Chapter 12

Enhancing Decision Making

LEARNING OBJECTIVES

After reading this chapter, you will be able to answer the following questions:

1. What are the different types of decisions and how does the decision-making process work?
2. How do information systems support the activities of managers and management decision making?
3. How do business intelligence and business analytics support decision making?
4. How do different decision-making constituencies in an organization use business intelligence?
5. What is the role of information systems in helping people working in a group make decisions more efficiently?

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CHAPTER OUTLINE

WHAT TO SELL? WHAT PRICE TO CHARGE? ASK THE DATA

What's the best way to get a discount on your morning coffee at Starbucks? Well, if you live in Manhattan, you could get up an hour early and take the subway downtown to Brooklyn. A single expresso is 10 cents cheaper than in your neighborhood, as are a caffee latte and slice of lemon pound cake. But a muffin runs 10 cents more uptown in Marble Hill, and a tall Pike's Place Roast costs $1.70 no matter where you live.

Starbucks is one of many retailers using sophisticated software to analyze, store by store and item by item, how demand responds to changes in price. What customers are willing to pay for certain items depends very much on the neighborhood or even the region of the country where they live. Shoppers in certain locations are willing to pay more.

The Duane Reade drugstore chain, recently purchased by Walgreens, is also adept at adjusting prices. Software analyzing sales patterns found that parents of newborn babies are not as price-sensitive as those with toddlers, so the company was able to raise prices on diapers for newborn infants without losing sales. The chain's information systems also showed how to adjust pricing based on location. Shoppers at the Duane Reade store near 86th Street and Lexington Avenue pay 20 cents more for a box of Kleenex and 50 cents more for a bottle of Pepto-Bismol than customers in Harlem.

Business analytics software such as that used by Duane Reade typically analyzes patterns in sales data to create a "pricing profile." A store near a big commuting hub might discount convenience items to present a low-cost image while one in a family neighborhood with many young children might discount baby items to get more people through the door.

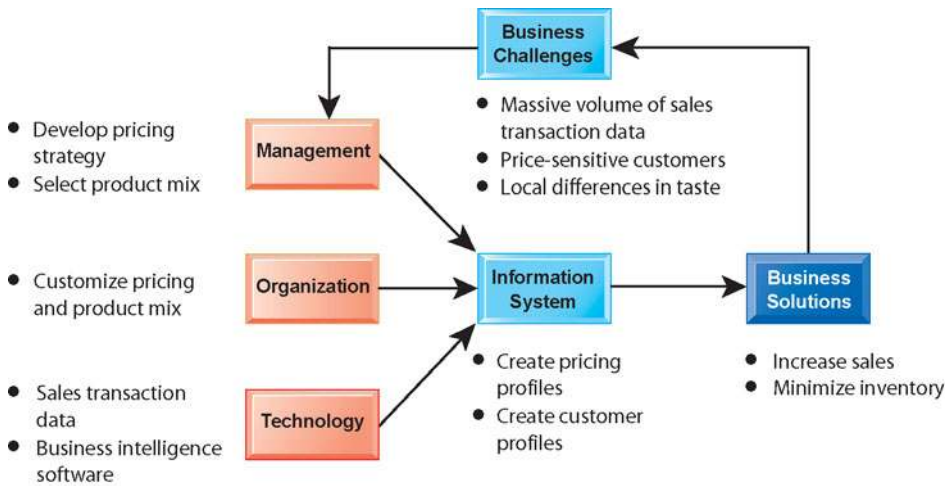
Analyzing large troves of digital sales and customer information from both online and physical stores also helps retailers decide what to sell as well. Fashion Web site HauteLook confirmed that Southerners buy more white, green, and pink than people from other regions, while ShopItToMe learned that the average woman spends less on fashion in Dallas than in Washington D.C. and that women are thinner on both coasts than in the U.S. heartland and wear more petite clothing and shoe sizes meant for smaller women.

How much of a difference does this knowledge make? Lots. 1-800-Flowers, which sells flowers and gift baskets online, has used analytics software from SAS Inc. to tweak its online storefront and marketing activities. The software helped the company quickly record and analyze buyer profiles to help improve targeting of its product, determine what "specials" to offer, and plan sales and marketing strategies based on an understanding of real customer needs. The company is able to quickly change prices and offerings on its Web site—often every hour. In the first half of 2010, 1-800-Flowers used more finely targeted Web pages and e-mail promotions to improve the conversion rate of Web site browsers to buyers by 20 percent.

Sources: Anne Kadet, "Price-Point Politics," *The Wall Street Journal*, July 24, 2010; Steve Lohr, "A Data Explosion Remakes Retailing," and Christina Binkley, "Fashion Nation: What Retailers Know about Us," *The Wall Street Journal*, July 28, 2010.

The experiences of Starbucks, Duane Reade, and 1-800-Flowers are powerful illustrations of how information systems improve decision making. Managers at these retail chains were unable to make good decisions about what prices to charge to improve profitability and what items to sell in stores to maximize sales at different locations and different time periods. They had access to customer purchase data, but they were unable to analyze millions of pieces of data on their own. Bad decisions about how much to charge and how to stock stores lowered sales revenue and prevented these companies from responding quickly to customer needs.

The chapter-opening diagram calls attention to important points raised by this case and this chapter. Starbucks, Duane Reade, and 1-800-Flowers started using business intelligence software, which is able to find patterns and trends in massive quantities of data. Information from these business intelligence systems helps managers at these companies make better decisions about pricing, shelf stocking, and product offerings. They are able to see where they can charge a higher price or where they must lower prices to maximize sales revenue, as well as what items to stock and when to change their merchandise mix. Better decision making using business intelligence has made all of these companies more profitable.



12.1 Decision Making and Information Systems

Decision making in businesses used to be limited to management. Today, lower-level employees are responsible for some of these decisions, as information systems make information available to lower levels of the business. But what do we mean by better decision making? How does decision making take place in businesses and other organizations? Let's take a closer look.

BUSINESS VALUE OF IMPROVED DECISION MAKING

What does it mean to the business to make better decisions? What is the monetary value of improved decision making? Table 12-1 attempts to measure the monetary value of improved decision making for a small U.S. manufacturing firm with $280 million in annual revenue and 140 employees. The firm has identified a number of key decisions where new system investments might improve the quality of decision making. The table provides selected estimates of annual value (in the form of cost savings or increased revenue) from improved decision making in selected areas of the business.

We can see from Table 12-1 that decisions are made at all levels of the firm and that some of these decisions are common, routine, and numerous. Although the value of improving any single decision may be small, improving hundreds of thousands of "small" decisions adds up to a large annual value for the business.

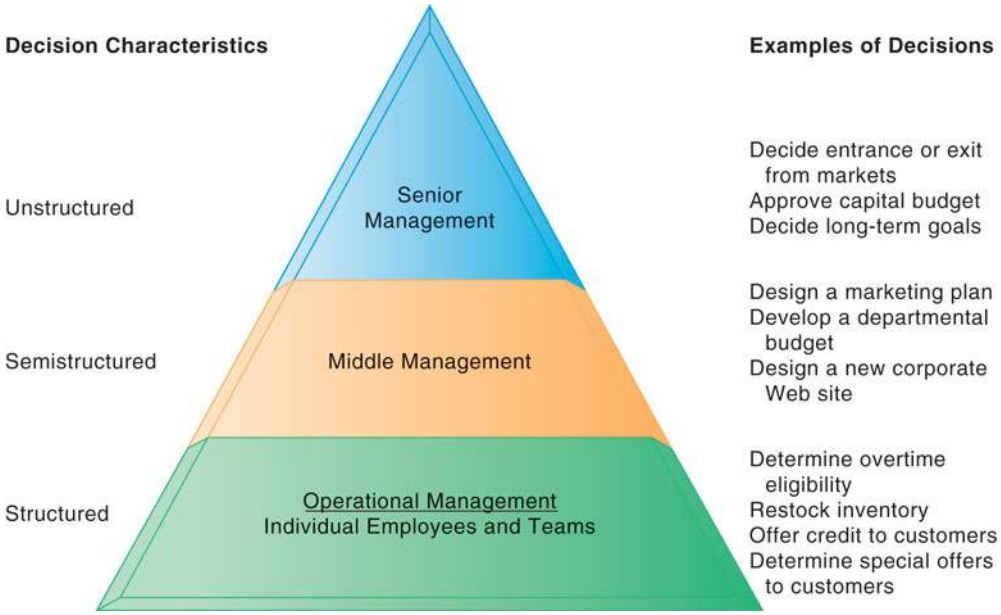
TYPES OF DECISIONS

Chapters 1 and 2 showed that there are different levels in an organization. Each of these levels has different information requirements for decision support and responsibility for different types of decisions (see Figure 12-1). Decisions are classified as structured, semistructured, and unstructured.

TABLE 12-1 BUSINESS VALUE OF ENHANCED DECISION MAKING

EXAMPLE DECISION	DECISION MAKER	NUMBER OF ANNUAL DECISIONS	ESTIMATED VALUE TO FIRM OF A SINGLE IMPROVED DECISION	ANNUAL VAUE
Allocate support to most valuable customers	Accounts manager	12	$ 100,000	$1,200,000
Predict call center daily demand	Call center management	4	150,000	600,000
Decide parts inventory levels daily	Inventory manager	365	5,000	1,825,000
Identify competitive bids from major suppliers	Senior management	1	2,000,000	2,000,000
Schedule production to fill orders	Manufacturing manager	150	10,000	1,500,000
Allocate labor to complete a job	Production floor manager	100	4,000	400,000

FIGURE 12-1 INFORMATION REQUIREMENTS OF KEY DECISION-MAKING GROUPS IN A FIRM



Senior managers, middle managers, operational managers, and employees have different types of decisions and information requirements.

Unstructured decisions are those in which the decision maker must provide judgment, evaluation, and insight to solve the problem. Each of these decisions is novel, important, and nonroutine, and there is no well-understood or agreed-on procedure for making them.

Structured decisions, by contrast, are repetitive and routine, and they involve a definite procedure for handling them so that they do not have to be treated each time as if they were new. Many decisions have elements of both types of decisions and are **semistructured**, where only part of the problem has a clear-cut answer provided by an accepted procedure. In general, structured decisions are more prevalent at lower organizational levels, whereas unstructured problems are more common at higher levels of the firm.

Senior executives face many unstructured decision situations, such as establishing the firm's five- or ten-year goals or deciding new markets to enter. Answering the question "Should we enter a new market?" would require access to news, government reports, and industry views as well as high-level summaries of firm performance. However, the answer would also require senior managers to use their own best judgment and poll other managers for their opinions.

Middle management faces more structured decision scenarios but their decisions may include unstructured components. A typical middle-level management decision might be "Why is the reported order fulfillment report showing a decline over the past six months at a distribution center in Minneapolis?" This middle manager will obtain a report from the firm's enterprise system or distribution management system on order activity and operational efficiency at the Minneapolis distribution center. This is the structured part of the decision. But before arriving at an answer, this middle manager will have to interview employees and gather more unstructured information from external sources about local economic conditions or sales trends.

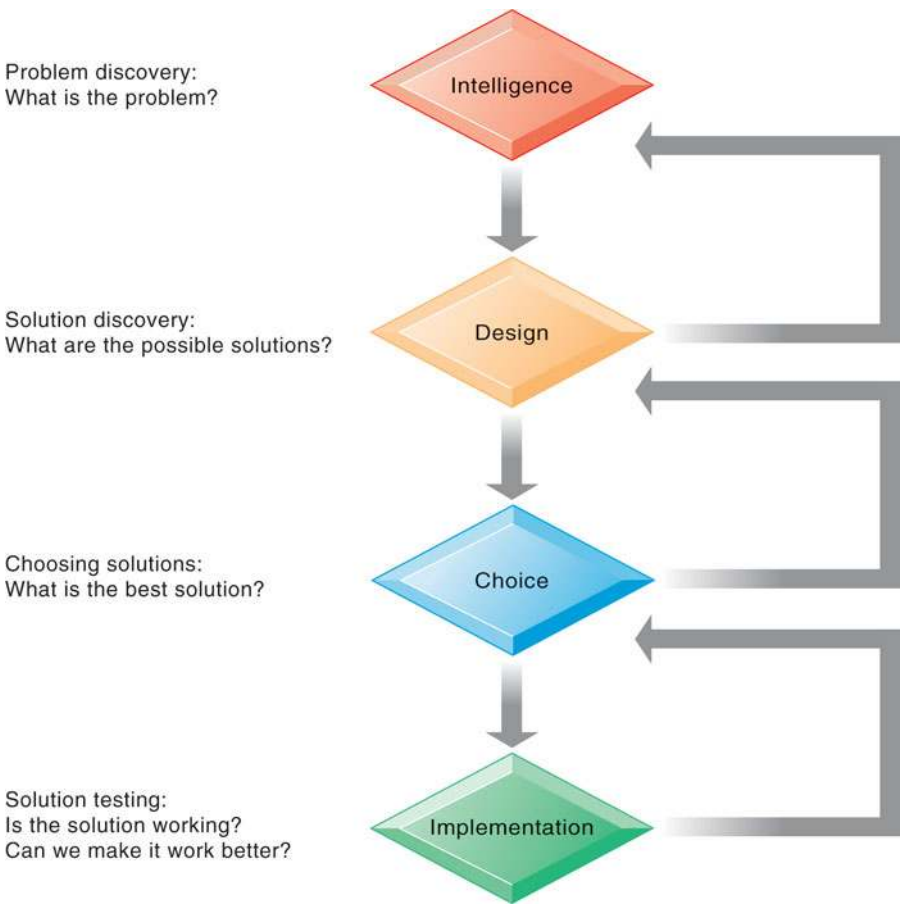
Operational management and rank-and-file employees tend to make more structured decisions. For example, a supervisor on an assembly line has to decide whether an hourly paid worker is entitled to overtime pay. If the employee worked more than eight hours on a particular day, the supervisor would routinely grant overtime pay for any time beyond eight hours that was clocked on that day.

A sales account representative often has to make decisions about extending credit to customers by consulting the firm's customer database that contains credit information. If the customer met the firm's prespecified criteria for granting credit, the account representative would grant that customer credit to make a purchase. In both instances, the decisions are highly structured and are routinely made thousands of times each day in most large firms. The answer has been preprogrammed into the firm's payroll and accounts receivable systems.

THE DECISION-MAKING PROCESS

Making a decision is a multistep process. Simon (1960) described four different stages in decision making: intelligence, design, choice, and implementation (see Figure 12-2).

FIGURE 12-2 STAGES IN DECISION MAKING



The decision-making process is broken down into four stages.

Intelligence consists of discovering, identifying, and understanding the problems occurring in the organization—why a problem exists, where, and what effects it is having on the firm.

Design involves identifying and exploring various solutions to the problem.

Choice consists of choosing among solution alternatives.

Implementation involves making the chosen alternative work and continuing to monitor how well the solution is working.

What happens if the solution you have chosen doesn't work? Figure 12-2 shows that you can return to an earlier stage in the decision-making process and repeat it if necessary. For instance, in the face of declining sales, a sales management team may decide to pay the sales force a higher commission for making more sales to spur on the sales effort. If this does not produce sales increases, managers would need to investigate whether the problem stems from poor product design, inadequate customer support, or a host of other causes that call for a different solution.

MANAGERS AND DECISION MAKING IN THE REAL WORLD

The premise of this book and this chapter is that systems to support decision making produce better decision making by managers and employees, above average returns on investment for the firm, and ultimately higher profitability. However, information systems cannot improve all the different kinds of decisions taking place in an organization. Let's examine the role of managers and decision making in organizations to see why this is so.

Managerial Roles

Managers play key roles in organizations. Their responsibilities range from making decisions, to writing reports, to attending meetings, to arranging birthday parties. We are able to better understand managerial functions and roles by examining classical and contemporary models of managerial behavior.

The **classical model of management**, which describes what managers do, was largely unquestioned for the more than 70 years since the 1920s. Henri Fayol and other early writers first described the five classical functions of managers as planning, organizing, coordinating, deciding, and controlling. This description of management activities dominated management thought for a long time, and it is still popular today.

The classical model describes formal managerial functions but does not address what exactly managers do when they plan, decide things, and control the work of others. For this, we must turn to the work of contemporary behavioral scientists who have studied managers in daily action. **Behavioral models** state that the actual behavior of managers appears to be less systematic, more informal, less reflective, more reactive, and less well organized than the classical model would have us believe.

Observers find that managerial behavior actually has five attributes that differ greatly from the classical description. First, managers perform a great deal of work at an unrelenting pace—studies have found that managers engage in more than 600 different activities each day, with no break in their pace. Second, managerial activities are fragmented; most activities last for less than nine minutes, and only 10 percent of the activities exceed one hour in duration. Third, managers prefer current, specific, and ad hoc information (printed information often will be too old). Fourth, they prefer oral forms of

communication to written forms because oral media provide greater flexibility, require less effort, and bring a faster response. Fifth, managers give high priority to maintaining a diverse and complex web of contacts that acts as an informal information system and helps them execute their personal agendas and short- and long-term goals.

Analyzing managers' day-to-day behavior, Mintzberg found that it could be classified into 10 managerial roles. **Managerial roles** are expectations of the activities that managers should perform in an organization. Mintzberg found that these managerial roles fell into three categories: interpersonal, informational, and decisional.

Interpersonal Roles. Managers act as figureheads for the organization when they represent their companies to the outside world and perform symbolic duties, such as giving out employee awards, in their **interpersonal role**. Managers act as leaders, attempting to motivate, counsel, and support subordinates. Managers also act as liaisons between various organizational levels; within each of these levels, they serve as liaisons among the members of the management team. Managers provide time and favors, which they expect to be returned.

Informational Roles. In their **informational role**, managers act as the nerve centers of their organizations, receiving the most concrete, up-to-date information and redistributing it to those who need to be aware of it. Managers are therefore information disseminators and spokespersons for their organizations.

Decisional Roles. Managers make decisions. In their **decisional role**, they act as entrepreneurs by initiating new kinds of activities; they handle disturbances arising in the organization; they allocate resources to staff members who need them; and they negotiate conflicts and mediate between conflicting groups.

Table 12-2, based on Mintzberg's role classifications, is one look at where systems can and cannot help managers. The table shows that information systems are now capable of supporting most, but not all, areas of management life.

TABLE 12-2 MANAGERIAL ROLES AND SUPPORTING INFORMATION SYSTEMS

ROLE	BEHAVIOR	SUPPORT SYSTEMS
Interpersonal Roles		
Figurehead	→	Telepresence systems
Leader	Interpersonal →	Telepresence, social networks, Twitter
Liaison	→	Smartphones, social networks
Informational Roles		
Nerve center	→	Management information systems, ESS
Disseminator	Information →	E-mail, social networks
Spokesperson	processing →	Webinars, telepresence
Decisional Roles		
Entrepreneur	Decision →	None exist
Disturbance handler	making →	None exist
Resource allocator	→	Business intelligence, DSS systems
Negotiator	→	None exist

Sources: Kenneth C. Laudon and Jane P. Laudon; and Mintzberg, 1971.

Real-World Decision Making

We now see that information systems are not helpful for all managerial roles. And in those managerial roles where information systems might improve decisions, investments in information technology do not always produce positive results. There are three main reasons: information quality, management filters, and organizational culture (see Chapter 3).

Information Quality. High-quality decisions require high-quality information. Table 12-3 describes information quality dimensions that affect the quality of decisions.

If the output of information systems does not meet these quality criteria, decision-making will suffer. Chapter 6 has shown that corporate databases and files have varying levels of inaccuracy and incompleteness, which in turn will degrade the quality of decision making.

Management Filters. Even with timely, accurate information, some managers make bad decisions. Managers (like all human beings) absorb information through a series of filters to make sense of the world around them. Managers have selective attention, focus on certain kinds of problems and solutions, and have a variety of biases that reject information that does not conform to their prior conceptions.

For instance, Wall Street firms such as Bear Stearns and Lehman Brothers imploded in 2008 because they underestimated the risk of their investments in complex mortgage securities, many of which were based on subprime loans that were more likely to default. The computer models they and other financial institutions used to manage risk were based on overly optimistic assumptions and overly simplistic data about what might go wrong. Management wanted to make sure that their firms' capital was not all tied up as a cushion against defaults from risky investments, preventing them from investing it to generate profits. So the designers of these risk management systems were encouraged to measure risks in a way that minimzed their importance. Some trading desks also oversimplified the information maintained about the mortgage securities to make them appear as simple bonds with higher ratings than were warranted by their underlying components (Hansell, 2008).

Organizational Inertia and Politics. Organizations are bureaucracies with limited capabilities and competencies for acting decisively. When environments change and businesses need to adopt new business models to survive,

TABLE 12-3 INFORMATION QUALITY DIMENSIONS

QUALITY DIMENSION	DESCRIPTION
Accuracy	Do the data represent reality?
Integrity	Are the structure of data and relationships among the entities and attributes consistent?
Consistency	Are data elements consistently defined?
Completeness	Are all the necessary data present?
Validity	Do data values fall within defined ranges?
Timeliness	Area data available when needed?
Accessibility	Are the data accessible, comprehensible, and usable?

strong forces within organizations resist making decisions calling for major change. Decisions taken by a firm often represent a balancing of the firm's various interest groups rather than the best solution to the problem.

Studies of business restructuring find that firms tend to ignore poor performance until threatened by outside takeovers, and they systematically blame poor performance on external forces beyond their control such as economic conditions (the economy), foreign competition, and rising prices, rather than blaming senior or middle management for poor business judgment (John, Lang, Netter, et al., 1992).

HIGH-VELOCITY AUTOMATED DECISION MAKING

Today, many decisions made by organizations are not made by managers, or any humans. For instance, when you enter a query into Google's search engine, Google has to decide which URLs to display in about half a second on average (500 milliseconds). Google indexes over 50 billion Web pages, although it does not search the entire index for every query it receives. The same is true of other search engines. The New York Stock Exchange is spending over $450 million in 2010–2011 to build a trading platform that can executes incoming orders in less that 50 milliseconds. High frequency traders at electronic stock exchanges execute their trades in under 30 milliseconds.

The class of decisions that are highly structured and automated is growing rapidly. What makes this kind of automated high-speed decision making possible are computer algorithms that precisely define the steps to be followed to produce a decision, very large databases, very high-speed processors, and software optimized to the task. In these situations, humans (including managers) are eliminated from the decision chain because they are too slow.

This also means organizations in these areas are making decisions faster than what managers can monitor or control. Inability to control automated decisions was a major factor in the "Flash Crash" experienced by U.S. stock markets on May 6, 2010, when the Dow Jones Industrial Average fell over 600 points in a matter of minutes before rebounding later that day. The stock market was overwhelmed by a huge wave of sell orders triggered primarily by high-speed computerized trading programs within a few seconds, causing shares of some companies like Proctor & Gamble to sell for pennies.

How does the Simon framework of intelligence-design-choice-implementation work in high-velocity decision environments? Essentially, the intelligence, design, choice, and implementation parts of the decision-making process are captured by the software's algorithms. The humans who wrote the software have already identified the problem, designed a method for finding a solution, defined a range of acceptable solutions, and implemented the solution. Obviously, with humans out of the loop, great care needs to be taken to ensure the proper operation of these systems lest they do significant harm to organizations and humans. And even then additional safeguards are wise to observe the behavior of these systems, regulate their performance, and if necessary, turn them off.

12.2 Business Intelligence in the Enterprise

Chapter 2 introduced you to the different types of systems used for supporting management decision making. At the foundation of all of these decision support systems are business intelligence and business analytics infrastructure

that supplies the data and the analytic tools for supporting decision making. In this section, we want to answer the following questions:

- What are business intelligence (BI) and business analytics (BA)
- Who makes business intelligence and business analytics hardware and software?
- Who are the users of business intelligence?
- What kinds of analytical tools come with a BI/BA suite?
- How do managers use these tools?
- What are some examples of firms who have used these tools?
- What management strategies are used for developing BI/BA capabilities?

WHAT IS BUSINESS INTELLIGENCE?

When we think of humans as intelligent beings we often refer to their ability to take in data from their environment, understand the meaning and significance of the information, and then act appropriately. Can the same be said of business firms? The answer appears to be a qualified "yes." All organizations, including business firms, do indeed take in information from their environments, attempt to understand the meaning of the information, and then attempt to act on the information. Just like human beings, some business firms do this well, and others poorly.

"Business intelligence" is a term used by hardware and software vendors and information technology consultants to describe the infrastructure for warehousing, integrating, reporting, and analyzing data that comes from the business environment. The foundation infrastructure collects, stores, cleans, and makes relevant information available to managers. Think databases, data warehouses, and data marts described in Chapter 6. "Business analytics" is also a vendor-defined term that focuses more on tools and techniques for analyzing and understanding data. Think online analytical processing (OLAP), statistics, models, and data mining, which we also introduced in Chapter 6.

So, stripped to its essentials, business intelligence and analytics are about integrating all the information streams produced by a firm into a single, coherent enterprise-wide set of data, and then, using modeling, statistical analysis tools (like normal distributions, correlation and regression analysis, Chi square analysis, forecasting, and cluster analysis), and data mining tools (pattern discovery and machine learning), to make sense out of all these data so managers can make better decisions and better plans, or at least know quickly when their firms are failing to meet planned targets.

One company that uses business intelligence is Hallmark Cards. The company uses SAS Analytics software to improve its understanding of buying patterns that could lead to increased sales at more than 3,000 Hallmark Gold Crown stores in the United Sates. Hallmark wanted to strengthen its relationship with frequent buyers. Using data mining and predictive modeling, the company determined how to market to various consumer segments during holidays and special occasions as well as adjust promotions on the fly. Hallmark is able to determine which customer segments are most influenced by direct mail, which should be approached through e-mail, and what specific messages to send each group. Business intelligence has helped boost Hallmark sales to its loyalty program members by 5 to 10 percent.

Business Intelligence Vendors

It is important to remember that business intelligence and analytics are products defined by technology vendors and consulting firms. They consist of hardware and software suites sold primarily by large system vendors to very large Fortune 500 firms. The largest five providers of these products are SAP, Oracle, IBM, SAS Institute, and Microsoft (see Table 12-4). Microsoft's products are aimed at small to medium size firms, and they are based on desktop tools familiar to employees (such as Excel spreadsheet software), Microsoft Sharepoint collaboration tools, and Microsoft SQL Server database software. The size of the American BI and BA marketplace in 2010 is estimated to be $10.5 billion and growing at over 20% annually (Gartner, 2010). This makes business intelligence and business analytics one of the fastest-growing and largest segments in the U.S. software market.

THE BUSINESS INTELLIGENCE ENVIRONMENT

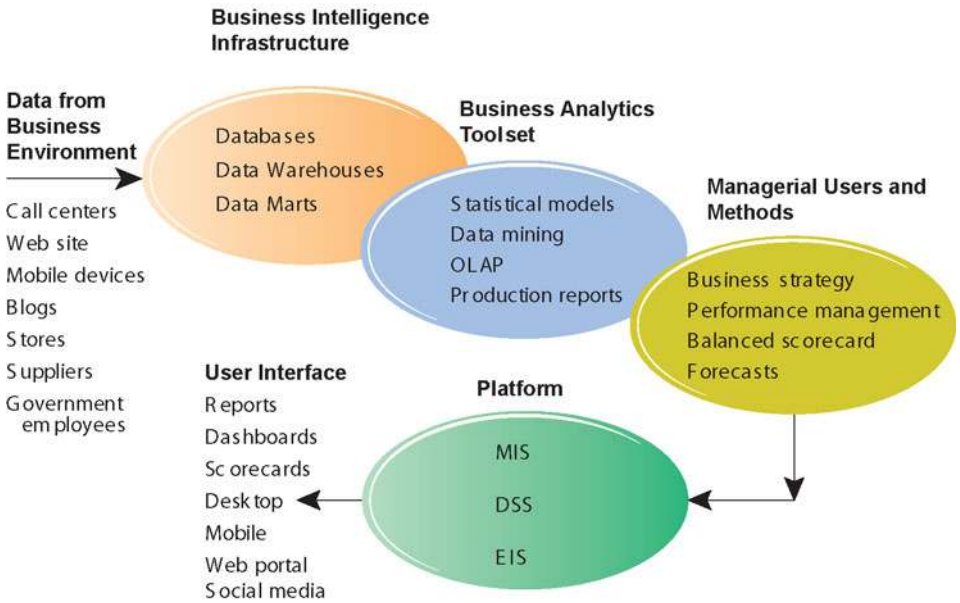
Figure 12-3 gives an overview of a business intelligence environment, highlighting the kinds of hardware, software, and management capabilities that the major vendors offer and that firms develop over time. There are six elements in this business intelligence environment:

- **Data from the business environment:** Businesses must deal with both structured and unstructured data from many different sources, including mobile devices and the Internet. The data need to be integrated and organized so that they can be analyzed and used by human decision makers.
- **Business intelligence infrastructure:** The underlying foundation of business intelligence is a powerful database system that captures all the relevant data to operate the business. The data may be stored in transactional databases or combined and integrated into an enterprise-data warehouse or series of interrelated data marts.
- **Business analytics toolset:** A set of software tools are used to analyze data and produce reports, respond to questions posed by managers, and track the progress of the business using key indicators of performance.
- **Managerial users and methods:** Business intelligence hardware and software are only as intelligent as the human beings who use them. Managers impose order on the analysis of data using a variety of managerial methods that define strategic business goals and specify how progress will be measured. These include business performance management and balanced scorecard approaches focusing on key performance indicators and industry strategic analyses focusing on changes in the general business environment, with special attention to competitors. Without strong senior management over-

TABLE 12-4 MARKET LEADERS AND SHARE FOR THE TOP BUSINESS INTELLIGENCE VENDORS

VENDOR	MARKET SHARE	BUSINESS INTELLIGENCE SOFTWARE
SAP	25%	SAP BusinessObjects EPM Solutions
SAS Institute	15%	SAS Activity Based Management; financial, human capital, profitability, and strategy management
Oracle	14%	Enterprise Performance Management System
IBM	11%	IBM Cognos
Microsoft	7%	SQL Server with PowerPivot

FIGURE 12-3 BUSINESS INTELLIGENCE AND ANALYTICS FOR DECISION SUPPORT



Business intelligence and analytics requires a strong database foundation, a set of analytic tools, and an involved management team that can ask intelligent questions and analyze data.

sight, business analytics can produce a great deal of information, reports, and online screens that focus on the wrong matters and divert attention from the real issues. You need to remember that, so far, only humans can ask intelligent questions.

- **Delivery platform—MIS, DSS, ESS.** The results from business intelligence and analytics are delivered to managers and employees in a variety of ways, depending on what they need to know to perform their jobs. MIS, DSS, and ESS, which we introduced in Chapter 2, deliver information and knowledge to different people and levels in the firm—operational employees, middle managers, and senior executives. In the past, these systems could not share data and operated as independent systems. Today, one suite of hardware and software tools in the form of a business intelligence and analytics package is able to integrate all this information and bring it to managers' desktop or mobile platforms.
- **User interface:** Business people are no longer tied to their desks and desktops. They often learn quicker from a visual representation of data than from a dry report with columns and rows of information. Today's business analytics software suites emphasize visual techniques such as dashboards and scorecards. They also are able to deliver reports on Blackberrys, iPhones, and other mobile handhelds as well as on the firm's Web portal. BA software is adding capabilities to post information on Twitter, Facebook, or internal social media to support decision making in an online group setting rather than in a face-to-face meeting.

BUSINESS INTELLIGENCE AND ANALYTICS CAPABILITIES

Business intelligence and analytics promise to deliver correct, nearly real-time information to decision makers, and the analytic tools help them quickly

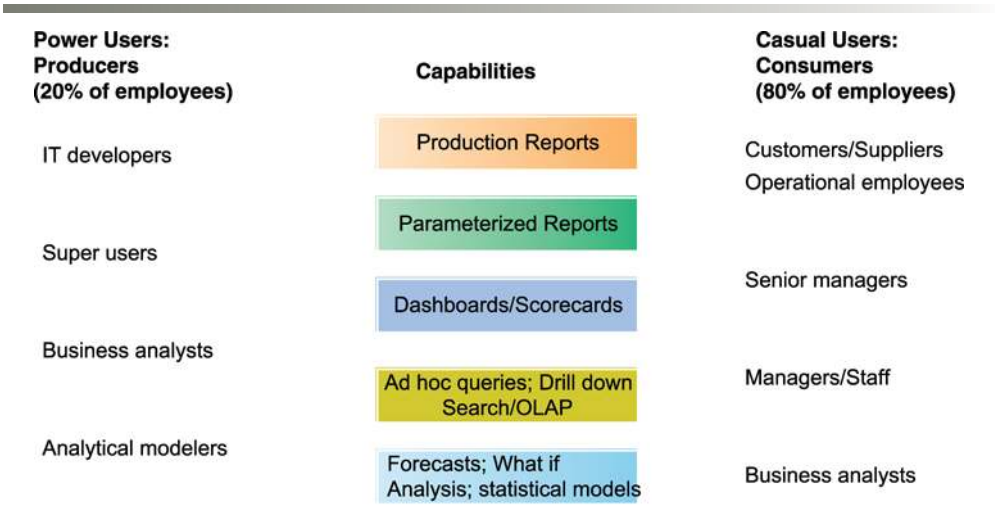
understand the information and take action. There are 5 analytic functionalities that BI systems deliver to achieve these ends:

- **Production reports:** These are predefined reports based on industry-specific requirements (see Table 12-5).
- **Parameterized reports.** Users enter several parameters as in a pivot table to filter data and isolate impacts of parameters. For instance, you might want to enter region and time of day to understand how sales of a product vary by region and time. If you were Starbucks, you might find that customers in the East buy most of their coffee in the morning, whereas in the Northwest customers buy coffee throughout the day. This finding might lead to different marketing and ad campaigns in each region. (See the discussion of pivot tables in Section 12.3).
- **Dashboards/scorecards:** These are visual tools for presenting performance data defined by users
- **Ad hoc query/search/report creation:** These allow users to create their own reports based on queries and searches
- **Drill down:** This is the ability to move from a high-level summary to a more detailed view
- **Forecasts, scenarios, models**: These include the ability to perform linear forecasting, what-if scenario analysis, and analyze data using standard statistical tools.

Who Uses Business Intelligence and Business Analytics?

In previous chapters, we have described the different information constituencies in business firms—from senior managers to middle managers, analysts, and operational employees. This also holds true for BI and BA systems (see Figure 12-4). Over 80 percent of the audience for BI consists of casual users who rely largely on production reports. Senior executives tend use BI to monitor firm activities using visual interfaces like dashboards and scorecards. Middle managers and analysts are much more likely to be immersed in the data and software, entering queries and slicing and dicing the data along different

FIGURE 12-4 BUSINESS INTELLIGENCE USERS



Casual users are consumers of BI output, while intense power users are the producers of reports, new analyses, models, and forecasts.

dimensions. Operational employees will, along with customers and suppliers, be looking mostly at prepackaged reports.

Examples of Business Intelligence Applications

The most widely used output of a BI suite of tools are pre-packaged production reports. Table 12-5 illustrates some common pre-defined reports from Oracle's BI suite of tools.

Predictive Analytics

Predictive analytics, which we introduced in Chapter 6, are being built into mainstream applications for everyday decision making by all types of employees, especially in finance and marketing. For example, Capital One conducts more than 30,000 experiments each year using different interest rates, incentives, direct mail packaging, and other variables to identify the best potential customers for targeting its credit card offers. These people are most likely to sign up for credit cards and to pay back Capital One for the balances they ring up in their credit card accounts. Predictive analytics have also worked especially well in the credit card industry to identify customers who are at risk for leaving.

Dealer Services, which offers inventory financing for used-car dealers, is trying to use predictive analytics to screen potential customers. Thousands of used-car dealers, who were formerly franchisees for General Motors and Chrysler, are seeking financing from companies such as Dealer Services so that they can go into business on their own. Using WebFOCUS software from Information Builders, the company is building a model that will predict the best loan prospects and eliminate up to 10 of the 15 hours required to review a financing application. The model reviews data including dealer size and type, number of locations, payment patterns, histories of bounced checks, and inventory practices and is revalidated and updated as conditions change.

FedEx is using SAS Institute's Enterprise Miner and predictive analytic tools to develop models that predict how customers will respond to price changes and new services, which customers are most at risk of switching to competitors, and how much revenue will be generated by new storefront or drop-box locations. The accuracy rate of the predictive analysis system ranges from 65 to 90 percent. FedEx is now starting to use predictive analytics in call centers to help

TABLE 12-5 EXAMPLES OF BUSINESS INTELLIGENCE PRE-DEFINED PRODUCTION REPORTS

BUSINESS FUNCTIONAL AREA	PRODUCTION REPORTS
Sales	Forecast sales; sales team performance; cross selling; sales cycle times
Service/Call Center	Customer satisfaction; service cost; resolution rates; churn rates
Marketing	Campaign effectiveness; loyalty and attrition; market basket analysis
Procurement and Support	Direct and indirect spending; off-contract purchases; supplier performance
Supply Chain	Backlog; fulfillment status; order cycle time; bill of materials analysis
Financials	General ledger; accounts receivable and payable; cash flow; profitability
Human Resources	Employee productivity; compensation; workforce demographics; retention

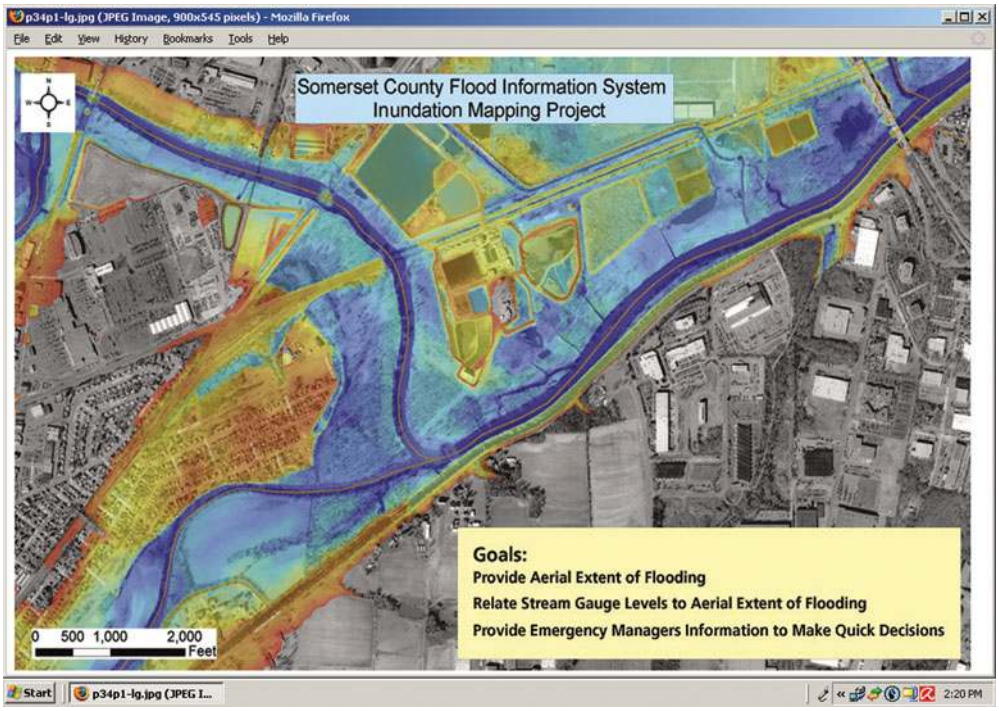
customer service representatives identify customers with the highest levels of dissatisfaction and take the necessary steps to make them happy.

Data Visualization and Geographic Information Systems

By presenting data in visual form, **data visualization** tools help users see patterns and relationships in large amounts of data that would be difficult to discern if the data were presented as traditional lists of text. For example, managers and employees of Day & Zimmermann, an industrial, defense, and workforce solutions provider, have detailed, real-time visibility into the company's inventory of contractors and workers through a set of dashboards populated with real-time data from a SAP ERP Human Capital Management system. The dashboards make it much easier to understand the organization's staffing levels than static paper reports. The real-time data indicate exactly what type of worker is available in what location and when a project is due to be completed. If a project is ahead of schedule, information from the dashboards helps decision makers rapidly determine when and where to reassign its workers.

Geographic information systems (GIS) help decision makers visualize problems requiring knowledge about the geographic distribution of people or other resources. Their software ties location data to points, lines, and areas on a map. Some GIS have modeling capabilities for changing the data and automatically revising business scenarios. GIS might be used to help state and local governments calculate response times to natural disasters and other emergencies or to help banks identify the best location for installing new branches or ATM terminals.

For example, Columbia, South Carolina-based First Citizens Bank uses GIS software from MapInfo to determine which markets to focus on for retaining customers and which to focus on for acquiring new customers. MapInfo also lets the bank drill down into details at the individual branch level and individualize



Somerset County, New Jersey, developed a GIS based on ESRI software to provide Web access to geospatial data about flood conditions. The system provides information that helps emergency responders and county residents prepare for floods and enables emergency managers to make decisions more quickly.

goals for each branch. Each branch is able to see whether the greatest revenue opportunities are from mining their database of existing customers or from finding new customers. With clearer branch segmentation and more focused service goals, the bank has moved from making cold sales calls to calls that are more service- and courtesy-oriented.

Business Intelligence in the Public Sector

Business intelligence systems are also used in the public sector. The Interactive Session on Organizations describes a school district's move to quantify and analyze student performance data to make better decisions about how to allocate resources to enhance student and teacher performance.

MANAGEMENT STRATEGIES FOR DEVELOPING BI AND BA CAPABILITIES

There are two different strategies for adopting BI and BA capabilities for the organization: one-stop integrated solutions versus multiple best-of-breed vendor solutions. The hardware firms (IBM, HP, and now Oracle, which owns Sun Microsystems) want to sell your firm integrated hardware/software solutions that tend to run only on their hardware (the totally integrated solution). It's called "one stop shopping." The software firms (SAP, SAS, and Microsoft) encourage firms to adopt the "best of breed" software and that runs on any machine they want. In this strategy, you adopt the best database and data warehouse solution, and select the best business intelligence and analytics package from whatever vendor you believe is best.

The first solution carries the risk that a single vendor provides your firm's total hardware and software solution, making your firm dependent on its pricing power. It also offers the advantage of dealing with a single vendor who can deliver on a global scale. The second solution offers greater flexibility and independence, but with the risk of potential difficulties integrating the software to the hardware platform, as well as to other software. Vendors always claim their software is "compatible" with other software, but the reality is that it can be very difficult to integrate software from different vendors. Microsoft in particular emphasizes building on its desktop interface and operating system (Windows), which are familiar to many users, and developing server applications that run on Microsoft local area networks. But data from hardware and software produced by different vendors will have to flow seamlessly into Microsoft workstations to make this strategy work. This may not be adequate for Fortune 500 firms needing a global networking solution.

Regardless of which strategy your firm adopts, all BI and BA systems lock the firm into a set of vendors and switching is very costly. Once you train thousands of employees across the world on using a particular set of tools, it is extremely difficult to switch. When you adopt these systems, you are in essence taking in a new partner.

The marketplace is very competitive and given to hyperbole. One BI vendor claims "[Our tools] bring together a portfolio of services, software, hardware and partner technologies to create business intelligence solutions. By connecting intelligence across your company, you gain a competitive advantage for creating new business opportunities." As a manager, you will have to critically evaluate such claims, understand exactly how these systems could improve your business, and determine whether the expenditures are worth the benefits.

INTERACTIVE SESSION: ORGANIZATIONS

DATA-DRIVEN SCHOOLS

As more and more reports suggest that American schoolchildren are falling behind those from other countries, improving our schools has become an increasingly urgent mission for the nation. Actually achieving that improvement is a difficult task. One approach gaining sway is more intensive use of information systems to measure educational performance at the individual and school district level and identify problem areas requiring additional resources and intervention.

The 139,000-student Montgomery County public school system in Rockville, Maryland, is at the forefront of the push for data-driven DSS in schools. Forty employees at the school district's Office of Shared Accountability generate reports on how many students take algebra in middle school or read below grade level. The district's Edline and M-Stat systems alert principals to individuals with patterns of failing so they can receive extra resources, such as after-school tutoring, study sessions, and special meetings with parents.

Earlier this decade, Montgomery County school superintendent Jerry Weast predicted that the increasing stratification between students in what he called the "green zone" (white and wealthy students) and students in the "red zone" (poor and minority students) would weigh down the school district as a whole. Having exhausted other options, administrators initiated a plan to create a data collection system for test scores, grades, and other data useful for identifying students with problems and speeding up interventions to improve their learning and educational performance.

Principals access and analyze student performance data to help make instructional decisions over the course of the year, as opposed to only when annual standardized test data arrives. This way, teachers can meet the needs of students who require additional instruction or other types of intervention before they fall behind. Test scores, grades, and other data are entered into the system in real time, and can be accessed in real time. In the past, school data were disorganized, and trends in individual student performance as well as overall student body performance were difficult to diagnose.

Kindergarten teachers are now able to monitor their students' success in reading words, noting which words each student struggles with on a handheld device like a Palm Pilot. The device calculates the accuracy with which the student reads each passage and, over time, provides information about what sorts of problems the student consistently encounters. Also, when students begin to deviate from their normal academic patterns, like getting a rash of poor grades, the system sends alerts to parents and school administrators. In many cases, this quicker response is enough to help the student reverse course before failing.

Many parents in Montgomery County have expressed concern that the new systems are an excessive and unnecessary expenditure. In the short term, President Obama's stimulus plan provides increased funding to schools over the next two years. Projects like these are likely to become more popular as it becomes clearer that a data-driven approach yields quantifiable results. But will they become the standard in American schools? The long-term sustainability of these systems is still unclear.

In Montgomery County, one of the primary goals of the implementation of data-driven systems was to close the achievement gap between white and minority students in the lower grades. Teachers and administrators would use different types of information organized by the DSS to identify gifted students earlier and challenge them with a more appropriate course load of more advanced placement (AP) classes. Data collected on each child would offer teachers insight into what methods worked best for each individual.

The results are very impressive. In Montgomery, 90 percent of kindergartners were able to read at the level required by standardized testing, with minimal differences among racial and socioeconomic groups. These numbers are up from 52 percent of African-Americans, 42 percent of Latinos, and 44 percent of low-income students just seven years ago. Also, the system has effectively identified students with abilities at an earlier age. The number of African-American students who passed at least one AP test at Montgomery has risen from 199 earlier this decade to 1,152 this year; the number of Latino students went from 218 to 1,336.

Some critics claim that the emphasis on closing the achievement gap between different student populations is shortchanging gifted students and those with disabilities. "Green zone" parents question whether their children are receiving enough attention

and resources with so much emphasis being placed on the improving the red zone. Green zone districts in Montgomery County receive $13,000 per student, compared with $15,000 in the red zone. Red zone classes have only 15 students in kindergarten and 17 in the first and second grates, compared with 25 and 26 in the green zone. School administrators counter that the system not only provides appropriate help for underperforming students, but also that it provides the additional challenges that are vital to a gifted child's development.

Other evidence suggests that the gains in reducing the achievement gap earlier in childhood erode as children get older. Among eighth graders in Montgomery County, approximately 90 percent of white and Asian eighth graders tested proficient or advanced in math on state tests, compared with only half of African-Americans and Hispanics. African-American and Hispanic SAT scores were over 300 points below those of whites and Asians. Still, the data-driven implementation has been responsible for some large improvements over past statistics. Some of the red zone schools have seen the most dramatic improvement in test scores and graduation rates.

In many ways, the data-driven systems build from the wealth of standardized testing information created by the No Child Left Behind Act passed during the Bush presidency. Some parents and educators complain about the amount and frequency of standardized testing, suggesting that children should be spending more time on projects and creative tasks. But viable alternative strategies to foster improvement in struggling school districts are difficult to develop.

It's not just students that are subject to this data-driven approach. Montgomery County teachers have been enrolled in a similar program that identifies struggling teachers and supplies data to help them improve. In many cases, contracts and tenure make it difficult to dismiss less-effective teachers. To try and solve this problem, teachers unions and administrators have teamed up to develop a peer review program that pairs underperforming teachers with a mentor who provides guidance and support.

After two years, teachers who fail to achieve results appear before a larger panel of teachers and principals that makes a decision regarding their potential termination or extension of another year of peer review. But teachers are rarely terminated in the program—instead, they're given tangible evidence of things they're doing well and things they can improve based on data that's been collected on their day-to-day performance, student achievement rates, and many other metrics.

Not all teachers have embraced the data-driven approach. The Montgomery Education Association, the county's main teachers' union, estimates that keeping a "running record" of student results on reading assessments and other testing adds about three to four hours to teachers' weekly workloads. According to Raymond Myrtle, principal of Highland Elementary in Silver Spring, "this is a lot of hard work. A lot of teachers don't want to do it. For those who don't like it we suggested they do something else." To date, 11 of 33 teachers at Highland have left the district or are teaching at other Montgomery schools.

Sources: www.montgomeryschoolsmd.org, accessed October 15, 2010; www.datadrivenclassroom.com, accessed October 15, 2010; John Hechinger, "Data-Driven Schools See Rising Scores," *The Wall Street Journal*, June 12, 2009; and Daniel de Vise, "Throwing a Lifeline to Struggling Teachers," *Washington Post*, June 29, 2009.

CASE STUDY QUESTIONS

1. Identify and describe the problem discussed in the case.
2. How do business intelligence systems provide a solution to this problem? What are the inputs and outputs of these systems?
3. What management, organization, and technology issues must be addressed by this solution?
4. How successful is this solution? Explain your answer.
5. Should all school districts use such a data-driven approach to education? Why or why not?

MIS IN ACTION

Explore the Web site of the Montgomery County, Maryland School District and then answer the following questions:

1. Select one of the district's elementary, middle, or high schools and describe the data available on that particular school. What kinds of decisions do these data support? How do these data help school officials improve educational performance?
2. Select one of the district's schools and then the School Survey Results. How do these surveys help decision makers improve educational quality?

12.3 Business Intelligence Constituencies

There are many different constituencies that make up a modern business firm. Earlier in this text and in this chapter we identified three levels of management: lower supervisory (operational) management, middle management, and senior management (vice president and above, including executive or "C level" management, e.g. chief executive officer, chief financial officers, and chief operational officer.) Each of these management groups has different responsibilities and different needs for information and business intelligence, with decisions becoming less structured among higher levels of management (review Figure 12-1).

DECISION SUPPORT FOR OPERATIONAL AND MIDDLE MANAGEMENT

Operational and middle management are generally charged with monitoring the performance of key aspects of the business, ranging from the down-time of machines on a factory floor, to the daily or even hourly sales at franchise food stores, to the daily traffic at a company's Web site. Most of the decisions they make are fairly structured. Management information systems (MIS) are typically used by middle managers to support this type of decision making, and their primary output is a set of routine production reports based on data extracted and summarized from the firm's underlying transaction processing systems (TPS). Increasingly, middle managers receive these reports online on the company portal, and are able to interactively query the data to find out why events are happening. To save even more analysis time, managers turn to exception reports, which highlight only exceptional conditions, such as when the sales quotas for a specific territory fall below an anticipated level or employees have exceeded their spending limits in a dental care plan. Table 12-6 provides some examples of MIS applications.

Support for Semistructured Decisions

Some managers are "super users" and keen business analysts who want to create their own reports, and use more sophisticated analytics and models to find patterns in data, to model alternative business scenarios, or to test specific

TABLE 12-6 EXAMPLES OF MIS APPLICATIONS

COMPANY	MIS APPLICATION
California Pizza Kitchen	Inventory Express application "remembers" each restaurant's ordering patterns and compares the amount of ingredients used per menu item to predefined portion measurements established by management. The system identifies restaurants with out-of-line portions and notifies their managers so that corrective actions will be taken.
PharMark	Extranet MIS identifies patients with drug-use patterns that place them at risk for adverse outcomes.
Black & Veatch	Intranet MIS tracks construction costs for various projects across the United States.
Taco Bell	Total Automation of Company Operations (TACO) system provides information on food, labor, and period-to-date costs for each restaurant.

hypotheses. Decision support systems (DSS) are the BI delivery platform for this category of users, with the ability to support semi-structured decision making.

DSS rely more heavily on modeling than MIS, using mathematical or analytical models to perform what-if or other kinds of analysis. "What-if" analysis, working forward from known or assumed conditions, allows the user to vary certain values to test results to predict outcomes if changes occur in those values. What happens if we raise product prices by 5 percent or increase the advertising budget by $1 million? **Sensitivity analysis** models ask what-if questions repeatedly to predict a range of outcomes when one or more variables are changed multiple times (see Figure 12-5). Backward sensitivity analysis helps decision makers with goal seeking: If I want to sell 1 million product units next year, how much must I reduce the price of the product?

Chapter 6 described multidimensional data analysis and OLAP as one of the key business intelligence technologies. Spreadsheets have a similar feature for multidimensional analysis called a **pivot table**, which manager "super users" and analysts employ to identify and understand patterns in business information that may be useful for semistructured decision making.

Figure 12-6 illustrates a Microsoft Excel pivot table that examines a large list of order transactions for a company selling online management training videos and books. It shows the relationship between two dimensions: the sales region and the source of contact (Web banner ad or e-mail) for each customer order. It answers the question: does the source of the customer make a difference in addition to region? The pivot table in this figure shows that most customers come from the West and that banner advertising produces most of the customers in all the regions.

One of the Hands-on MIS projects for this chapter asks you to use a pivot table to find answers to a number of other questions using the same list of transactions for the online training company as we used in this discussion. The complete Excel file for these transactions is available in MyMISLab. We have also added a Learning Track on creating pivot tables using Excel 2010.

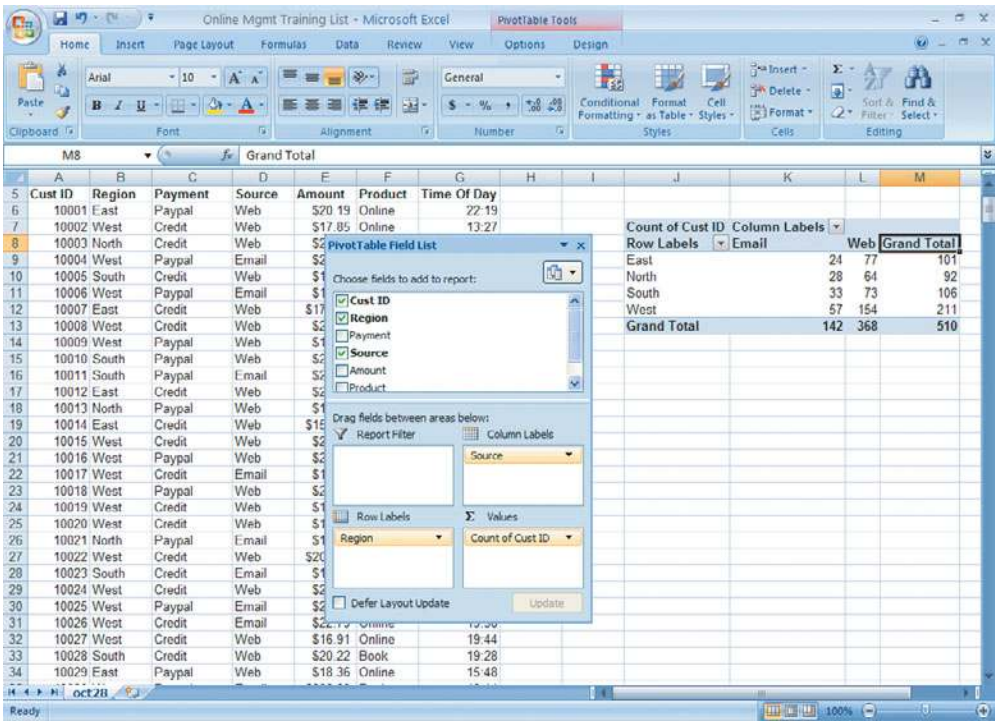
In the past, much of this modeling was done with spreadsheets and small stand-alone databases. Today these capabilities are incorporated into large

FIGURE 12-5 SENSITIVITY ANALYSIS

Total fixed costs	19000					
Variable cost per unit	3					
Average sales price	17					
Contribution margin	14					
Break-even point	1357					
		Variable Cost per Unit				
Sales Price	1357	2	3	4	5	6
	14	1583	1727	1900	2111	2375
	15	1462	1583	1727	1900	2111
	16	1357	1462	1583	1727	1900
	17	1267	1357	1462	1583	1727
	18	1188	1267	1357	1462	1583

This table displays the results of a sensitivity analysis of the effect of changing the sales price of a necktie and the cost per unit on the product's break-even point. It answers the question, "What happens to the break-even point if the sales price and the cost to make each unit increase or decrease?"

FIGURE 12-6 A PIVOT TABLE THAT EXAMINES CUSTOMER REGIONAL DISTRIBUTION AND ADVERTISING SOURCE



In this pivot table, we are able to examine where an online training company's customers come from in terms of region and advertising source.

enterprise BI systems where they are able to analyze data from large corporate databases. BI analytics include tools for intensive modeling, some of which we described earlier. Such capabilities help Progressive Insurance identify the best customers for its products. Using widely available insurance industry data, Progressive defines small groups of customers, or "cells," such as motorcycle riders aged 30 or above with college educations, credit scores over a certain level, and no accidents. For each "cell," Progressive performs a regression analysis to identify factors most closely correlated with the insurance losses that are typical for this group. It then sets prices for each cell, and uses simulation software to test whether this pricing arrangement will enable the company to make a profit. These analytic techniques, make it possible for Progressive to profitably insure customers in traditionally high-risk categories that other insurers would have rejected.

DECISION SUPPORT FOR SENIOR MANAGEMENT: BALANCED SCORECARD AND ENTERPRISE PERFORMANCE MANAGEMENT METHODS

The purpose of executive support systems (ESS), introduced in Chapter 2, is to help C-level executive managers focus on the really important performance information that affect the overall profitability and success of the firm. There are two parts to developing ESS. First, you will need a methodology for understanding exactly what is "the really important performance information" for a specific

firm that executives need, and second, you will need to develop systems capable of delivering this information to the right people in a timely fashion.

Currently, the leading methodology for understanding the really important information needed by a firm's executives is called the **balanced scorecard method** (Kaplan and Norton, 2004; Kaplan and Norton, 1992). The balanced score card is a framework for operationalizing a firm's strategic plan by focusing on measurable outcomes on four dimensions of firm performance: financial, business process, customer, and learning and growth (Figure 12-7). Performance on each dimension is measured using **key performance indicators (KPIs)**, which are the measures proposed by senior management for understanding how well the firm is performing along any given dimension. For instance, one key indicator of how well an online retail firm is meeting its customer performance objectives is the average length of time required to deliver a package to a consumer. If your firm is a bank, one KPI of business process performance is the length of time required to perform a basic function like creating a new customer account.

The balanced scorecard framework is thought to be "balanced" because it causes managers to focus on more than just financial performance. In this view, financial performance is past history—the result of past actions—and managers should focus on the things they are able to influence today, such as business process efficiency, customer satisfaction, and employee training. Once a scorecard is developed by consultants and senior executives, the next step is automating a flow of information to executives and other managers for each of the key performance indicators. There are literally hundreds of consulting and

FIGURE 12-7 THE BALANCED SCORECARD FRAMEWORK

In the balanced scorecard framework, the firm's strategic objectives are operationalized along four dimensions: financial, business process, customer, and learning and growth. Each dimension is measured using several KPIs.

software firms that offer these capabilities, which are described below. Once these systems are implemented, they are often referred to as ESS.

Another closely related popular management methodology is **business performance management (BPM)**. Originally defined by an industry group in 2004 (led by the same companies that sell enterprise and database systems like Oracle, SAP, and IBM), BPM attempts to systematically translate a firm's strategies (e.g., differentiation, low-cost producer, market share growth, and scope of operation) into operational targets. Once the strategies and targets are identified, a set of KPIs are developed that measure progress towards the targets. The firm's performance is then measured with information drawn from the firm's enterprise database systems. BPM uses the same ideas as balanced scorecard but with a stronger strategy flavor (BPM Working Group, 2004).

Corporate data for contemporary ESS are supplied by the firm's existing enterprise applications (enterprise resource planning, supply chain management, and customer relationship management). ESS also provide access to news services, financial market databases, economic information, and whatever other external data senior executives require. ESS also have significant **drill-down** capabilities if managers need more detailed views of data.

Well-designed ESS enhance management effectiveness by helping senior executives monitor organizational performance, track activities of competitors, recognize changing market conditions, and identify problems and opportunities. Immediate access to data increases executives' ability to monitor activities of lower units reporting to them. That very monitoring ability enables decision making to be decentralized and to take place at lower operating levels, increasing management's span of control.

Contemporary business intelligence and analytics technology has enabled a whole new style and culture of management called "information driven management" or "management by facts." Here, information is captured at the factory floor (or sales floor) level, and immediately entered into enterprise systems and databases, and then to corporate headquarters executive dashboards for analysis—not in a matter of months, days, weeks, but in hours and seconds. It's real time management. You can see real-time management at work in hundreds of corporations in 2010, and many more are building this new decision support environment. Valero provides a good example in the Interactive Session on Management.

GROUP DECISION-SUPPORT SYSTEMS (GDSS)

The DSS we have just described focus primarily on individual decision making. However, so much work is accomplished in groups within firms that a special category of systems called **group decision-support systems (GDSS)** has been developed to support group and organizational decision making.

A GDSS is an interactive computer-based system for facilitating the solution of unstructured problems by a set of decision makers working together as a group in the same location or in different locations. Collaboration systems and Web-based tools for videoconferencing and electronic meetings described earlier in this text support some group decision processes, but their focus is primarily on communication. GDSS, however, provide tools and technologies geared explicitly toward group decision making.

GDSS-guided meetings take place in conference rooms with special hardware and software tools to facilitate group decision making. The hardware includes computer and networking equipment, overhead projectors, and display screens. Special electronic meeting software collects, documents, ranks, edits,

INTERACTIVE SESSION: MANAGEMENT

PILOTING VALERO WITH REAL-TIME MANAGEMENT

If you haven't heard of Valero, don't worry. It's largely unknown to the public although investors recognize it as one of the largest oil refiners in the United States. Valero Energy is a top-fifty Fortune 500 company headquartered in San Antonio, Texas, with annual revenues of $70 billion. Valero owns 16 refineries in the United States, Canada, and Aruba that produce gasoline, distillates, jet fuel, asphalt, petrochemicals, and other refined products. The company also owns 10 ethanol plants located in the Midwest with a combined ethanol production capacity of about 1.1 billion gallons per year.

In 2008, Valero's chief operating officer (COO) called for the development of a Refining Dashboard that would display real-time data related to plant and equipment reliability, inventory management, safety, and energy consumption. Using a series of monitors on the walls of the headquarters operations center room, with a huge central monitor screen showing a live display of the company's Refining Dashboard, the COO and other plant managers can review the performance of the firm's 16 major refineries in the United States and Canada.

The COO and his team review the performance of each refinery in terms of how each plant is performing compared to the production plan of the firm. For any deviation from plan, up or down, the plant manager is expected to provide the group an explanation, and a description of corrective actions. The headquarters group can drill down from executive level to refinery level and individual system-operator level displays of performance.

Valero's Refining Dashboard is available on the Web to plant managers in remote locations. The data are refreshed every five minutes. The dashboard taps directly into the firm's SAP Manufacturing Integration and Intelligence application where each plant's history of production and current production data is stored. Valero's management estimates that the dashboards are saving $230 million per year at the 16 refineries where they are in use.

Valero's Refining Dashboard has been so successful that the firm is developing separate dashboards that show detailed statistics on power consumption for each unit of the firm, and each plant. Using the shared data, managers will be able to share best practices with one another, and make changes in equipment to reduce energy consumption while maintaining production targets. The dashboard system has the unintended consequence of helping managers learn more about how their company actually operates, and how to improve it.

But how much do Valero's executive dashboards really make a difference? One of the dangers of real time management is not measuring the right things. Dashboards that display information unrelated to the firm's strategic goals might be largely irrelevant, although pretty to look at. Valero's goals and measures of performance were inspired by Solomon benchmark performance studies used in the oil and gas industry. How helpful were they?

Valero's stock price fell from a high of $80 in June 2008, to about $20 in November 2010. As it turns out, Valero's profits are not strongly related to small changes in its refining efficiency. Instead, its profitability is largely determined by the spread between the price of refined products and the price of crude oil, referred to as the "refined product margin." The global economic slowdown beginning in 2008 and extending through 2010 weakened demand for refined petroleum products, which put pressure on refined product margins throughout 2009 and 2010. This reduced demand, combined with increased inventory levels, caused a significant decline in diesel and jet fuel profit margins.

The price of crude and aggregate petroleum demand are largely beyond the control of Valero management. The cost of refining crude varies within a very narrow range over time, and there are no technological breakthroughs expected in refining technology. Although Valero's dashboard focuses on one of the things management can control within a narrow range (namely refining costs), the dashboard does not display a number of strategic factors beyond its control, which nevertheless powerfully impact company performance. Bottom line: a powerful dashboard system does not turn an unprofitable operation into a profitable one.

Another limitation of real-time management is that it is most appropriate for process industries such as oil refining where the process is relatively unchanging, well known and understood, and central to the revenues of a firm. Dashboard systems say nothing about innovation in products, marketing, sales, or any other area of the firm where innovation is important. Apple Corporation did not invent the

Apple iPhone using a performance dashboard, although it might have such a dashboard today to monitor iPhone manufacturing and sales. Managers have to be sensitive to, and reflect upon, all the factors that shape the success of their business even if they are not reflected in the firm's dashboards.

Sources: Chris Kahn, "Valero Energy Posts 3Q Profit, Reverses Loss," *Business Week*, October 26, 2010; Valero Energy Corporation, Form 10K Annual Report for the fiscal year ended December 31, 2009, filed with the Securities and Exchange Commission, February 28, 2010; and Doug Henderson, "Execs Want Focus on Goals, Not Just Metrics," *InformationWeek*, Novemvber 13, 2009.

CASE STUDY QUESTIONS

1. What management, organization, and technology issues had to be addressed when developing Valero's dashboard?
2. What measures of performance do the dashboards display? Give examples of several management decisions that would benefit from the information provided by Valero's dashboards.
3. What kinds of information systems are required by Valero to maintain and operate its refining dashboard?
4. How effective are Valero's dashboards in helping management pilot the company? Explain your answer.
5. Should Valero develop a dashboard to measure the many factors in its environment that it does not control? Why or why not?

MIS IN ACTION

1. Visit Valero.com and click on its annual report in the Investor Relations section. On page 2 of the annual report you will find Valero's corporate vision statement. Read its corporate vision statement of strategic objectives (especially vision statement #2). Based on the firm's vision, what other corporate dashboards might be appropriate for senior management?
2. Read the annual report and develop a list of factors mentioned in the report that explain the company's poor performance over the last two years. Devise a method for measuring these profitability factors, and then using electronic presentation software create a corporate profitability dashboard for senior managers.

and stores the ideas offered in a decision-making meeting. The more elaborate GDSS use a professional facilitator and support staff. The facilitator selects the software tools and helps organize and run the meeting.

A sophisticated GDSS provides each attendee with a dedicated desktop computer under that person's individual control. No one will be able to see what individuals do on their computers until those participants are ready to share information. Their input is transmitted over a network to a central server that stores information generated by the meeting and makes it available to all on the meeting network. Data can also be projected on a large screen in the meeting room.

GDSS make it possible to increase meeting size while at the same time increasing productivity because individuals contribute simultaneously rather than one at a time. A GDSS promotes a collaborative atmosphere by guaranteeing contributors' anonymity so that attendees focus on evaluating the ideas themselves without fear of personally being criticized or of having their ideas rejected based on the contributor. GDSS software tools follow structured methods for organizing and evaluating ideas and for preserving the results of meetings, enabling nonattendees to locate needed information after the meeting. GDSS effectiveness depends on the nature of the problem and the group and on how well a meeting is planned and conducted.

12.4 Hands-on MIS Projects

The projects in this section give you hands-on experience analyzing opportunities for DSS, using a spreadsheet pivot table to analyze sales data, and using online retirement planning tools for financial planning.

Management Decision Problems

1. Applebee's is the largest casual dining chain in the world, with 1,970 locations throughout the United States and nearly 20 other countries worldwide. The menu features beef, chicken, and pork items, as well as burgers, pasta, and seafood. The Applebee's CEO wants to make the restaurant more profitable by developing menus that are tastier and contain more items that customers want and are willing to pay for despite rising costs for gasoline and agricultural products. How might information systems help management implement this strategy? What pieces of data would Applebee's need to collect? What kinds of reports would be useful to help management make decisions on how to improve menus and profitability?
2. During the 1990s, the Canadian Pacific Railway used a tonnage-based operating model in which freight trains ran only when there was sufficient traffic to justify the expense. This model focused on minimizing the total number of freight trains in service and maximizing the size of each train. However, it did not necessarily use crews, locomotives, and equipment efficiently, and it resulted in inconsistent transit times and delivery schedules. Canadian Pacific and other railroads were losing business to trucking firms, which offered more flexible deliveries that could be scheduled at the times most convenient for customers. How could a DSS help Canadian Pacific and other railroads compete with trucking firms more effectively?

Improving Decision Making: Using Pivot Tables to Analyze Sales Data

Software skills: Pivot tables
Business skills: Analyzing sales data

This project gives you an opportunity to learn how to use Excel's PivotTable functionality to analyze a database or data list.

Use the data list for Online Management Training Inc. (OMT) described earlier in the chapter. This is a list of the sales transactions at OMT for one day. You can find this spreadsheet file MyMISLab.

Use Excel's PivotTable to help you answer the following questions:

- Where are the average purchases higher? The answer might tell managers where to focus marketing and sales resources, or pitch different messages to different regions.
- What form of payment is the most common? The answer might be used to emphasize in advertising the most preferred means of payment.
- Are there any times of day when purchases are most common? Do people buy products while at work (likely during the day) or at home (likely in the evening)?
- What's the relationship between region, type of product purchased, and average sales price?

Improving Decision Making: Using a Web-Based DSS for Retirement Planning

Software skills: Internet-based software
Business skills: Financial planning

This project will help develop your skills in using Web-based DSS for financial planning.

The Web sites for CNN Money and MSN Money Magazine feature Web-based DSS for financial planning and decision making. Select either site to plan for retirement. Use your chosen site to determine how much you need to save to have enough income for your retirement. Assume that you are 50 years old and plan to retire in 16 years. You have one dependant and $100,000 in savings. Your current annual income is $85,000. Your goal is to be able to generate an annual retirement income of $60,000, including Social Security benefit payments.

- To calculate your estimated Social Security benefit, search for and use the Quick Calculator at the Social Security Administration Web site.
- Use the Web site you have selected to determine how much money you need to save to help you achieve your retirement goal.
- Critique the site—its ease of use, its clarity, the value of any conclusions reached, and the extent to which the site helps investors understand their financial needs and the financial markets.

Learning Track Module

The following Learning Track provides content relevant to topics covered in this chapter:

1. Building and Using Pivot Tables

Review Summary

1. *What are the different types of decisions and how does the decision-making process work?*

   The different levels in an organization (strategic, management, operational) have different decision-making requirements. Decisions can be structured, semistructured, or unstructured, with structured decisions clustering at the operational level of the organization and unstructured decisions at the strategic level. Decision making can be performed by individuals or groups and includes employees as well as operational, middle, and senior managers. There are four stages in decision making: intelligence, design, choice, and implementation. Systems to support decision making do not always produce better manager and employee decisions that improve firm performance because of problems with information quality, management filters, and organizational culture.

2. *How do information systems support the activities of managers and management decision making?*

   Early classical models of managerial activities stress the functions of planning, organizing, coordinating, deciding, and controlling. Contemporary research looking at the actual behavior of managers has found that managers' real activities are highly fragmented, variegated, and brief in duration and that managers shy away from making grand, sweeping policy decisions.

Information technology provides new tools for managers to carry out both their traditional and newer roles, enabling them to monitor, plan, and forecast with more precision and speed than ever before and to respond more rapidly to the changing business environment. Information systems have been most helpful to managers by providing support for their roles in disseminating information, providing liaisons between organizational levels, and allocating resources. However, information systems are less successful at supporting unstructured decisions. Where information systems are useful, information quality, management filters, and organizational culture can degrade decision-making.

3. *How do business intelligence and business analytics support decision making?*

   Business intelligence and analytics promise to deliver correct, nearly real-time information to decision makers, and the analytic tools help them quickly understand the information and take action. A business intelligence environment consists of data from the business environment, the BI infrastructure, a BA toolset, managerial users and methods, a BI delivery platform (MIS, DSS, or ESS), and the user interface. There are six analytic functionalities that BI systems deliver to achieve these ends: pre-defined production reports, parameterized reports, dashboards and scorecards, ad hoc queries and searches, the ability to drill down to detailed views of data, and the ability to model scenarios and create forecasts.

4. *How do different decision-making constituencies in an organization use business intelligence?*

   Operational and middle management are generally charged with monitoring the performance of their firm. Most of the decisions they make are fairly structured. Management information systems (MIS) producing routine production reports are typically used to support this type of decision making. For making unstructured decisions, middle managers and analysts will use decision-support systems (DSS) with powerful analytics and modeling tools, including spreadsheets and pivot tables. Senior executives making unstructured decisions use dashboards and visual interfaces displaying key performance information affecting the overall profitability, success, and strategy of the firm. The balanced scorecard and business performance management are two methodologies used in designing executive support systems (ESS).

5. *What is the role of information systems in helping people working in a group make decisions more efficiently?*

   Group decision-support systems (GDSS) help people working together in a group arrive at decisions more efficiently. GDSS feature special conference room facilities where participants contribute their ideas using networked computers and software tools for organizing ideas, gathering information, making and setting priorities, and documenting meeting sessions.

Key Terms

Balanced scorecard method, 474
Behavioral models, 458
Business performance management (BPM), 475
Choice, 458
Classical model of management, 458
Data visualization, 467
Decisional role, 459
Design, 458
Drill down, 475
Geographic information systems (GIS), 467
Group decision-support systems (GDSS), 475
Implementation, 458
Informational role, 459
Intelligence, 458
Interpersonal role, 459
Key performance indicators (KPIs), 474
Managerial roles, 454
Pivot table, 472
Sensitivity analysis, 472
Semistructured decisions, 456
Structured decisions, 456
Unstructured decisions, 456

Review Questions

1. What are the different types of decisions and how does the decision-making process work?
   - List and describe the different levels of decision making and decision-making constituencies in organizations. Explain how their decision-making requirements differ.
   - Distinguish between an unstructured, semistructured, and structured decision.
   - List and describe the stages in decision making.
2. How do information systems support the activities of managers and management decision making?
   - Compare the descriptions of managerial behavior in the classical and behavioral models.
   - Identify the specific managerial roles that can be supported by information systems.
3. How do business intelligence and business analytics support decision making?
   - Define and describe business intelligence and business analytics.
   - List and describe the elements of a business intelligence environment.
   - List and describe the analytic functionalities provided by BI systems.
   - Compare two different management strategies for developing BI and BA capabilities.
4. How do different decision-making constituencies in an organization use business intelligence?
   - List each of the major decision-making constituencies in an organization and describe the types of decisions each makes.
   - Describe how MIS, DSS, or ESS provide decision support for each of these groups.
   - Define and describe the balanced scorecard method and business performance management.
5. What is the role of information systems in helping people working in a group make decisions more efficiently?
   - Define a group decision-support system (GDSS) and explain how it differs from a DSS.
   - Explain how a GDSS works and how it provides value for a business.

Discussion Questions

1. As a manager or user of information systems, what would you need to know to participate in the design and use of a DSS or an ESS? Why?
2. If businesses used DSS, GDSS, and ESS more widely, would managers and employees make better decisions? Why or why not?
3. How much can business intelligence and business analytics help companies refine their business strategy? Explain your answer.

Video Cases

Video Cases and Instructional Videos illustrating some of the concepts in this chapter are available. Contact your instructor to access these videos.

Collaboration and Teamwork: Designing a University GDSS

With three or four of your classmates, identify several groups in your university that might benefit from a GDSS. Design a GDSS for one of those groups, describing its hardware, software, and people elements. If possible, use Google Sites to post links to Web pages, team communication announcements, and work assignments; to brainstorm; and to work collaboratively on project documents. Try to use Google Docs to develop a presentation of your findings for the class.

Does CompStat Reduce Crime?

CASE STUDY

CompStat (short for COMPuter STATistics or COMParative STATistics) originated in the New York City Police Department (NYPD) in 1994 when William Bratton was police commissioner. CompStat is a comprehensive, city-wide database that records all reported crimes or complaints, arrests, and summonses issued in each of the city's 76 precincts. City officials had previously believed that crime could not be prevented by better information and analytical tools but instead by using more foot patrols in neighborhoods along with the concept of "community policing" in which efforts were made to strengthen the involvement of community groups. In contrast, Bratton and Rudy Giuliani, then the mayor of New York City, believed that police could be more effective in reducing crime if operational decisions took place at the precinct level and if decision makers had better information. Precinct commanders were in a better position than police headquarters to understand the specific needs of the communities they served and to direct the work of the 200 to 400 police officers they managed. CompStat gave precinct commanders more authority and responsibility, but also more accountability.

At weekly meetings, representatives from each of the NYPD's precincts, service areas, and transit districts are put on the "hot seat" at police headquarters and required to provide a statistical summary of the week's crime complaint, arrest, and summons activity, as well as significant cases, crime patterns, and police activities. Commanders must explain what has been done to reduce crime in the districts under their command, and if crime has gone up, they must explain why. Commanders are held directly accountable for reducing crime in their area of command. In the past, they were evaluated primarily on the basis of their administrative skills, such as staying within budget and deploying resources efficiently.

The data these commanders provide, including specific times and locations of crimes and enforcement activities, are forwarded to the NYPD's CompStat Unit where they are loaded into a city-wide database. The system analyzes the data and produces a weekly CompStat report on crime complaint and arrest activity at the precinct, patrol borough, and city wide levels. The data are summarized by week, prior 30 days, and year-to-date for comparison with the previous year's activity and for establishing trends. The CompStat Unit also issues weekly commander profile reports to measure the performance of precinct commanders.

The weekly commander profile reports include information on the commander's date of appointment, years in rank, education and specialized training, most recent performance evaluation rating, the units that person previously commanded, the amount of overtime generated by police under that commander, absence rates, community demographics, and civilian complaints.

Using MapInfo geographic information system (GIS) software, the CompStat data can be displayed on maps showing crime and arrest locations, crime "hot spots," and other relevant information. Comparative charts, tables, and graphs can also be projected simultaneously. These visual presentations help precinct commanders and members of the NYPD's executive staff to quickly identify patterns and trends. Depending on the intelligence gleaned from the system, police chiefs and captains develop a targeted strategy for fighting crime, such as dispatching more foot patrols to high-crime neighborhoods, or issuing warnings to the public when a particular model of vehicle is susceptible to theft.

During Bratton's 27-month tenure, serious crime in New York dropped by 25 percent and homicides went down by 44 percent. Crime in New York City has dropped by 69 percent in the last 12 years. Skeptics do not believe that CompStat was responsible for these results. They point to the decline in the number of young, poor men, an improved economy, programs that reduced welfare rolls while giving poor people access to better housing, increasing the size of the NYC police force, and giving precinct commanders more decision-making responsibility and accountability.

Nevertheless, Bratton, convinced that CompStat was the catalyst for New York's drop in crime, implemented the system in Los Angeles to further prove its worth. Since the introduction of CompStat, combined violent and property crimes in Los Angeles dropped for six consecutive years. Yet the ratio of police officers to residents is only half that of New York and Chicago. CompStat has

also been adopted in Philadelphia, Austin, San Francisco, Baltimore, and Vancouver, British Columbia.

Skeptics point out that crime has fallen in all urban areas in the United States since 1990 regardless of whether the cities used CompStat. In fact, a critical study of CompStat by the Police Foundation found that CompStat encouraged police to be only reactive rather than pro-active in fighting crime. Sending police to where crime has become a problem is, in other words, too late. CompStat encouraged what the Police Foundation called "whack-a-mole" theory of policing, similar to the game played in amusement parks. Rather than change police departments into nimble crime fighters, the Foundation found that a database had been attached to traditional organizations, which themselves remained unchanged.

Because of the emphasis placed on reducing crime and because of the newfound importance of crime statistics to officers' careers, CompStat has created pressure on some precinct commanders to manipulate crime statistics to produce favorable results. Officers must continue to improve their crime statistics, despite shrinking budgets and dwindling numbers of officers. A study conducted in 2009 via a questionnaire given to 1,200 retired police captains and more senior officers concluded that nearly a third of respondents were aware of unethical manipulation of crime data.

More than 100 survey respondents said that intense pressure to produce annual crime reductions led some supervisors and precinct commanders to manipulate crime statistics. For example, officers were known to check catalogs, eBay, and other sites for items similar to those reported stolen, looking for lower prices they could use to reduce the values of the stolen goods for record-keeping purposes. Grand larceny, a felony, is considered to be theft of goods valued at $1,000 or more, whereas theft of goods valued at less than $1,000 is only a misdemeanor. Using this method, precincts could reduce the number of felony thefts, considered an "index crime" and tracked by CompStat. Surveys and anecdotal evidence also indicated a lack of receptiveness on the part of police in some areas, possibly motivated by a desire to reduce the number of crime incidents reported.

Some survey respondents stated that precinct commanders or aides dispatched to crime scenes sometimes tried to persuade victims not to file complaints or urged them to change their accounts of what happened in ways that could downgrade offenses to lesser crimes.

Previous studies of CompStat encountered an unwillingness by the NYPD to disclose their data reporting methods. A professor performing a study that ultimately praised CompStat's influence on crime in New York City was given full access to NYPD crime data, but the NYPD did not cooperate with the Commission to Combat Police Corruption (CCPC), an independent board that monitors police corruption. The commission sought subpoena power to demand the NYPD turn over its data and data collection procedures to uncover potential wrong doing by the police. Unfortunately, the commission was denied access to this data after strong police department opposition.

On the other hand, versions of CompStat have been adopted by hundreds of other police departments across the United States, and the CompStat approach has been credited with improving police work in many cities. In New York City itself, much of the public believes that crime is down, and that the city has become a safer and more pleasant place to live.

Sources: William K. Rashbaum, "Retired Officers Raise Questions on Crime Data," *The New York Times,* February 6, 2010; A.G. Sulzberger and Karen Zraick, "Forget Police Data, New Yorkers Rely on Own Eyes, *The New York Times*, February 7, 2010; Luis Garicano, "How Does Information Technology Help Police Reduce Crime?" TNIT Newsletter 3 (December, 2009); and New York City Police Department, "COMPSTAT Process," www.nyc.gov/html/nypd/html, accessed October 9, 2006.

CASE STUDY QUESTIONS

1. What management, organization, and technology factors make CompStat effective?
2. Can police departments effectively combat crime without the CompStat system? Is community policing incompatible with CompStat? Explain your answer.
3. Why would officers misreport certain data to CompStat? What should be done about the misreporting of data? How can it be detected?