CHAPTER OUTLINE

5.1 Managers and Decision Making
5.2 What Is Business Intelligence?
5.3 Business Intelligence Applications for Data Analysis
5.4 Business Intelligence Applications for Presenting Results
5.5 Business Intelligence in Action: Corporate Performance Management

LEARNING OBJECTIVES >>>

1. Explain different ways in which IT supports managerial decision making.
2. Provide examples of different ways that organizations make use of BI.
3. Explain the value that different BI applications provide to large and small businesses.
4. Offer examples of how businesses and government agencies can use different BI applications to analyze data.
5. Explain how your university could use CPM to effect solutions to two campus problems.
If you were in the business of supplying heating oil in the northeastern United States, would it be useful to know if a big winter snowstorm was likely to arrive with subzero temperatures in Massachusetts the following month? If you were a firefighter in the backcountry of California and knew that the odds of intense Santa Anna winds would increase dramatically in 3 weeks, how would you react? If you were a Home Depot manager, wouldn't you want to have snow shovels in stock if there was going to be a large snowstorm? If you worked in the Federal Emergency Management Agency, would you want to get a 30-day advance warning of the next hurricane?

Although there is widespread use of satellite imaging and computer modeling in the field of meteorology, the founders of EarthRisk Technologies (www.earthrisktech.com), a 2010 startup, say it is still nearly impossible to use current weather forecasting models to make anything more than the most general predictions about weather more than 2 weeks away.

EarthRisk has implemented weather forecasting software to estimate the likelihood of extreme weather events 30 to 40 days in advance. The founders emphasize that EarthRisk provides information that helps its clients make decisions of value. EarthRisk draws on 60 years of weather data to identify conditions that could lead to big temperature swings weeks later. The weather events that precede a hot or cold stretch are like dominoes toppling in sequence. The company's software predicts the probability of each domino falling over and sells that information to energy companies that want to lock in fuel prices before periods of peak demand.

EarthRisk's next project is to detect Atlantic hurricanes days in advance by analyzing conditions such as ocean temperatures, sea level pressures, and vertical wind shear.

As Ruben and Lisa prepare to reopen Ruby's Club for business, they need to establish some measurements to help them stay on track. They have a goal of a $300,000 net profit for their first year after their grand "reopening." This is an increase from $150,000 the previous year. To achieve this, they have to deal with one of the biggest problems they face—shrinkage.

Shrinkage occurs when a bartender pours someone a little more alcohol than the drink recipe calls for, gives someone a free drink, or accidentally spills some alcohol on the floor. The result is that a bottle of alcohol that (for example) should provide enough alcohol to make 40 drinks only actually brings in money for 30 drinks. This shrinkage may not seem like much, but on a large scale (including food items) it can make a huge difference.

What Ruben and Lisa need is data and decision support. This chapter refers to this as business intelligence. They need to know how to set and measure monthly and weekly goals to know whether or not they are on track to make their overall goal of $300,000 net profit when they reopen.
Introduction

Business intelligence (BI) is a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions. BI applications enable decision makers to quickly ascertain the status of a business enterprise by examining key information. Managers need current, timely, and accurate information that their current systems often cannot provide. Implementing BI applications can generate significant benefits throughout a company, supporting important decisions about the firm’s overall business goals.

Consider these examples:

- The low-budget Oakland A’s of major-league baseball analyzed data to develop new statistics to discover undervalued players. The team’s analysis was described in a 2003 book by Michael Lewis, Moneyball, which was made into a 2011 movie starring Brad Pitt.
- Retailers such as Walmart and Kohl’s analyze sales, pricing, and economic, demographic, and weather data to tailor product selections at particular stores and determining the timing of price markdowns.
- Shipping companies, such as UPS, analyze data on truck delivery times and traffic patterns to fine-tune routing.
- Online dating services, such as Match.com, constantly analyze their Web listings of personal characteristics, reactions, and communications to improve their algorithms for matching individuals on dates.

This chapter describes information systems that support decision making. We begin by reviewing the manager’s job and the nature of modern managerial decisions. This discussion will help you to understand why managers need computerized support. You then learn about the concepts of business intelligence for supporting individuals, groups, and entire organizations.

It is impossible to overstate the importance of BI to you. Recall from Chapter 1 that the essential goal of information systems is to provide the right information to the right person in the right amount at the right time in the right format. In essence, BI achieves this goal. BI systems provide business intelligence that you can act on in a timely fashion.

It is also impossible to overstate the importance of your input into the BI process within an organization, for several reasons. First, you (the user community) will decide what data should be stored in your organization’s data warehouse. You will then work closely with the MIS department to obtain these data.

Going further, you will use your organization’s BI applications, probably from your first day on the job. With some BI applications, such as data mining and decision support systems, you will decide how you want to analyze the data (user-driven analysis). With other BI applications such as dashboards, you will decide which data you want to see and in which format. Again, you will work closely with your MIS department to ensure that the dashboard meets your needs.

Questions

1. What impact will EarthRisk have on the business model of The Weather Channel? If you were a Weather Channel executive, what would you do to counter the threat of EarthRisk?
2. Provide examples of other organizations to whom long-range weather forecasts would be valuable.

Much of this chapter is concerned with large-scale BI applications. However, you should keep in mind that smaller organizations, and even individual users, can implement small-scale BI applications as well. For example, Excel spreadsheets provide some BI functions, as do SQL queries of a database.

The most popular BI tool by far is Excel. For years, BI vendors “fought” against the use of Excel. Eventually, however, they decided to “join it” by designing their software so that it interfaces with Excel. How does this process work? Essentially, users download plug-ins that add functionality (e.g., the ability to list the top 10 percent of customers, based on sales) to Excel (or any of the Microsoft Office products). This process can be thought of as creating “Excel on steroids.” Excel then connects to the vendor’s application server—which provides additional data-analysis capabilities—which in turn connects to a back-end database, such as a data mart or warehouse. This arrangement gives Excel users the functionality and access to data that are typical of sophisticated BI products, while allowing users to work with a familiar client: Excel.

Microsoft has made similar changes to its product line. In particular, Excel can now be used with MS SQL Server (a database product), and it can be utilized in advanced BI applications, such as dashboards and data mining/predictive analysis.

After you finish this chapter, you will have a basic understanding of decision making, the business intelligence process, and BI applications in organizations today. This knowledge will enable you to immediately and confidently provide input into your organization’s BI processes and applications. Further, the hands-on exercises in this chapter will familiarize you with the actual use of BI software. These exercises will enable you to use your organization’s BI applications to effectively analyze data and thus make better decisions. Enjoy!

5.1 Managers and Decision Making

Management is a process by which an organization achieves its goals through the use of resources (people, money, materials, and information). These resources are considered to be inputs. Achieving the organization’s goals is the output of the process. Managers oversee this process in an attempt to optimize it. A manager’s success is often measured by the ratio between inputs and outputs for which he or she is responsible. This ratio is an indication of the organization’s productivity.

The Manager’s Job and Decision Making

To appreciate how information systems support managers, you must first understand the manager’s job. Managers do many things, depending on their position in the organization, the type and size of the organization, the organization’s policies and culture, and the personalities of the managers themselves. Despite these variations, however, all managers perform three basic roles:

1. **Interpersonal roles:** figurehead, leader, liaison
2. **Informational roles:** monitor, disseminator, spokesperson, analyzer
3. **Decisional roles:** entrepreneur, disturbance handler, resource allocator, negotiator

Early information systems primarily supported the informational roles. In recent years, information systems have been developed that support all three roles. In this chapter, you will focus on the support that IT can provide for decisional roles.

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A decision refers to a choice among two or more alternatives that individuals and groups make. Decisions are diverse and are made continuously. Decision making is a systematic process. Economist Herbert Simon described decision making as composed of three major phases: intelligence, design, and choice. Once the choice is made, the decision is implemented. Figure 5.1 illustrates this process, indicating which tasks are included in each phase. Note that there is a continuous flow of information from intelligence to design to choice (bold lines), but at any phase there may be a return to a previous phase (broken lines).

This model of decision making is quite general. Undoubtedly, you have made decisions where you did not construct a model of the situation, validate your model with test data, or conduct a sensitivity analysis. The model we present here is intended to encompass all of the conditions that might occur when making a decision. For some decisions, some steps or phrases may be minimal, implicit (understood), or absent.

The decision-making process starts with the intelligence phase, in which managers examine a situation and identify and define the problem or opportunity. In the design phase, decision makers construct a model for the situation. They do this by making assumptions that simplify reality and by expressing the relationships among all the relevant variables. Managers then validate the model by using test data. Finally, decision makers set criteria for evaluating all of the potential solutions that are proposed. The choice phase involves selecting a solution or course of action that seems best suited to resolve the problem. This solution (the decision) is then implemented. Implementation is successful if the proposed solution solves the problem or seizes the opportunity. If the solution fails, then the process returns to the previous phases. Computer-based decision support assists managers in the decision-making process.

Figure 5.1 The process and phases of decision making.

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Why Managers Need IT Support

Making good decisions is very difficult without solid information. Information is vital for each phase and activity in the decision-making process. Even when information is available, however, decision making is difficult because of the following trends:

- The number of alternatives is constantly increasing from innovations in technology, improved communications, the development of global markets, and the use of the Internet and e-business. A key to good decision making is to explore and compare many relevant alternatives. The more alternatives that exist, the more a decision maker needs computer-assisted searches and comparisons.
- Most decisions must be made under time pressure. It is often not possible to process information manually fast enough to be effective.
- Because of increased uncertainty in the decision environment, decisions are becoming more complex. It is usually necessary to conduct a sophisticated analysis in order to make a good decision.
- It is often necessary to rapidly access remote information, consult with experts, or conduct a group decision-making session, all without incurring large expenses. Decision makers can be situated in different locations, as can the information. Bringing them all together quickly and inexpensively can be a major challenge.

These trends create major difficulties for decision makers. Fortunately, as you will see throughout this chapter, a computerized analysis can be of enormous help.

What Information Technologies Are Available to Support Managers?

In addition to discovery, communication, and collaboration tools (Chapter 4) that provide indirect support to decision making, several other information technologies have been successfully used to support managers. As noted, these technologies are collectively referred to as business intelligence (BI). BI is closely linked to data warehousing, which provides the data needed for BI. You will now learn about additional aspects of decision making to place our discussion of BI in context. You will first look at the different types of decisions that managers face.

A Framework for Computerized Decision Analysis

To better understand BI, you will note that various types of decisions can be placed along two major dimensions: problem structure and the nature of the decision. Figure 5.2 provides an overview of decision making along these two dimensions.

Problem Structure. The first dimension of decision making is problem structure, where decision-making processes fall along a continuum ranging from highly structured to highly unstructured (see the left column in Figure 5.2). Structured decisions refer to routine and repetitive problems for which standard solutions exist, such as inventory control. In a structured problem, the first three phases of the decision process—intelligence, design, and choice—are laid out in a particular sequence, and the procedures for obtaining the best (or at least a good enough) solution are known. Two basic criteria that are used to evaluate proposed solutions are minimizing costs and maximizing profits. These types of decisions are candidates for decision automation.

At the other extreme of problem complexity are unstructured decisions. These are “fuzzy” complex problems for which there are no cut-and-dried solutions. An unstructured problem is one in which there is no standardized procedure for carrying out any of the three phases. In such a problem, human intuition and judgment often play an important role in making the decision. Typical unstructured problems include planning new service offerings, hiring an executive, and choosing a set of research and development (R&D) projects.
for the coming year. Although BI cannot make unstructured decisions, it can provide information that assists decision makers.

Located between structured and unstructured problems are semistructured problems, in which only some of the decision process phases are structured. Semistructured problems require a combination of standard solution procedures and individual judgment. Examples of semistructured problems are evaluating employees, setting marketing budgets for consumer products, performing capital acquisition analysis, and trading bonds.

**The Nature of Decisions.** The second dimension of decision support deals with the nature of decisions. All managerial decisions fall into one of three broad categories:

1. **Operational control:** executing specific tasks efficiently and effectively
2. **Management control:** acquiring and using resources efficiently in accomplishing organizational goals
3. **Strategic planning:** the long-range goals and policies for growth and resource allocation

These categories are displayed along the top row of **Figure 5.2**.

**Note:** Strategic decisions define the context in which management control decisions are made. In turn, management control decisions define the context in which operational control decisions are made.

**The Decision Matrix.** The decision matrix. The three primary classes of decision types and the three broad categories of the nature of decisions can be combined in a decision-support matrix that consists of nine cells, as diagrammed in **Figure 5.2**. Lower-level managers perform tasks in cells 1 and 4, but not 7 because operational managers are not expected to make strategic decisions. The tasks in cells 2, 5, and 8 are usually the responsibility of middle-managers and professional staff. Finally, the tasks in cells 6 and 9 are generally carried out by senior executives while cell 3 is empty because senior executives are not involved in day-to-day operational tasks.

**Computer Support for Structured Decisions.** Examples of computer support that might be used for the nine cells in the matrix are displayed in the right-hand column of **Figure 5.2**. Structured and some semistructured decisions, especially of the operational and management control type, have been supported by computers since the 1950s. Decisions of this type are made in all functional areas, but particularly in finance and operations management.

<table>
<thead>
<tr>
<th>Oper</th>
<th>Manag</th>
<th>Strat</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts receivable, order entry</td>
<td>Budget analysis, short-term forecasting, personnel reports, make-or-buy analysis</td>
<td>Building a new plant, mergers and acquisitions, planning (product, quality assurance, compensation, etc.)</td>
<td>MIS, statistical models (management science, financial, etc.)</td>
</tr>
<tr>
<td>Semi</td>
<td>Production scheduling, inventory control</td>
<td>Credit evaluation, budget preparation, plant layout, project scheduling, reward systems design</td>
<td>Decision support systems, business intelligence</td>
</tr>
<tr>
<td>Unstructured</td>
<td>Negotiating, recruiting an executive, buying hardware, lobbying</td>
<td>New technology development, product R&amp;D, social responsibility planning</td>
<td>Decision support systems, expert systems, enterprise resource planning, neural networks, business intelligence, big data</td>
</tr>
</tbody>
</table>

**Figure 5.2.** Decision support framework. Technology is used to support the decisions shown in the column at the far right.
Problems that lower-level managers encounter on a regular basis typically have a high level of structure. Examples are capital budgeting (for example, replacement of equipment), allocating resources, distributing merchandise, and controlling inventory. For each type of structured decision, prescribed solutions have been developed, which often include mathematical formulas that can often be used. This approach is called management science or operations research, and it is executed with the aid of computers.

Apply the Concept 5.1

Background If you look back through this section you will see that Henry Mintzberg's 1973 book, The Nature of Managerial Work, was referenced when the three basic roles of a manager were presented. This text focuses on the decisional role because that is the one most supported by information systems. Professor Mintzberg's work goes much farther than just the decisional role.

Activity Visit http://www.wiley.com/go/rainer/applytheconcept and click on the link provided for Apply the Concept 5.1. It will take you to a YouTube video titled "Data Driven Decision Making" by user "minnetonka schools." This video mentions a strategic plan, operational control, and decisional control. As you watch the video, be sure to watch for these key points and to see how they are supported by data.

Deliverable

Write a short paper (a couple of paragraphs is plenty) for your professor detailing how Minnetonka Schools uses data to make better decisions. Also ask a few teachers to see if your school has any similar data systems that allow this type of decision making. If it does not, what would you recommend (from the student perspective) that would help you be successful? Submit this paper to your instructor.

Quiz questions are assignable in WileyPLUS, and available on the Book Companion Site at http://www.wiley.com/college/rainer.

Ruby's Club Questions

1. Discuss how the three roles of a manager (interpersonal, informational, and decisional) might play out as Ruben and Lisa tackle shrinkage. Will bartenders become defensive? Should they share financial information? How much should they monitor the bartenders?
2. Which of the four reasons why a manager needs IT support do you feel is most applicable in this situation? Is it that the number of alternatives is increasing? Time pressure? Uncertainty? Or the need to bring remote individuals and data into the picture?
3. Is the shrinkage problem a structured, semistructured, or unstructured situation? If it is structured, what controls may be put in place to handle it? If it is unstructured, what policies might be instituted to help reign in the problem?
4. Does this situation fall into operational control, management control, or strategic planning? Or does it fall into all three?
5. In what ways could IT provide help to Ruben and Lisa as they try to make their $300,000 net profit and control shrinkage?
5.2 What Is Business Intelligence?

To provide users with access to corporate data, many organizations are implementing data warehouses and data marts, which you learned about in Chapter 3. Users analyze the data in warehouses and marts using a wide variety of BI tools. Many vendors offer integrated packages of these tools under the overall label of “business intelligence (BI)” software. Major BI vendors include SAS (www.sas.com), Hyperion (www.hyperion.com, now owned by Oracle), Business Objects (www.businessobjects.com, now owned by SAP), Information Builders (www.informationbuilders.com), SPSS (www.spss.com, now owned by IBM), and Cognos (www.ibm.com/cognos).

As has been shown, BI is vital to modern decision making and organizational performance. Let's now consider in greater detail the technical foundation for BI and the wide variety of ways that BI can be used.

The term business intelligence is relatively new. Business and IT analyst Howard Dresner coined the term in 1989 while he was an analyst at Gartner, a market research firm. The term is especially popular in industry, where it is used as an umbrella term that encompasses all decision support applications.

BI encompasses not only applications but also technologies and processes. It includes both “getting data in” (to a data mart or warehouse) and “getting data out” (through BI applications).

In addition, a significant change is taking place within the BI environment. In the past, organizations used BI only to support management. Today, however, BI applications are increasingly available to front-line personnel (e.g., call center operators), suppliers, customers, and even regulators. These groups rely on BI to provide them with the most current information.

The Scope of Business Intelligence

The use of BI in organizations varies considerably. In smaller organizations, BI may be limited to Excel spreadsheets. In larger ones, BI is often enterprise-wide, and it includes applications such as data mining/predictive analytics, dashboards, and data visualization. It is important to recognize that the importance of BI to organizations continues to grow. It is not an exaggeration to say that for many firms, BI is now a requirement for competing in the marketplace, as illustrated in IT's About Business 5.1.

It's About Business 5.1

Analytics in the National Basketball Association

Six high-definition cameras are positioned within the Oracle Arena, home of the National Basketball Association’s Golden State Warriors. The system is part of SportVU (www.sportvu.com) a player-tracking system from Stats (www.stats.com). Data from the cameras, collected 25 times per second, is analyzed by SportVU’s proprietary algorithms.

The software deciphers and identifies every dribble and pass, based only on optical movement of the ball and its relative distance to the players.

Stats thought that the NBA would be an excellent venue for its SportVU system for several reasons. First, with its consistent scoring, there would be enough data points in a game that teams would be
interested to see the results. Second, the NBA games are played in a relatively confined space (a regulation NBA court is only 94 feet by 50 feet), meaning that it is relatively easy to film players. Finally, the NBA is a $4 billion industry that would have money to spare on an analytics system.

Unfortunately for Stats, NBA teams had already had access to play-by-play data for decades. This data consisted of simple, textual rundowns that efficiently mapped how a game played out. A brief scan of a one-page printout as the coach was running into the locker room at halftime, and he could determine intermediate-level metrics such as assist-to-field-goal ratio and turnovers-per-minute.

As a result, the system was a difficult sell to the NBA, but four teams signed on to be charter members: the Houston Rockets, the Dallas Mavericks, the San Antonio Spurs, and the Oklahoma City Thunder. The Golden State Warriors signed on later.

The system has provided these teams with many previously unknown metrics. For example, the system revealed that for the Warriors’ first 14 home games at Oracle Arena, guards Monta Ellis and Stephen Curry accounted for nearly 60 percent of the team’s entire ball possession. Curry, the team’s point guard, had achieved 937 touches of the ball over those games, compared to 948 for Ellis, the team’s leading scorer. More interesting for the Warriors was seeing that the team had a 51.5 percent shooting percentage off passes from Ellis compared to 44.6 percent from Curry.

The system provided other interesting insights for all five teams as well. These insights included points per touch, catch-and-shoot field-goal percentage, secondary assists per game, and even how physically far apart players were from their defenders during the game.

Golden State did have a .477 winning percentage after implementing SportVU, compared to .395 before they deployed the system. In addition, SportVU clients San Antonio, Dallas, and Oklahoma City represent three of the eight Western Conference playoff teams. The most successful NBA franchise in history, the Boston Celtics, recently signed on as the sixth SportVU-equipped team.

Concluding that the SportVU system has contributed to the success of these teams is premature in mid-2012. Stats is planning on adding features to its SportVU system, including near real-time functionality, so that the tracking data can be synchronized to the play-by-play data in less than 30 seconds. This new functionality will provide a close representation and analysis of on-court play almost as it is happening.


Questions

1. How do you think an NBA player would feel about SportVU? Pro or con? Support your answer.
2. How do you think an NBA coach would feel about SportVU? Pro or con? Support your answer.
3. How do you think an NBA team’s front office would feel about SportVU? Pro or con? Support your answer.
4. Do the constituencies represented in the first three questions differ in how you think they would feel about SportVU? If so, why? If not, why not?

Not all organizations use BI in the same way. For example, some organizations employ a single or a few applications, while others utilize enterprisewide BI. The following subsections examine three specific BI targets that represent different levels of change:

- The development of a single or a few related BI applications
- The development of infrastructure to support enterprisewide BI
- Support for organizational transformation

These targets differ in terms of their focus; scope; level of sponsorship, commitment, and required resources; technical architecture; impact on personnel and business processes; and benefits.

**The Development of a Single or a Few Related BI Applications.** This BI target is often a point solution for a departmental need, such as campaign management in
marketing. Sponsorship, approval, funding, impacts, and benefits typically occur at the
departmental level. For this target, organizations usually create a data mart to store the
necessary data. Organizations must be careful that the mart—an “independent” applica-
tion—does not become a “data silo” that stores data that are inconsistent with and cannot
be integrated with data used elsewhere in the organization.

The Development of Infrastructure to Support Enterprisewide BI. This
BI target supports current and future BI needs. A crucial component of BI at this level is an
enterprise data warehouse. Because it is an enterprisewide initiative, senior management
often provides sponsorship, approval, and funding. In addition, the impacts and benefits are
felt throughout the organization.

An example of this target is the 3M Corporation. Traditionally 3M’s various divisions
had operated independently and had utilized separate decision support platforms. Not only
was this arrangement costly, but it also prevented 3M from integrating the data and present-
ing a “single face” to its customers. Thus, for example, sales representatives did not know
whether or how business customers were interacting with other 3M divisions. The solution
was to develop an enterprise data warehouse that enabled 3M to operate as an integrated
company. As an added benefit, the cost of implementing this system was covered by savings
resulting from the consolidation of the various platforms.

Support for Organizational Transformation. With this target, BI is used to
fundamentally transform the ways in which a company competes in the marketplace. BI
supports a new business model and it enables the business strategy. Because of the scope
and importance of these changes, critical elements such as sponsorship, approval, and fund-
ing originate at the highest organizational levels. The impact on personnel and processes
can be significant, and the benefits are organizationwide.

Harrah’s Entertainment provides a good example of this BI target. Traditionally, Harrah
had managed its various properties as “independent fiefdoms.” Then, in the early 1990s, gam-
bling on riverboats and Indian reservations became legal. Harrah’s senior management per-
ceived this as an opportunity to expand the company’s properties. In addition, the company
decided to implement a new business model that would enable it to operate all of these prop-
eries in an integrated way. At the heart of this model was the collection and use of customer data
and the creation of a customer loyalty program, known as Total Rewards, that encouraged
customers to play across all of Harrah’s casinos. To implement this strategy, Harrah’s had to
create a BI infrastructure (a data warehouse) that collected data from casino, hotel, and special
event systems (e.g., wine-tasting weekends) across the various customer touchpoints (e.g., slot
machines, table games, and Internet). Harrah’s used these data to reward loyal customers and
reach out to them in personal and appealing ways—for example, through promotional offers
created using BI. As a result, the company became a leader in the gaming industry.

Nonprofit organizations also use BI to transform the way they operate. As you see in
IT’s About Business 5.2, Marwell Wildlife uses BI to transform the organization’s conserva-
tion efforts.
Some of the most important data available to Marwell comes from a survey of nomadic herdsmen in northern Kenya, the area where most of the remaining Grevy’s zebras live. People in the local pastoral communities are able to provide valuable information to Marwell because they have such an in-depth knowledge about the landscape and its wildlife.

To extract information from the local communities, field researchers from Marwell and other organizations partnering in the survey spent a month in remote areas of Kenya, conducting a questionnaire-based survey. These field researchers gathered information about the distribution of the zebra population and threats to zebras, and learned about the attitudes of the people of the region toward the zebra.

The survey confirmed what conservationists have long recognized—that the needs of the local human population can conflict with those of an endangered species. An obvious example of this conflict is the fact that local herdsmen were hunting the zebras, but there were also more subtle manifestations of this conflict. The zebras live in dry areas near herdsmen who raise livestock, so the zebras often compete with livestock for water and pasture space.

The researchers also analyzed their data for insights into human practices and attitudes that may have an impact on the zebra population. The IBM analytics software enabled them to examine multiple variables affecting attitudes, such as education level and whether or not people had been previously exposed to conservation efforts, to better understand the reasons behind people’s various attitudes and beliefs.

In Chapter 3, you studied the basics of data warehouses and data marts. In this section, you have seen how important data warehouses and marts are to the different ways that organizations use BI. In the next section, you will learn how the user community can analyze the data in warehouses and marts, how the results of these analyses are presented to users, and how organizations can use the results of these analyses.

Some of the patterns the researchers uncovered did not relate to the zebras, but rather to the humans sharing their habitat. Marwell researchers discovered that herdsmen saw benefits from living close to the zebras. For example, zebras can point the way to pastures in dry years and they attract tourists, which boosts the economy. The researchers further found that zebras are hunted not just for their meat, but also for medicine. Zebra fat is highly valued by the pastoral communities as a treatment for illnesses ranging from headaches to tuberculosis. Most of the survey respondents said that they would be glad to switch to conventional medicines if they were available. These findings show promising opportunities to make changes that have the potential to benefit people and zebras.


Questions
1. What other types of data could Marwell analyze to better understand the problem of the Grevy’s zebra?
2. What advantages does the IBM software provide to Marwell in its goal to save endangered species? Are there other advantages not mentioned in this case? Provide specific examples.

BEFORE YOU GO ON . . .
1. Define BI.
2. Discuss the breadth of support provided by BI applications to organizational employees.
3. Identify and discuss the three basic targets of BI.

Apply the Concept 5.2
Background You have read in this section about how data can be used to provide business intelligence. Google Analytics is a tool that provides just such data to help businesses make decisions about their website. The information is captured by Google and then presented to create business intelligence. However, Google only provides the data in graphs and charts. It is still up to the business to make informed decisions based on the information they find.
By looking at this application, you should begin to see how data must be captured, categorized, and be flexible for reporting. The video illustrates the dimensions of a cube without calling it a cube, mentions a data warehouse as the repository of all the data, and shows “drill down” without calling it such.

**Activity** Visit [http://www.wiley.com/go/rainer/applytheconcept](http://www.wiley.com/go/rainer/applytheconcept) and click on the link provided for Apply the Concept 5.2. It will take you to a YouTube video titled “Google Analytics for Business Intelligence” by user “clicksharpmarketing.” By watching this video, you should begin to see how data must be captured, be categorized, and be flexible for reporting. The video illustrates the dimensions of a cube without calling it a cube, mentions a data warehouse as the repository of all the data, and shows “drill down” without calling it such.

Based on the terms that were introduced in the video, answer the following:

1. What is a bounce rate?
2. What is the difference between a visit and a new visit?
3. Define the three main categories of Web traffic.
4. What is the concept of a key word, and how is it used by Google Analytics?

**Deliverable**

Write an email to your best “imaginary” friend who is also a Web designer. Explain these terms in the email to help him/her know how to analyze results from their Web sites. Submit your “email” to your professor.


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**5.3 Business Intelligence Applications for Data Analysis**

A good strategy to study the ways in which organizations use BI applications is to consider how the users analyze data, how the results of their analyses are presented to them, and how managers and executives implement these results. Recall from Chapter 3 that the data are stored in a data warehouse or data mart. The user community analyzes these data using a variety of BI applications. The results of these analyses can be presented to users via other BI applications. Finally, managers and executives put the overall results to good use. You will become familiar with data analysis, presentation, and use in depth in the next three sections.

A variety of BI applications for analyzing data are available. They include multidimensional analysis (also called online analytical processing, or OLAP), data mining, and decision support systems.

**Multidimensional Analysis or Online Analytical Processing**

Some BI applications include online analytical processing (OLAP) capabilities, also referred to as multidimensional data analysis. OLAP involves “slicing and dicing” data stored in a dimensional format, drilling down the data to greater detail, and aggregating the data.
Consider our example from Chapter 3. Recall Figure 3.10 showing the data cube. The product is on the x-axis, geography is on the y-axis, and time is on the z-axis. Now, suppose you want to know how many nuts the company sold in the West region in 2009. You would slice and dice the cube using nuts as the specific measure for product, West as the measure for geography, and 2009 as the measure for time. The value(s) in the cell(s) that remain after our slicing and dicing is (are) the answer to our question. You might also want to know how many nuts were sold in January 2009; this is an example of drilling down. Alternatively, you might want to know how many nuts were sold during 2008–2010, which is an example of aggregation, also called “rollup.”

**Data Mining**

**Data mining** refers to the process of searching for valuable business information in a large database, data warehouse, or data mart. Data mining can perform two basic operations: (1) predicting trends and behaviors and (2) identifying previously unknown patterns. BI applications typically provide users with a view of what has happened. Data mining helps to explain why it is happening, and it predicts what will happen in the future.

Regarding the first operation, data mining automates the process of finding predictive information in large databases. Questions that traditionally required extensive hands-on analysis can now be answered directly and quickly from the data. A typical example of a predictive problem is **targeted marketing**. Data mining can use data from past promotional mailings to identify those people who are most likely to respond favorably to future mailings. Another example of a predictive problem is forecasting bankruptcy and other forms of default. Data mining can also identify previously hidden patterns in a single step. For example, it can analyze retail sales data to discover seemingly unrelated products that people often purchase together. The classic example is beer and diapers. Data mining found that young men tend to buy beer and diapers at the same time when they shop at a convenience store.

One significant pattern-discovery operation is detecting fraudulent credit card transactions. After you use your credit card for a time, a pattern emerges of the typical ways you use your card—the places you use your card, the amount you spend, and so on. If your card is stolen and used fraudulently, this usage is often different from your pattern. Data mining tools can discern this difference and bring this issue to your attention.

Numerous data mining applications are used in business and in other fields. According to a Gartner report (www.gartner.com), most of the Fortune 1000 companies worldwide currently use data mining, as the following representative examples illustrate. Note that in most cases the intent of data mining is to identify a business opportunity in order to create a sustainable competitive advantage.

- **Retailing and sales**: Predicting sales, preventing theft and fraud, and determining correct inventory levels and distribution schedules among outlets. For example, retailers such as AAFES (stores on military bases) use Fraud Watch from SAP (www.sap.com) to combat fraud by employees in their 1,400 stores.
- **Banking**: Forecasting levels of bad loans and fraudulent credit card use, predicting credit card spending by new customers, and determining which kinds of customers will best respond to (and qualify for) new loan offers.
- **Manufacturing and production**: Predicting machinery failures, and finding key factors that help optimize manufacturing capacity.
- **Insurance**: Forecasting claim amounts and medical coverage costs, classifying the most important elements that affect medical coverage, and predicting which customers will buy new insurance policies.
- **Policework**: Tracking crime patterns, locations, and criminal behavior; identifying attributes to assist in solving criminal cases.
- **Health care**: Correlating demographics of patients with critical illnesses, and developing better insights on how to identify and treat symptoms and their causes.
- **Marketing**: Classifying customer demographics that can be used to predict which customers will respond to a mailing or buy a particular product.
Decision Support Systems

Decision support systems (DSS) combine models and data in an attempt to analyze semi-structured problems with extensive user involvement. Models are simplified representations, or abstractions, of reality. DSS enable business managers and analysts to access data interactively, to manipulate these data, and to conduct appropriate analyses.

Decision support systems can enhance learning and contribute to all levels of decision making. DSS also employ mathematical models. In addition, they have the related capabilities of sensitivity analysis, what-if analysis, and goal-seeking analysis, which you will learn about next. You should keep in mind that these three types of analysis are useful for any type of decision support application. For example, Excel supports them.

Sensitivity Analysis. Sensitivity analysis is the study of the impact that changes in one or more parts of a decision-making model have on other parts. Most sensitivity analyses examine the impact that changes in input variables have on output variables.

Most models include two types of input variables: decision variables and environmental variables. “What is our reorder point for these raw materials?” is a decision variable (internal to the organization). “What will the rate of inflation be?” is an environmental variable (external to the organization). The output in this example would be the total cost of raw materials. The point of a sensitivity analysis is usually to determine the impact of environmental variables on the result of the analysis.

Sensitivity analysis is extremely valuable because it enables the system to adapt to changing conditions and to the varying requirements of different decision-making situations. It provides a better understanding of the model and the problem that the model purports to describe.

What-If Analysis. A model builder must make predictions and assumptions regarding the input data, many of which are based on the assessment of uncertain futures. The results depend on the accuracy of these assumptions, which can be highly subjective. What-if analysis attempts to predict the impact of a change in the assumptions (input data) on the proposed solution. For example, what will happen to the total inventory cost if the originally assumed cost of carrying inventories is not 10 percent but 12 percent? In a well-designed BI system, managers themselves can interactively ask the computer these types of questions as many times as needed.

Goal-Seeking Analysis. Goal-seeking analysis represents a “backward” solution approach. It attempts to find the value of the inputs necessary to achieve a desired level of output. For example, let’s say that an initial BI analysis predicted a profit of $2 million. Management might want to know what sales volume would be necessary to generate a profit of $3 million. To find out, the company would perform a goal-seeking analysis.

However, managers cannot simply press a button that says “increase sales.” Some action(s) will be necessary to make the sales increase possible. The action(s) could be to lower prices, to increase research and development, to provide a higher commission rate for the sales force, to increase advertising, to take some other action, or to implement some combination of these actions. Whatever the action is, it will cost money, and the goal-seeking analysis must take this into account.

Apply the Concept 5.3

Background This section has shown that data is more abundant today than ever before. One thing we are learning is that there is much we can know that we do not know. In fact, there are many questions that we do not even know should be asked! This is
the purpose of data mining. It uses computers and software to look into large databases searching out trends that can become the foundation for future business planning.

**Activity** Visit [http://www.wiley.com/go/rainer/applytheconcept](http://www.wiley.com/go/rainer/applytheconcept) and click on the link provided for Apply the Concept 5.3. It will take you to a video about data mining. As you watch, consider the following questions:

1. What is the goal of data mining?
2. What is classification?
3. What is clustering?
4. How does a person know if a model is right?

Now go to Walmart and look around the store. How did the company determine which items would be on an end cap (the end of an aisle)? Who decided how high to put the Cheerios and where to put the Lucky Charms? Why is the milk in the back of the store? How much of the layout do you think was determined by past data mining?

**Deliverable**

Write a newspaper article titled “I Was Data Mined By Walmart—Why I Buy Too Much” for your professor that details the answers to the four questions above and that presents your thoughts from your visit to Walmart. Submit this to your instructor.

**Quiz questions are assignable in WileyPLUS, and available on the Book Companion Site at [http://www.wiley.com/college/rainer](http://www.wiley.com/college/rainer).**

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**RUBY’S CLUB**

**QUESTIONS**

1. Ruben and Lisa hope to use Excel as their decision support tool. Which analysis would be best suited for their goal and shrinkage problem? The what-if analysis? The goal-seeking analysis? Or the sensitivity analysis? Or, do you think it would be a combination of all three?

2. What tools can you find in Excel that would support these analyses? *(Hint: Google “Sensitivity Analysis Excel.”)*

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**5.4 Business Intelligence Applications for Presenting Results**

The results of the types of data analyses you just learned about can be presented with dashboards and data visualization technologies. Today, users increasingly rely on data that are real time or almost real time. Therefore, you will note a discussion of real-time BI in this section.

**Dashboards**

Dashboards evolved from executive information systems, which were information systems designed specifically for the information needs of top executives. However, as you saw in this chapter’s opening case, today all employees, business partners, and customers can use digital dashboards.

A dashboard provides easy access to timely information and direct access to management reports. It is very user friendly and is supported by graphics. Of special importance, it enables managers to examine exception reports and drill down into detailed data. Table 5.1 summarizes the various capabilities that are common to many dashboards. In addition,
some of the capabilities discussed in this section are now part of many BI products, as illustrated in Figure 5.3.

One outstanding example of a dashboard is the “Bloomberg.” Bloomberg LLP (www.bloomberg.com), a privately held company, provides a subscription service that sells financial data, software to analyze these data, trading tools, and news (electronic, print, TV, and radio). All of this information is accessible through a color-coded Bloomberg keyboard that displays the desired information on a computer screen, either the user’s or one that Bloomberg provides. Users can also set up their own computers to access the service without a Bloomberg keyboard. The subscription service plus the keyboard is called the “Bloomberg.” It literally represents a do-it-yourself dashboard, because users can customize their information feeds as well as the look and feel of those feeds (see Figure 5.4).

### Table 5.1 The Capabilities of Dashboards

<table>
<thead>
<tr>
<th>Capability</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill down</td>
<td>The ability to go to details, at several levels. Can be done through a series of menus or by clicking on a drillable portion of the screen.</td>
</tr>
<tr>
<td>Critical success factors (CSFs)</td>
<td>The factors most critical for the success of business. Can be organizational, industry, departmental, or for individual workers.</td>
</tr>
<tr>
<td>Key performance indicators (KPIs)</td>
<td>The specific measures of CSFs.</td>
</tr>
<tr>
<td>Status access</td>
<td>The latest data available on KPIs or some other metric, often in real time.</td>
</tr>
<tr>
<td>Trend analysis</td>
<td>Short-term, medium-term, and long-term trend of KPIs or metrics, which are projected using forecasting methods.</td>
</tr>
<tr>
<td>Exception reporting</td>
<td>Reports that highlight deviations larger than certain thresholds. Reports may include only deviations.</td>
</tr>
</tbody>
</table>

Figure 5.3 Sample performance dashboard.
In another example, Figure 5.5 shows a human resources dashboard/scorecard developed by iDashboards, one of the leading BI software vendors. At a glance, users can see employee productivity, hours, team, department, and division performance in graphical, tabular, summary, and detailed form. The selector box to the left enables the user to easily change between specific analysts to compare their performance.

A unique and interesting application of dashboards to support the informational needs of executives is the Management Cockpit. Essentially, a Management Cockpit is a strategic management room containing an elaborate set of dashboards that enable top-level decision makers to pilot their businesses better. The goal is to create an environment that encourages more efficient management meetings and boosts team performance via effective communication. To help achieve this goal, the dashboard graphically displays key performance indicators and information relating to critical success factors on the walls of a meeting room, called the Management Cockpit Room (see Figure 5.6). The cockpitlike arrangement of instrument panels and displays helps managers visualize how all the different factors in the business interrelate.

Courtesy of iDashboards

**Figure 5.5** A human resource dashboard/scorecard.

**Figure 5.4** The Bloomberg Terminal is a specific set of hardware and software used by financial professionals on trading floors around the world.
Within the room, the four walls are designated by color: Black, Red, Blue, and White. The Black Wall displays the principal success factors and financial indicators. The Red Wall measures market performance. The Blue Wall projects the performance of internal processes and employees. The White Wall indicates the status of strategic projects. The Flight Deck, a six-screen, high-end PC, enables executives to drill down to detailed information. External information needed for competitive analyses can easily be imported into the room.

Board members and other executives hold meetings in the Cockpit Room. Managers also meet there with the comptroller to discuss current business issues. For this purpose, the Management Cockpit can implement various what-if scenarios. It also provides a common basis for information and communication. Finally, it supports efforts to translate a corporate strategy into concrete activities by identifying performance indicators.

Data Visualization Technologies

After data have been processed, they can be presented to users in visual formats such as text, graphics, and tables. This process, known as data visualization, makes IT applications more attractive and understandable to users. Data visualization is becoming more and more popular on the Web for decision support. A variety of visualization methods and software packages that support decision making are available. Two particularly valuable applications are geographic information systems and reality mining.

**Geographic Information Systems.** A geographic information system (GIS) is a computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps. Its most distinguishing characteristic is that every record or digital object has an identified geographical location. This process, called geocoding, enables users to generate information for planning, problem solving, and decision making. In addition, the graphical format makes it easy for managers to visualize the data.

Today, relatively inexpensive, fully functional PC-based GIS packages are readily available. Representative GIS software vendors are ESRI ([www.esri.com](http://www.esri.com)), Intergraph ([www.intergraph.com](http://www.intergraph.com)), and Pitney Bowes Mapinfo ([www.pbinsight.com/welcome/mapinfo](http://www.pbinsight.com/welcome/mapinfo)). In addition, both government sources and private vendors provide diversified commercial GIS data. Some of these GIS packages are free—for example, CD-ROMs from Mapinfo and downloadable material from [www.esri.com](http://www.esri.com) and [http://data.geocomm.com](http://data.geocomm.com).
There are countless applications of GISs to improve decision making in both the public and private sectors. For example, IT’s About Business 5.3 shows how SecureAlert uses electronically transmitted location data and data visualization in its monitoring system.

**SecureAlert**

SecureAlert ([www.securealert.com](http://www.securealert.com)) works with law enforcement agencies around the United States to track about 15,000 ex-convicts, all of whom wear electronic, location-reporting ankle cuffs. To accomplish this task, SecureAlert must collect and analyze billions of global positioning system (GPS) signals transmitted by the cuffs each day. Technicians at SecureAlert’s monitoring center watch computer screens filled with multicolored dots moving about digital maps. Each dot represents someone on parole or probation wearing one of the company’s cuffs.

The more traditional part of the work consists of ensuring that people under house arrest stay in their houses. However, advances in the way information is collected and analyzed mean that SecureAlert is not just watching. The company says that it can actually predict when a crime is about to be committed.

Using data from the ankle cuffs and other sources, SecureAlert identifies patterns of suspicious behavior. A person convicted of domestic violence, for example, might get out of jail and set up a law-abiding routine. Quite often, however, SecureAlert’s technology sees such people backslide and start visiting locations frequented by their victims. If the convict gets too close to these locations for comfort, an alarm goes off at SecureAlert and a flashing siren appears on SecureAlert screens. At this time, the system can call an offender through a two-way cellphone attached to the ankle cuff to ask what the person is doing, or set off a 95-decibel audio device as a warning to others. More typically, the company will notify probation officers or police about the suspicious activity and have them investigate.

SecureAlert emphasizes that if a parolee wearing an ankle cuff wanders out-of-bounds, there is always a human in the process to make a judgment call. The company says that it is always tuning its monitoring systems to balance between “crying wolf” and “catching serious situations.” SecureAlert’s innovative use of information technology saves law enforcement agencies a great deal of time and money, while also contributing to the prevention of crime.


**Questions**

1. Discuss the privacy implications of the SecureAlert system.
2. What are the weaknesses of the SecureAlert system? Provide specific examples to support your answer.

**Reality Mining.** One important emerging trend is the integration of GISs and global positioning systems (GPSs, discussed in Chapter 10). Using GISs and GPSs together can produce an interesting new type of technology, called **reality mining.** Reality mining allows analysts to extract information from the usage patterns of mobile phones and other wireless devices.
Real-Time Business Intelligence

Until recently, BI has focused on the use of historical data. This focus has changed with the emergence of technology for capturing, storing, and using real-time data. Real-time BI enables users to employ multidimensional analysis, data mining, and decision support-systems to analyze data in real time. In addition, it helps organizations to make decisions and to interact with customers in new ways as presented in IT’s About Business 5.4.

Catalina Marketing

Catalina Marketing (www.catalinamarketing.com) provides precision marketing capabilities to manufacturers, retailers, and health providers. The company’s marketing systems enable the delivery of the right message to the right audience in the right environment so clients can successfully build their brands. In this way, Catalina helps clients develop deeper, more productive consumer relationships.

Catalina manages the evolving purchase histories of more than 75 percent of U.S. shoppers. The company uses the transaction-level data to help clients develop customized, measurable campaigns to acquire, maximize, and retain their most valuable consumers. Catalina clients include manufacturers such as Coca-Cola, Kellogg’s, Kraft Foods, and Procter & Gamble, and retailers such as Kmart, Kroger, Ralph’s, Safeway, Stop & Shop, Target, and Winn-Dixie.

Catalina’s in-store network consists of 50,000 food, drug, and mass-merchant locations worldwide. In the United States, Catalina is installed in more than 26,000 locations. In addition, Catalina’s CouponNetwork.com is one of the world’s largest consumer couponing sites.

Catalina’s primary database holds more than 2.5 petabytes of data and adds data on more than 300 million transactions per week. When you pay with a loyalty card at any one of 50,000 member grocery, drug, or mass-merchant retail stores in the United States, Germany, and Japan, insights derived from Catalina’s database trigger promotions and offers based on your past purchases. Catalina’s point-of-sale printers at checkout lanes produce coupons that are handed to customers along with their receipts within seconds of the transactions.

To deliver its data analytics results in a timely fashion, Catalina pioneered in-database processing with Netezza (www.netezza.com). In-database processing means that data analytics software runs inside a database or data warehouse. This process eliminates the time, effort, and expense of moving large data sets from an enterprise database or data warehouse to a separate data analytics software application. In-database processing meant that Catalina moved its scoring of purchase-behavior models into the Netezza data warehouse for faster processing.

For Catalina, in-database processing was the only way to solve a productivity challenge. Catalina’s data warehouse is roughly the same size as the enterprise data warehouses at Walmart and Bank of America. The company uses it to analyze what consumers buy, the pattern of items they buy together, and how these purchase patterns vary by geography, market area, chain, store, and zip code. Most importantly for Catalina and its clients, these analyses predict and reveal the power of promotions, delivered through coupons, to change purchasing behavior.

Catalina captures transactions and delivers coupons in real time no matter which store a customer is shopping in. As a result, Catalina can support multistore “threshold” promotions that were never before possible. For example, a retail chain or manufacturer might offer $10 off your next shopping trip if you buy 10 products from a specific manufacturer within three months. In this example, Catalina delivers up-to-the-minute customer status information to all retail locations. And, customers earn an incentive instantaneously, no matter which store they are in, as soon as they meet the purchase threshold.

Without data-driven analyses, redemption rates on coupons are around 1 percent. With basic targeting, such as giving buyers of diet soda or dog food coupons for alternative brands, redemption rates rise to 6 to 10 percent. Using historical purchase-
behavior data and the sophisticated predictive models that Catalina uses, redemption rates are as high as 25 percent.


Questions

1. Why is the timely delivery of coupons tailored to customers’ purchase histories so important to Catalina’s client companies? Provide specific examples to support your answer.

2. Discuss privacy concerns that could come from Catalina’s use of customers’ purchase histories. Provide examples to support your answer.

Apply the Concept 5.4

Background This section discusses visualization tools to help understand the information that is contained in data. This is important because it is easier and much quicker to glance at a graph than it is to look at a page full of numbers. MicroStrategy is a company that specializes in dashboards and products that help with data visualization. Recently, the company has also offered iPad and iPhone apps to allow data to be accessible on mobile devices. Taking things a step further, MicroStrategy now can create a conference room that allows sharing of graphs and charts over devices to a large TV or projector in the meeting room.

Activity Visit http://www.wiley.com/go/rainer/applytheconcept and click on the link provided for Apply the Concept 5.4. It will take you to a YouTube video titled “MicroStrategy Mobile Integrates with Apple TV” by user “microstrategybi.” This video demonstrates how the company’s product not only allows a single user to analyze data visually, but that user can easily share his or her view of the data with others in a conference room with minimal setup. You may also want to visit MicroStrategy’s Web site as mentioned in the video for more information (this link is also provided at http://www.wiley.com/go/rainer/applytheconcept).

Deliverable

Write an imaginary request to your boss to install a system like this in your boardroom. Be sure to point out what is so significant of visual, instant, on-demand information sharing. Because you know your boss is skeptical of everything, go ahead and address the following concern as well: “Given that strategy cannot change instantaneously, why do we need information on a minute-by-minute basis?”

Submit your request to your professor.

Quiz questions are assignable in WileyPLUS, and available on the Book Companion Site at http://www.wiley.com/college/rainer.

RUBY’S CL U B  Q U E S T I O N S

1. Dashboards are very nice, but seem very complex to create. Do you think graphs and charts in Excel could be as effective as the elaborate dashboard examples provided in the chapter?

2. What type of chart do you think would be beneficial in tackling the problem of shrinkage? Would it be a bar chart? Pie chart? Line chart? How could this be developed in Excel?
5.5 Business Intelligence in Action: Corporate Performance Management

Corporate performance management (CPM) is involved with monitoring and managing an organization’s performance according to key performance indicators (KPIs) such as revenue, return on investment (ROI), overhead, and operational costs. For online businesses, CPM includes additional factors such as the number of page views, server load, network traffic, and transactions per second. BI applications allow managers and analysts to analyze data to obtain valuable information and insights concerning the organization’s KPIs.

BEFORE YOU GO ON . . .

1. What is corporate performance management?
2. How do BI applications contribute to corporate performance management?

Apply the Concept 5.5

Background Key performance indicators (KPIs) are defined by management as the key ratios or numbers that it needs to watch to be sure the company is staying on track according to the managers’ strategy. Once these are determined (often through data mining), dashboards can be created so that management can look at and understand current trends and performance measures.

Activity Visit http://www.wiley.com/go/rainer/applytheconcept and click on the link provided for Apply the Concept 5.5. It will take you to a YouTube video titled “Introduction to Dashboards” by user “asutraining.” Also visit the site mentioned in the video (also provided at http://www.wiley.com/go/rainer/applytheconcept) and look at the dashboard descriptions. At the time of this writing, the “factbook” (on the left-hand side of the Web site) was in the public domain. Click on this link and look through the data. As you watch the video and review the Web site, consider the following questions:

1. Why does Arizona State University (ASU) have a procedure in place to grant access to its dashboards?
2. Would you be able to get access?
3. How important is the use of color in a dashboard?
4. Why a summary page and a data page?

Deliverable

Write a small report to the vice president of academic affairs at ASU (do not send it of course) that details of your findings. Outline the past trends, the current situations, and the future possibilities for the vice-president. Explain how the dashboard proved helpful in your report. Submit it to your instructor.

Quiz questions are assignable in WileyPLUS, and available on the Book Companion Site at http://www.wiley.com/college/rainer.

What’s in it for ME?

FOR THE ACCOUNTING MAJOR

BI is used extensively in auditing to uncover irregularities. It is also used to uncover and prevent fraud. CPAs use BI for many of their duties, ranging from risk analysis to cost control.

FOR THE FINANCE MAJOR

People have been using computers for decades to solve financial problems. Innovative BI applications have been created for activities such as making stock market
decisions, refinancing bonds, assessing debt risks, analyzing financial conditions, predicting business failures, forecasting financial trends, and investing in global markets.

**FOR THE MARKETING MAJOR**

Marketing personnel utilize BI in many applications, from planning and executing marketing campaigns to allocating advertising budgets to evaluating alternative routings of salespeople. New marketing approaches such as targeted marketing and database marketing are heavily dependent on IT in general and on data warehouses and BI applications in particular.

**FOR THE PRODUCTION/OPERATIONS MANAGEMENT MAJOR**

BI supports complex operations and production decisions, from inventory control to production planning to supply chain integration.

**FOR THE HUMAN RESOURCES MANAGEMENT MAJOR**

Human resources personnel use BI for many of their activities. For example, BI applications can find résumés of applicants posted on the Web and sort them to match needed skills and to support management succession planning.

**FOR THE MIS MAJOR**

MIS provides the data infrastructure used in BI. MIS personnel are also involved in building, deploying, and supporting BI applications.

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**SUMMARY**

1. **Explain different ways in which IT supports managerial decision making.**

   When making a decision, either organizational or personal, the decision maker goes through a three-step process: intelligence, design, and choice. When the choice is made, the decision is implemented.

   Several information technologies have been successfully used to directly support managers. Collectively, they are referred to as business intelligence information systems. **Figure 5.2** provides a matrix that shows how technology supports the various types of decisions that managers must make.

2. **Provide examples of different ways that organizations make use of BI.**

   - **The development of a single or a few related BI applications.**
     This BI target is often a point solution for a departmental need, such as campaign management in marketing. A data mart is usually created to store necessary data.

   - **The development of infrastructure to support enterprise-wide BI.** This target supports current and future BI needs. A critical component is an enterprise data warehouse.

   - **Support for organizational transformation.** With this target, BI is used to fundamentally change how a company competes in the marketplace. BI supports a new business model and enables the business strategy.

3. **Explain the value that different BI applications provide to large and small businesses.**

   Users have a variety of BI applications available to help them analyze data. These applications include multidimensional analysis, data mining, and decision support systems.

   Multidimensional analysis, also called online analytical processing (OLAP), involves “slicing and dicing” data stored in a dimensional format, drilling down to greater detail, and aggregating data. Data mining refers to the process of searching for valuable business information in a large database, data warehouse, or data mart. Decision
support systems (DSS) combine models and data in an attempt to analyze semistructured and some unstructured problems with extensive user involvement. (The examples of using each application at your university, we leave to you.)

4. Offer examples of how businesses and government agencies can use different BI applications to analyze data.
A dashboard provides easy access to timely information and direct access to management reports. A geographic information system (GIS) is a computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps. Reality mining analyzes information extracted from the usage patterns of mobile phones and other wireless devices. (Examples of how these technologies might be used by businesses and government agencies, we leave to you.)

5. Explain how your university could use CPM to effect solutions to two campus problems.
CPM is involved with monitoring and managing an organization’s performance according to key performance indicators (KPIs) such as revenue, return on investment (ROI), overhead, and operational costs. (An example of how your university might use CPM, we leave to you.)

>>> CHAPTER GLOSSARY

**business intelligence** A broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions.

**corporate performance management** The area of business intelligence involved with monitoring and managing an organization’s performance, according to key performance indicators (KPIs) such as revenue, return on investment (ROI), overhead, and operational costs.

**dashboard** A BI application that provides rapid access to timely information and direct access to management reports.

**data mining** The process of searching for valuable business information in a large database, data warehouse, or data mart.

**decision** A choice among two or more alternatives that individuals and groups make.

**decision support systems (DSS)** Business intelligence systems that combine models and data in an attempt to solve semistructured and some unstructured problems with extensive user involvement.

**geographic information system** A computer-based system for capturing, integrating, manipulating, and displaying data using digitized maps.

**management** A process by which organizational goals are achieved through the use of resources.

**models (in decision making)** Simplified representations, or abstractions, of reality.

**online analytical processing (OLAP) (or multidimensional data analysis)** A set of capabilities for “slicing and dicing” data using dimensions and measures associated with the data.

**reality mining** Extraction by analysts of information from the usage patterns of mobile phones and other wireless devices.

>>> DISCUSSION QUESTIONS

1. Your company is considering opening a new factory in China. List several typical activities involved in each phase of the decision (intelligence, design, and choice).

2. Recall that data mining found that young men tend to buy beer and diapers at the same time when they shop at a convenience store. Now that you know this relationship exists, can you provide a rationale for it?

3. American Can Company announced that it was interested in acquiring a company in the health maintenance organization (HMO) field. Two decisions were involved in this act: (1) the decision to acquire an HMO and (2) the decision of which HMO to acquire. How can the company use BI to assist it in this endeavor?

4. Discuss the strategic benefits of BI systems.


>>> PROBLEM-SOLVING ACTIVITIES

1. The city of London (United Kingdom) charges an entrance fee for automobiles and trucks into the central city district. About a thousand digital cameras photograph the license plate of every vehicle passing by. Computers read the plate numbers and match them against records in a database of cars for which the fee has been paid for that day. If the computer does not find a match, the car owner receives a citation by mail. Examine the issues pertaining to how this process is accomplished, the mistakes it can make, and the consequences of those
mistakes. Also examine how well the system is working by checking press reports. Finally, relate the process to business intelligence.

2. Enter www.cognos.com and visit the demos on the right side of the page. Prepare a report on the various features shown in each demo.


4. Enter www.teradatastudentnetwork.com (TSN) (you will need a password) and find the paper titled "Data Warehousing Supports Corporate Strategy at First American Corporation" (by Watson, Wixom, and Goodhue). Read the paper and answer the following questions:
   a. What were the drivers for the data warehouse/business intelligence project in the company?
   b. What strategic advantages were realized?
   c. What were the critical success factors for the project?


8. Visit the sites of some GIS vendors (such as www.mapinfo.com, www.esri.com, or www.autodesk.com). Download a demo. What are some of the most important capabilities and applications?


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**COLLABORATION EXERCISE**

**Background**

In this chapter a company named MicroStrategy has come up multiple times. This business offers many products for business use that are intended to help companies manage and interpret their data. One of these products is a free tool called "MicroStrategy Cloud Personal" where you can upload your own data and let MicroStrategy software create reports for you. Go to http://www.wiley.com/go/rainer/collaboration and click the link provided. It will take you to Microstrategy's Web site explaining some "cloud" tools available for personal data analysis.

**Activity**

Work with a team to create data on the money you spend on food for a week. Have each team member create 10 rows of data in a spreadsheet. You will first have to agree on the type of data you will create and the column titles so everyone's data will match up. Once you all create your data points, combine them into one spreadsheet and upload it into the MicroStrategy Personal Cloud.

**Deliverable**

Share your work with your teammates. Let everyone on the team have some time to look through the data and then compile a report for your professor based on the data your team put together. Be sure to include images of your graphs and reports. Is there anything in this analysis that surprises you? Did you determine if you should change any habits based on this work?

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**CLOSING CASE 1 > Procter & Gamble Uses Analytics in Novel Ways**

Procter & Gamble (www.pg.com), the world's largest consumer products company with $79 billion in sales and 127,000 employees, manages massive streams of data in order to effectively operate its global business. The company has been forecasting its profits on a monthly basis for about 40 years, trying to predict components such as sales, commodity prices, and exchange rates. Before P&G deployed new information technologies, decisions took weeks or months, because data had to be manually gathered, collated, and channeled through various committees before reaching high-level company executives.

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**THE PROBLEM**
THE IT SOLUTION

Today, P&G uses high-speed networks, data visualization, and high-speed analysis on multiple streams of data and information. More efficient software and increased computing power has vastly increased the amount of real-time data that P&G can process compared to what IT could do previously. In order to make better, faster decisions, P&G implemented the information technologies Business Sphere, the Immersion Lab, and the Handshake Room.

P&G implemented Business Sphere early in 2011. Business Sphere is an umbrella technology that integrates 14 different technologies from multiple vendors. The room contains two huge monitors, which give the executives a visual of the 4 billion times each day that P&G products are used in more than 80 countries.

In the Immersion Lab, another information technology employed by P&G, managers work in a mock hotel room where they try out many different mobile devices, building confidence that their employees can work anywhere on any type of phone or tablet.

In the Handshake Room, P&G solves customers' business problems and makes sales. The Handshake Room provides virtual store simulations with two screens along one wall. One of the screens, about 8 feet square, shows blank store shelves onto which can be projected three-dimensional images of any P&G product that a manager might want to stock in any size or label configuration. Another monitor shows store interiors of big retailers such as Walmart and Safeway. P&G can insert any new store display into these views so buyers can observe the display's look and its effect on store flow.

THE RESULTS

P&G's executives hold their meetings in the Business Sphere at the company's headquarters. In four clicks on a tablet computer, they can change the image on a screen from a view of a world map to a graph of toothpaste prices in India with a sales comparison that shows local brands are gaining market share. A few clicks on another computer can bring up a view of shampoo sales in Australia, which renders it immediately apparent that P&G will need to sell 585,000 more cases of shampoo for sales just to break even. Yet another view might indicate big opportunities for hair care in Germany and pet food in the United States.

One of the great advantages of the Business Sphere is that from day 1, it enabled managers in some 40 locations worldwide to see the exact same data. This data consistency meant that everyone can recognize and agree upon target countries, regions, or products for particular attention. Everyone can also easily judge the company's progress against its strategic plan and inroads made against the competition, in some cases even down to individual retailers.

The Business Sphere also enables P&G executives and managers to make decisions in minutes based on data provided. All information about sales is now decided at the executive level each week and production is viewed in near real time worldwide. The company is also increasing the amount of data collected by a factor of seven.

The Immersion Lab allows P&G managers to test various information technologies to ensure that they will work on whatever device an employee prefers. P&G analysts are also testing various tools that could allow employees to collaborate more effectively, such as wikis (discussed in detail in Chapter 8) for project management.

In the Handshake Room, P&G analysts ask customers to present a business problem. The analysts use the technology in the room to present a solution to the problem, and often make a sale on the spot.


Questions

1. Why is the Business Sphere so important to P&G executives? Provide examples to support your answer.
2. Why is the Handshake Room so important in gaining new business for P&G? Provide examples to support your answer.
In the city of Santa Cruz, California, there were 160 car thefts and 495 burglaries in 2011. For a city of 60,000, those numbers are average. Nonetheless, the Santa Cruz police force (SCPD) faces significant challenges. Since 2001, the SCPD has had to lay off 10 of its 104 officers, despite a citywide population growth in the city of 5,500 people. Therefore, the department now has to do more with less.

Since 2001, property crime in Santa Cruz decreased by 29 percent and violent crime decreased by 39 percent. At the end of 2011, both types of crime were at their lowest levels since 1973, when the collection of systematic nationwide data was instituted. Many factors—for example, an aging population and increased incarceration rates—have contributed to these decreases. However, most criminologists believe the major reason for these decreases to be the intelligence now available to the SCPD based on data analysis.

On July 1, 2011, the SCPD changed the way it fights crime. The department began using a new information system that provides intelligence to the police about when and where future crimes were most likely to take place and how officers could be deployed to prevent those crimes. The information system consists of a sophisticated algorithm (software) that analyzes large sets of data. This approach is called predictive policing.

The algorithm is based on one used by seismologists to predict earthquakes. It targets property crime such as home burglaries, car break-ins, and vehicle thefts. Such crimes tend to cluster and spread in a way that is similar to tremors after a large earthquake.

The algorithm identifies hot spots, which are 500-foot-by-500-foot areas at the highest risk for property crimes. The SCPD then divides the city into five regions, with at least one car on duty in each. Officers pick up their hot spot maps at the roll call meeting that precedes each shift. Each map contains a hot spot. Above each map is a set of statistics: the probability that a crime will take place in that hot spot that day; the two-hour-long windows when that potential crime is most likely to occur; and the likelihood that the crime will be a property crime.

Before the software was implemented, individual officers had to decide where and how to focus their time when on patrol based on their own limited experience of the area. After the implementation, officers were able to clearly identify hot spots based on the maps they received and then make a concerted effort to heavily patrol those areas.

The impacts of the new information system on crime in Santa Cruz are promising, although it is too early for them to be conclusive. By the end of July 2011, property crime was down 27 percent from the year before, an impressive drop, particularly given the 25 percent rise in the first 6 months of the year. Furthermore, seven criminals had been discovered inside the hot spots.

One afternoon at a hot spot, two women were detained after they were caught looking into cars in a triple-decker parking garage. One had an outstanding warrant out for her arrest for previous possession of methamphetamine and the other was caught in possession of meth on the site. At another hot spot, police officers stopped a man for suspicious behavior. When they searched him, they found stolen goods from a burglary that had taken place nearby a few days before. These arrests point to the effectiveness of the SCPD’s new predictive policing system.

Predictive policing saves Santa Cruz money. For every crime prevented by the police, they save the costs they would have incurred of processing and booking the perpetrators, detaining them if need be prior to trial, trying them in court, and housing them in correctional institutions postconviction.

When predictive policing was first introduced in Santa Cruz in July 2011, some police officers thought it sounded like “voodoo magic.” Relying on mathematics and statistics to combat property crime ran counter to many officers’ ideas of police work. Some officers took it as an affront to their skills. Others were concerned that it would mean extra work. However, many officers came around when they realized that driving through a 500-by-500-foot hot spot during an hour-long window requires very little effort in, for quite a lot of
result out. This favorable result-to-effort ratio perfectly exemplifies the impact of intelligence systems on various organizations, businesses, and government operations. Small, directed efforts, guided and informed by intelligence systems, can bring about great change.


**Questions**

1. What are the advantages of predictive policing to the city of Santa Cruz? Provide specific examples.
2. What are potential disadvantages of predictive policing to the city of Santa Cruz? To the SCPD? Provide specific examples.
3. Which of the following choices best describes predictive policing? (1) A way to catch criminals; (2) a way to prevent crimes from happening; or (3) both? Support your answer.

**SPREADSHEET ACTIVITY:** LINKING SHEETS WITH FORMULAS

**Objective:** The objective of this activity is to help you understand that while spreadsheets are powerful, an interconnected workbook is even more so. You will learn how to write formulae that use information contained in different pages to help tie the workbook together.

**Chapter Connection:** Even though the opening case makes the point that spreadsheets are antiquated and often not able to keep up with the vast amounts of data needed to run an organization, spreadsheets still occupy an important place in smaller organizations. This activity brings business intelligence to the smaller mom-and-pop organizations.

**Activity:** As you have seen, business intelligence is a huge concept. It can, however, also apply
DATABASE ACTIVITY: USING PIVOT TABLES

Objective
To learn how to turn a database into a pivot table, which is a structured representation of the database content that lets you observe the relationships of any data field, or group of data fields, to others.

CHAPTER CONNECTION
In this chapter, you read how information systems can be used for better decisions. Most of what you read discussed specialized tools for organizing and presenting data. These are found mostly in medium-large organizations and up. What’s a small business to do?

Even a small business can use a database management system (DBMS) to organize and store information. In this module, we will see one way to use an Access database to support decision making: the pivot table.

This is a small-scale example of business intelligence (section 5.2) and a BI application (section 5.3).

PREREQUISITES
None.

Activity
In this activity, which you will find online at http://www.wiley.com/go/rainer/database, you will use a sales database for a group of computer stores. You will analyze it for differences among stores, for trends, and to see how the group could improve sales.

1. Download the Ch 05 CarlaComputerStores database from http://www.wiley.com/go/rainer/database and open it.
2. Open the OrderQry query by clicking on it in the Navigation Pane at the left of the Access window.
Usage Hint: If you do not see the navigation pane, but the words “Navigation Pane” run vertically at the far left of the window, click on those words or on the » above them to expand it.

Usage Hint: Depending on how your copy of Access is set up, navigation pane items may open with a single or double click. If a single click does not work, double-click. If you are using your own copy, you can set this preference in Options under the File tab. In the Current Database section, click “Navigation Options…”

You will see what looks like a table with information about every sale since in this database. (Its first few rows are shown below.) As you will learn in the Chapter 10 activity, this “table” is not stored in the database. It is created as needed by combining data from other tables in a query. Those other tables are listed under Tables in the navigation pane. You can see how they are related to each other by clicking “Relationships” in the Database Tools ribbon.

These tables are a simplified version of what a real store would use. For example, a real database would include order date and method of payment. However, this database has purchase history: what each customer bought, when, at what store, and with what other items. That is what we will use here.

3. To analyze customer spending, look at this query in Pivot Table view. Select that view from the drop-down View menu at the left of the Home ribbon, or click the second icon from the left at the bottom right of the window.

Usage Hint: Access often provides multiple ways to do something. It usually does not matter which you choose. As you use Access more, you will develop preferences. They do not have to be the same as anyone else’s.

4. A windoid labeled “Pivot Table Field List” floats above the main Access window. It lists all the fields in the query, plus other items that can be derived from them. You will drag these into sections of the pivot table pane to analyze the data.

Usage Hint: If you do not see the Field List windoid, click the Field List icon in the Show/Hide section toward the left end of the ribbon, under the Design tab.
Let's see if there are differences in order size among stores. Drag OrderPrice into the main area of the pane, labeled “Drop Totals or Detail Fields Here.”

5. You will see all the order amounts in the central section of the pivot table. It is useless by itself. In terms of Chapter 1 concepts, it is data, not information. To organize them by store, drag StoreCity into the “Drop Row Fields Here” area at the left of the pane.

6. We want to see the average order size for each store. Select the OrderPrice column by clicking on its header. Then click the AutoCalc icon on the Design ribbon (Σ, the uppercase Greek letter sigma, a common mathematical symbol for summation). From the drop-down menu, select Average. You will see each store’s average order size below the list of orders.

**Usage Hint:** The overall average is labeled “Grand Total.” In everyday language, a “total” is what you get when you add several numbers. Access refers to that concept as a sum. To Access, a “total” is any summary calculation: sum, average, count, or any of the others listed under the AutoCalc icon.

Which city has the highest average sales? The lowest?

7. Suppose we only care about averages, not individual sales. To hide the details, select that column again and click “Hide Details” in the Show/Hide area at the left of the Design ribbon. “Show Details” in the same section will toggle them back on. You can hide or show details for one store by clicking “−” (hide) or “+” (show) under the store’s city.
8. This is called a “pivot table” because you can pivot data from the top to the left and vice versa to make it easier to analyze. Drag the StoreCity label from its current position, above the city names, to the “Drop Column Fields Here” area at the top of the table. Hide and show details. See how the display changes.

Usage Hint: If you get an error message when you move the label, delete one of the totals and re-create it. To delete a total, right-click it in the field list and select Delete, the only item in the drop-down menu that appears..

9. Select Show Details, if they are not already showing, to display order prices. Select it by clicking OrderPrice near the top of any city column. Under AutoCalc, display the sum and the count. One store has the highest total sales but the smallest average sale. Why?

10. Close the query, saving changes when prompted.

11. We want to analyze our sales by city. Open ItemsQry. The TotPrice column in this table is not in the database. It is a calculated field: it is derived on the fly by multiplying the price of the product (in ProductTbl, for consistency across all orders) and the quantity in a given order. Switch to Pivot Table view.

Usage Hint: If you are curious about how calculated fields work, switch to Design View of the query and look at the rightmost column in the lower pane. You will have to make the column wider to see the entire formula, but it is not complicated.

Now, move TotPrice into the main section of the pivot table pane and StoreCity into the Row Fields section. Select TotPrice in the pivot table, add its sum, and click Hide Details in the Show/Hide section of the ribbon.

12. It seems that Boston sold more during the period than any of the other stores. To find out why, we must drill down into the data. (Drilling down is central to most data analysis.) Add ProdCategory to the pivot table as a column field. What you get should look like this:

Usage Hint: If your product categories ended up to the left of the city names, just select its name at the top of the column and drag it to the right until a thick blue line shows up to the right of the StoreCity column. Then release your mouse button.

13. You realize that this table is not easy to interpret. A chart would be better. Choose Pivot Chart view from the drop-down menu at the left end of the ribbon, or click the Pivot Chart icon at the bottom right of the Access window. Add a legend with the tool in the Show/Hide section of the Design ribbon.

14. You now realize that this is not the ideal chart design. It tells us that Atlanta, for example, got more revenue from CPUs than from memory, but anyone who knows computers would expect that. We would like to know how Atlanta compares with other stores in terms of memory revenue. Click Switch Row/Column in the Active Field section of the Design ribbon. You should get a chart whose lower left corner looks like this:

Usage Hint: If your chart does not look like this, try returning to Pivot Table view, swapping categories and cities by dragging one column past the other, and returning to the chart. You may have to switch chart row and columns again.

15. From the part of this chart above the screen shot, we see that Chicago’s CPU sales are a concern. Before calling the Chicago store manager, however, we need to do more research. Go back to PivotTable view and drag ProdDescrip into the row field area. Each category will be broken down by product. To see only products in the CPU category, click the down arrow next to ProdCategory to get a list of categories to filter. Uncheck everything except CPU and confirm.

Usage Hint: Rather than unchecking all the categories except the one we care about, it is easier to uncheck everything by clicking “All,” then check “CPU.”
16. Now look at the chart again. The Chicago store did not sell any SuperCPUs! Its sales of the three slower models are more or less in line with expectations. We do not know the reason for this, of course. Maybe there are few gamers and graphic artists in the store's sales area. (These are two major markets for top-of-the-line systems.) Maybe the Chicago store ran a promotion for these during an earlier period and most of its potential customers bought one then. Maybe a competitor is running such a promo now. We do know, however, what we want to ask when we call the Chicago store manager.

17. Close your database, saving changes when prompted.

Deliverable
1. Your database, with the most recent pivot table and chart.
2. Answers to the questions in items 6 and 9 above, in the form specified by your instructor.

Quiz Questions
1. In step 6, which store had the highest average order amount?
   (a) Atlanta
   (b) Boston
   (c) Chicago
   (d) Denver
2. A pivot table is a way of looking at this type of Access object:
   (a) Query
   (b) Table
   (c) Form
   (d) Either A or B
   (e) Either B or C
3. The central section of the pivot table pane contains this type of information:
   (a) Names of pivot table categories
   (b) Summary data for pivot table cells
   (c) Individual data elements from the database, but not totals
   (d) Links to the underlying Access tables
4. If a pivot table has only one column (that is, it has categories down the left but none across the top), then:
   (a) You can create categories across the top by dragging categories from the side.
   (b) You can create categories across the top by dragging new table fields into the “Drag Column Fields Here” area.
   (c) You can analyze data in that column without having fields across the top.
   (d) All of the above are correct.

Discussion Questions
1. How could pivot tables be useful for someone in the kind of job you hope to have after you graduate? (Say what that job is.)
2. Describe a business decision for which pivot tables would not be helpful. Explain why you don’t think they would help with it.
3. Suppose you worked for a large chain of photo stores. Your database has millions of rows with a few dozen columns in each, but its structure is much like this one. Would that change your approach to using pivot tables? If so, how? (Assume your computer is fast enough that the database size does not cause slow response times. In practice, that might not be true.)

Additional Resources
The ten-minute video at http://www.wiley.com/rainer/go/database is an excellent resource for this activity. As you watch it, keep in mind that Access has many ways to do almost anything. Matthew MacDonald does not always do things exactly as we did here. You can do them as he does them, as described here, and often in other ways as well.