants, but companies are finding that there is often a poor match between the skills and attributes they require and the many hundreds of applications received. Thus, despite attracting a lot of applicants, they often still suffer from a shortage of good applicants. Furthermore, how can a company be sure it is accessing and attracting the very best talent in a particular field? Some interesting new developments are changing the way companies may address these issues.

Trovix offers a service based on its HR software, which uses embedded intelligence to help manage the entire recruitment process. Trovix argues that its tools Trovix Recruit and Trovix Intelligent Search can emulate human decision makers and assess a candidate's amount, depth, and relevance of work experience; education; and the like. The software presents in rank order the best candidates to fit an advertised position. Other features enable tracking of applicants, reporting, and communications. A number of institutions are using this service, including Stanford University, which needs to fill thousands of positions each year. Trend Micro adopted Trovix and was able to screen 700 applicants and list the top 10 in about 20 minutes. The accuracy is probably no better than manual processing, but the software can screen applicants faster.

A slightly more personal approach is available through some of the social networking sites, which offer support for companies to locate the best talent for a particular position. LinkedIn (*linkedin.com*) relies more on a networking approach. People who are part of the social network are encouraged to recommend others who might be suited to a particular job, irrespective of whether they are actively seeking new work. In this way, a company looking to recruit the best talent has its job advertised much more widely and may benefit from word-of-mouth recommendations and referrals. For example, LinkedIn offers prospective employers a network of more than 8 million people across 130 industries, meaning much larger exposure for job vacancies and a much larger talent pool to seek referrals from.

Another application of intelligent software is pre-employment screening. Tests, research background, and more can save time and increase accuracy.

Sources: Compiled from *Ere.net* (2006), *trovix.com*, *jobster.com*, and *LinkedIn.com*.

the help of specialized search engines. Online recruiting is able to "cast a wide net" to reach more candidates, which may bring in more qualified applicants at lower cost.

Recruitment online is beneficial for candidates as well. They are exposed to a larger number of job offerings, can get details of the positions quickly, and can begin to evaluate the prospective employer. To check the competitiveness of salary offerings, or to see how much one can make elsewhere in several countries, job candidates go to *monster.com*.

Example. The Finish Line Corp. had to process more than 330,000 candidates that applied for employment with the company in a 12-month period. More than 75 percent of them applied online. Using screening software by Unicru, 112,154 candidates were eliminated immediately. More than 60,000 hours of store managers' time were saved because of the reduction in the number of interviews conducted.

Using Social Networks and Intelligent Software. Recruitment at virtual worlds and social networking sites is very popular. It is done at most major sites—LinkedIn, MySpace, Facebook, Craigslist, and Second Life. Recruitment online is frequently supported by intelligent software agents. For an example of how this is done, see *IT at Work 9.5*.

HUMAN RESOURCES MAINTENANCE AND DEVELOPMENT

Once recruited, employees become part of the corporate human resources pool, which needs to be maintained and developed. Some activities supported by IT are the following.

Performance Evaluation. Most employees are evaluated periodically by their immediate supervisors. Peers or subordinates may also evaluate others. Evaluations are usually recorded on paper or electronic forms. Using such information manually is

a tedious and error-prone job. Once digitized, evaluations can be used to support many decisions, ranging from rewards to transfers to layoffs. For example, Cisco Systems is known for developing an IT-based human capital strategy. Many universities evaluate professors online. The evaluation form appears on the screen, and the students fill it in. Results can be tabulated in minutes. Corporate managers can analyze employees' performances with the help of intelligent systems, which provide systematic interpretation of performance over time. Several companies provide software for performance evaluation; e.g., *people_trak.com* and *talco.com, talco.com*.

Wage review is related to performance evaluation. For example, Hewlett-Packard's Atlanta-based U.S. Field Services Operations (USFO) Group has developed a paperless wage review (PWR) system. The Web-based system uses intelligent agents to deal with quarterly reviews of HP's 15,000 employees. (A similar system is used by most other groups, covering a total of 150,000 employees.) The agent software lets USFO managers and personnel access employee data from both the personnel and functional databases. The PWR system tracks employee review dates and automatically initiates the wage review process. It sends wage review forms to first-level managers by e-mail every quarter.

Training and Human Resources Development. Employee training and retraining is an important activity of the human resources department. Major issues are planning classes and tailoring specific training programs to meet the needs of the organization and employees. Sophisticated human resources departments build a career development plan for each employee. IT can support the planning, monitoring, and control of these activities by using workflow applications.

Some of the most innovative developments are in the areas of live online training (LOT) using WebEx (*webex.com*) or other online meeting software. YouTube, Teradata University Network (TUN), and *CNN.com* offer excellent educational videos. Flash animations and simulations are easily made available. Social media, such as Second Life, discussed in Chapter 8, offers the latest in training options. The aircraft industry has been using flight simulators for decades for training pilots. Second Life has a special forum on training and learning using virtual worlds. An example of how interactive simulation is utilized in training for the use of complex equipment is provided in *IT at Work 9.6*.

HR PLANNING, CONTROL, AND MANAGEMENT

In some industries, labor negotiation is an important aspect of HR planning, and it may be facilitated by IT. For most companies, administering employee benefits is also a significant part of the human resources function. Here are some examples of how IT can help.

Personnel Planning and HR Strategies. The HR department forecasts requirements for people and skills. In some geographic areas and for overseas assignments, it may be difficult to find particular types of employees. In such cases, the HR department plans how to find or develop from within sufficient human resources.

Benefits Administration. Employees' contributions to their organizations are rewarded by salary/wage, bonuses, and other benefits. Benefits include those for health and dental care as well as contributions for pensions. Managing the benefits system can be a complex task, due to its many components and the tendency of organizations to allow employees to choose and trade off benefits. In large companies, using computers for self-benefits selection can save a tremendous amount of labor and time for HR staff.

Providing flexibility in selecting benefits is viewed as a competitive advantage in large organizations. It can be successfully implemented when supported by computers. Some companies have automated benefits enrollments. Employees can self-register for specific benefits using the corporate portal or voice technology. Employees self-select desired benefits from a menu. Payroll pay cards are now in

IT at Work 9.6

Using Interactive Simulation in Training

HRM

An effective technology for e-training and e-learning is visual interactive simulation (VIS), which uses computer graphic displays to present the impact of decisions. It differs from regular graphics in that the user can adjust the decision-making process and see the results of the intervention. Some learners respond better to graphical displays, and this type of interaction can help students and managers learn about decision-making situations. For example, VIS was applied to examining the operations of a physician clinic environment within a physician network to provide high-quality, cost-effective healthcare in a family practice. The simulation system identified the most important input factors that significantly affected performance. These inputs, when properly managed, led to lower costs and higher service levels.

VIS can represent a static or a dynamic system. Static models display a visual image of the result of one decision alternative at a time. Dynamic models display systems that evolve over time, and the evolution can be represented by animation.

The learner can interact with the simulated model, watch the results develop over time, and try different decision strategies online. Enhanced learning, both about the problem and about the impact of the alternatives tested, can and does occur.

The major potential benefits of such systems are the following:

- Shortening the trainee's learning time
- Easing the learning of operating complex equipment
- Enabling self-learning, any place, any time
- Achieving better memorization
- Lowering the overall cost of training
- Recording the learning progress of individuals and improving it

Several companies provide the necessary software and learning procedure. One product is SimMAGIC, from Hannastar Technology Co., Ltd., in Taiwan. Figure 9.14a shows application in a pharmaceutical company; Figure 9.14b shows trainee progress charts.

Figure 9.14 SimMagic training app and progress charts. **(a)** SimMagic training application in the pharmaceutical industry. **(b)** SimMagic data presentation of the training process. (*Courtesy of HamStar Technology Ltd.*)

use in numerous companies, such as Payless Shoes, which has 30,000 employees in 5,000 stores. The system specifies the value of each benefit and the available benefits balance of each employee. Some companies use intelligent agents to assist the employees and monitor their actions.

Employee Relationship Management. In their effort to better manage employees, companies are developing human capital management, facilitated by the Web, to streamline the HR process. These Web applications are more commonly referred to as employee relationship management. For example, self-services such as tracking personal information and online training are very popular in ERM. Improved relationships with employees result in better retention and higher productivity.

IT at Work 9.7

Software Helps Cirque du Soleil

Cirque du Soleil is a Canada-based traveling circus. Using IT, the circus is able to entertain more people each year than the Red Sox and Yankees combined (over 10 million people in 2007, on four continents). How do they do it? First, this is no ordinary circus. It features astonishing acrobatics and Broadway-caliber music and dance in 18 different shows (in addition to traditional circus and opera). All this is done by 20,000 performers and 4,000 management employees, who are constantly on the move using 250 tractor-trailers. Twenty thousand performers are scheduled and transported with all of the stage equipment and costumes, which are constantly changing. The company grew very rapidly between 2000 and 2008, and several problems were created as a result of the rapid growth.

The logistics of people, transportation, accommodations, food, supplies, and so on, in hundreds of different cities each year, for several traveling groups is fairly difficult. And there are 200 different applications in all functional areas, from finance to POM, accounting, marketing, and human resources management. These applications were unable to share data, threatening the productivity of people and causing delays, problems, and unnecessary expenses. For example, if an employee gets sick, how quickly can a replacement be found? What is done if equipment is lost or a tractor-trailer is delayed?

The problem was compounded by the rapid growth of the business to include five permanent shows in Las Vegas and the frequent changes in programs and plans.

Because of the unique nature of the business, most of the applications were done in-house. For example, special software was needed to make or buy costumes and to assign artists to each costume that had to be made. In addition, the company installed ERP for human resources management, production scheduling, logistics, and finance. Even the medical records of the performers were tracked. To enable the various applications to communicate with each other, the company implemented IBM WebSphere Business Integration software to connect all of its disparate systems and applications. The integrated system replaced the manual work of the production managers, who do an inventory whenever a group arrives at a destination. If something was missing, several people were engaged in finding a replacement. Now, due to data sharing, there are very few cases of missing items. Furthermore, IBM WebSphere helped cut the development time for new applications, as well as the modification time of existing applications, by about 25 percent. Also, time to connect new business software to the intranet has been reduced by 20 percent. All of this helped increase productivity. In 2001, there were 65 tickets sold per employee, but by 2005 the total was 200.

Sources: Compiled from Barrett (2005), *IBM.com*, and *cirquedusoleil.com*.

Discussion Questions: Why was it necessary to integrate the functional applications? Could the company grow so rapidly otherwise? Explain how.

HRM applications are especially prone to ethical and legal considerations. For example, training activities that are part of HRM may involve ethical issues in recruiting and selecting employees and in evaluating performance. Likewise, TPS data processing and storage deal with private information about people, their performance, and so forth. Care should be taken to protect this information and the privacy of employees and customers.

Review Questions

1. List IT-supported recruitment activities.
2. How can training be done online?
3. Explain HR information systems.
4. Describe IT support for employee selection, promotion, and development.

Key Terms

auditing *274*
batch processing *261*
buffer stock *266*
clickstream data *263*
computer-integrated manufacturing (CIM) *267*
economic order quantity (EOQ) *266*
inventory control *266*
just-in-time (JIT) *266*
lean manufacturing *266*
online processing *261*
online transaction processing (OLTP) *261*
operational awareness *256*
operational-level information systems *256*
operational responsiveness *256*
project *267*
robot *265*
safety stock *266*
shortage *266*
standard operating procedures (SOP) *259*
tag cloud *257*
vendor-managed inventory (VMI) *262*
Web analytics *263*
XBRL *273*

Chapter Highlights and Insights

(Numbers refer to Learning Objectives)

1 Information systems applications support many functional activities. The major business functional areas are production/operations management, marketing, accounting/finance, and human resources management.

1 The backbone of most information systems applications are TPSs, which keep track of the routine, mission-central operations of the organization.

2 The major area of IT support to production/operations management is in logistics and inventory management: JIT, mass customization, and CIM.

3 Marketing and sales information systems deal with all activities related to customer orders, sales, advertising and promotion, market research, customer service, and product and service pricing. Using IT can increase sales, customers' satisfaction, and profitability.

4 Financial information systems deal with topics such as investment management, financing operations, raising capital, risk analysis, and credit approval.

4 Accounting information systems also cover many non-TPS applications in areas such as cost control, taxation, and auditing.

5 Most tasks related to HR development can be supported by human resources information systems. These tasks include employee recruitment and selection, hiring, performance evaluation, salary and benefits administration, training and development, labor negotiations, and work planning.

5 Online HR systems are extremely useful for recruiting and training.

Questions for Discussion

1. Explain Robert Anthony's management hierarchy.
2. Which functional areas are related to payroll, and how does the relevant information flow?
3. Describe how XBRL can help financial institutions.
4. Discuss how IT facilitates the capital budgeting process.
5. Discuss the role IT plays in auditing.
6. What is the value of lean manufacturing?
7. What is the objective of EOQ?
8. Describe waste and give three examples.
9. What are the risks of JIT?
10. Investigate the role of the Web in HR management.
11. Discuss the need for sharing data among functional areas.

Exercises and Projects

1. Review the Dartmouth-Hitchcock Medical Center case, which is found at the end of this chapter. Assume that RFID tags cost 5 cents each. How might use of RFID tags change the supply chain management? Would the new system at the medical center still be needed? Explain your analysis. Write a report on your conclusions.
2. Visit Teradata Student Network and find the podcast titled "Best-Practice Enterprise Risk Management" (by R. M. Mark). View the presentation and write a report on how IT can help a company with its risk management.
3. Visit Teradata Student Network and find the assignment regarding Advent Technology. Use the MicroStrategy Sales Force Analysis Module and answer the questions about sales at Advent.
4. Visit *secondlife.com* and find an island that interests you. For accountants, we suggest looking at the "CPA Island." Make a list of 10 major activities conducted on the site.

Group Assignments and Projects

1. Each group should visit (or investigate) a large company in a different industry and identify its channel systems. Then find out how IT supports each of those components. Finally, suggest improvements in the existing channel system that can be supported by IT technologies and that are not in use by the company today. Each group presents its findings.
2. The class is divided into groups of four. Each group member represents a major functional area: production/operations management, sales/marketing, accounting/finance, or human resources. Find and describe several examples of processes that require the integration of functional information systems in a company of your choice. Each group will also show the interfaces to the other functional areas. For example, accounting students can visit *accountantsworld.com* just to be surprised at what is there, and *1040.com* can be useful to both the accounting and finance areas.
3. Each group investigates an HR software vendor (Oracle, SAP, Lawson Software). The group prepares a list of all HR functionalities supported by the software. Then each group makes a presentation to convince the class that its vendor is the best.
4. Analyze the financial crisis of 2008. In your opinion, what roles did IT play to accelerate the crisis? Also, how did IT help to rectify some of the problems? Be specific.

Internet Exercises

1. Find free accounting software online. Download the software and try it. Write a report on your findings.
2. Search for an explanation of EOQ. Explain the formula.
3. Finding a job on the Internet is challenging; there are almost too many places to look. Visit the following sites: *careerbuilder.com, craigslist.org, LinkedIn.com, careermag.com, hotjobs.yahoo.com, jobcentral.com,* and *monster.com*. What do these sites provide you as a job seeker?
4. Visit *sas.com* and access revenue optimization there. Explain how the software helps in optimizing prices.
5. Enter *sas.com/solutions/profitmgmt/brief.pdf* and download the brochure on profitability management. Prepare a summary.
6. Visit *techsmith.com/camtasia/features.asp* and take the product tour. Do you think it is a valuable tool?
7. Examine the capabilities of the following financial software packages: TekPortal (from *teknowledge.com*), Financial Analyzer (from *oracle.com*), and Financial Management (from *sas.com*). Prepare a report comparing the capabilities of the software packages.
8. Review *salesforce.com*. What functional support does the software provide?

BUSINESS CASE

SunWest Foods Blends Data Silos into Real-Time Business Knowledge

SunWest Foods is California's second-largest rice and wild rice producer, milling up to 80 tons per hour at seasonal peaks. In 2010, SunWest employed a base of 100 staff in three processing/warehouse locations in Biggs, California, and a marketing office in Davis, California. Its largest milling facility encloses 125,000 square feet, 30,000 metric tons of storage. It has its own rail spur, 250,000 square feet of blacktop, and pollution control equipment scrubbing 240,000 cubic feet of air per minute. At seasonal peaks, processing reaches 80 tons per hour and staff tops 200 on 24-hours-a-day, seven-days-a-week shifts.

SunWest buys from 350 farms, then packages, distributes, and sells domestically and internationally. But its patchwork of ISs and data silos required multiple manual reentries of each order—some up to 10 times—wasting time and creating errors.

Staff worked weeks compiling business-pivotal reports from the patchwork of ISs and formats. Some decisions couldn't wait for adequate information. Inventory was kept high to ensure complete orders. After extensive research, SunWest selected Beck Consulting to install Microsoft Dynamics NAV.

Financial Clarity

SunWest has improved enterprise-wide financial controls, planning, and reporting. Jim Errecarte, SunWest president and CEO, explained: "We used to have a balance sheet for each company. Now we know P&L [profit and loss] for every profit center inside every company, plus all six product lines. The 10 to 15 staff-hours per month to assemble necessary reports have dropped to a few minutes."

Errecarte says, "Unequivocally, the impacts of our patchwork system were many extra steps and rushed business decisions based on incomplete reports we couldn't wait for—particularly in our commodity positions. We were overdue for one cohesive, end-to-end solution to encompass purchasing, sales, production, distribution, finances, and trend prediction."

SunWest previously had a generalized price list for each market sector. Now it can offer customer-specific prices, manage them easily, and track the benefits. This helps decision makers position the company wisely in the market and drive constant improvement.

Errecarte now creates most reports he needs in Microsoft Dynamics NAV without pulling others off-task. He gets the data four weeks faster and in formats he can easily use. In running a dynamic food and commodity business, that's critical.

Summary of Benefits

Today, massive staff time has been returned to business functions, executives pull their own reports in minutes, new money is coming in from wiser commodity buy-sell decisions, and customers almost never call about an imperfect order.

Here is a summary of benefits achieved through the integration of data silos:

- Data reentry time dropped 80 percent, making perfect orders the rule and freeing up 30 staff hours weekly.
- Commodity reports that took weeks are now instant and save 15 hours monthly.
- Marketing's wild rice reports, which had lagged by three months, are now real time.
- Panic calls on incomplete orders dropped from monthly to less than quarterly.

Sources: Compiled from Microsoft (2010) and SunWest (2010).

Questions

1. Why were multiple data entries of the same data necessary?
2. Prior to integration, why did SunWest have fragmented ISs?
3. Explain the waste at SunWest prior to integration. Why was there so much waste?
4. What functional areas have benefited from the integrated IS solution?
5. Why is real-time reporting and trusted data critical to SunWest?

NONPROFIT CASE

Wireless Inventory Management at Dartmouth-Hitchcock Medical Center

Dartmouth–Hitchcock Medical Center (DHMC) is a large medical complex in New Hampshire, with hospitals, a medical school, and over 600 practicing physicians in its many clinics. DHMC was growing rapidly and was encountering a major problem in the distribution of medical supplies. These supplies used to be ordered by nurses. But nurses are usually in short supply, so having nurses spending valuable time ordering supplies left them less time for their core competency—patient care. Furthermore, having nurses handling supply orders led to inventory management problems. For example, nurses were busy and did not see inventory management as their primary concern. As a result, they tended to overorder in an effort to save time in managing inventory. At the other extreme, they sometimes waited until the last minute to order supplies, which led to costly rush orders.

One solution would have been to transfer the task of inventory ordering and management to other staff, but doing so would have required hiring additional personnel, and the DHMC was short on budget. Also, the coordination with the nurses to find what was needed and when, as well as maintaining stock, would have been cumbersome.

What the medical center needed was a solution that would reduce the burden on the nurses but also reduce the inventory levels and the last-minute, expensive ordering. Given the size of the medical center, and the fact that there are over 30,000 different inventory items, this was not a simple task.

Solution to Supply Chain Problems

DHMC realized that its problem was related to the supply chain, so it looked to IT for solutions. The idea that DHMC chose was to connect wireless handheld devices with a purchasing and inventory management information system. Here is how the new system works: The medical center has a wireless LAN (Wi-Fi). Information about supplies then can be uploaded and downloaded from the devices to the network from anywhere within the range of the Wi-Fi. In remote clinics without Wi-Fi, the handhelds are docked into wireline network PCs.

For each item in stock, a **par level** (the level at which supplies must be reordered) was established, based on actual usage reports and in collaboration between nurses and the materials management staff. Now nurses simply scan an item each time it is consumed, and the software automatically adjusts the recorded inventory level. When a par level is reached for any inventory item, an order to the supplier is generated automatically. Similarly, when the inventory level at each nursing station dips below the station's par level, a shipment is arranged from the central supply room to that nursing station. The system also allows for nurses to make restocking requests, which can be triggered by scanning an item. The system works for the supplies of all non-nursing departments as well, such as HR and accounting.

The system is integrated with other applications from the same vendor, PeopleSoft Inc., now an Oracle company. One such application is Express PO, which enables purchasing managers to review and act on standing purchase orders, e-procurement, and contract management.

Performance Improvement

Inventory levels were reduced by 50 percent, paying for the system in just a few months. Materials purchasing and management now are consistent across the enterprise; the last-minute, sometimes expensive ordering has been eliminated; the time spent by nurses on ordering and tracking materials has been drastically reduced; and access to current information has been improved. All of this contributed to reduced costs and improved patient care.

The new system helped to modernize and redesign some of the center's business processes (e.g., distribution, procurement) and was able to support several business processes (e.g., operations, finance, and accounting), not just one. Although the system's major application is inventory management, the same vendor provided ready-made purchasing and contract management modules, which were integrated with the inventory module. The integration also included connection to suppliers, using the Internet.

This IT solution has proven useful for an organization whose business processes cross the traditional functional departmental lines. In this case, nursing is considered operations/production, and so is inventory control; purchasing and contract management are in the finance/accounting area.

Sources: Compiled from Grimes (2003), Supply Chain Management and Logistics (2004), *Oracle.com*.

Questions

1. What were DHMC's medical supplies distribution problems?
2. What factors or practices contributed to those problems?
3. Why does inventory management matter to DHMC?
4. How have DHMC's inventory management problems been solved?

ANALYSIS USING SPREADSHEETS

Calculation of Labor Savings at SunWest Foods

Refer to the preceding Business Case *SunWest Foods Blends Data Silos into Real-Time Business Knowledge*. Design a spreadsheet to calculate the savings in labor costs. Use the data from the case to estimate the reduction in wasted time. Assume that the hourly labor rate for staff workers is $15.00 and the rate for managers and senior executives is $100 per hour.

Resources on the Book's Web Site

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

Cases for Chapter 9 are available at wiley.com/college/turban:

9.1 Dollar General Uses Integrated Software

9.2 Regent Inns: Successful Implementation of E-Procurement

9.3 Musco Food Uses IT to Improve Sales and Operations

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