Chapter

11 Business Intelligence and Decision Support

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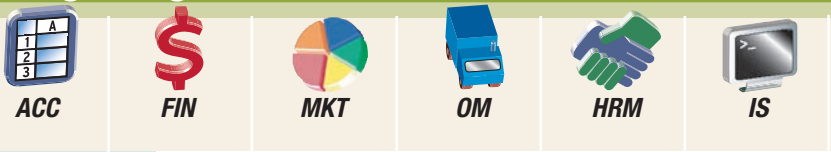
Learning Objectives

1. Understand organizations' need for business intelligence (BI), BI technologies, and how to make a business case for BI investments.
2. Describe BI architecture, data mining, predictive analytics, dashboards, scorecards, and other reporting and visualization tools.
3. Understand the value of data, text, and Web mining.
4. Understand managerial decision-making processes.
5. Describe decision support systems (DSSs), benefits, and structure.
6. Take a forward look at the future of BI in the form of mobile intelligence (MI).

Integrating *IT*



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QUICK LOOK at Chapter 11, Business Intelligence and Decision Support

This section introduces you to the business issues, challenges, and IT solutions in Chapter 11. Topics and issues mentioned in the Quick Look are explained in the chapter.

American businessman John Wanamaker, who's regarded as the father of modern advertising, remarked about 100 years ago, "Half the money I spend on advertising is wasted; the trouble is I don't know which half." Business intelligence (BI), data mining, and the decision support systems (DSS) discussed in this chapter are used to minimize *uncertainty* (the reverse of *intelligence*) and/or to be able to make faster, smarter decisions—often in real time. For example, marketers use BI to track, day by day, the effect of marketing campaigns on sales. Customer service and call center representatives (reps) access BI reports for up-to-the-minute status for problem resolution or to schedule service calls.

Today, BI vendors offer products or software-as-a-service (SaaS) packages to support each management level—strategic, tactical, or operational. BI packages are affordable to organizations of all sizes including SMEs (small and medium enterprises). According to analyst firm Gartner, "BI is truly for everybody because there is no company or role without information needs that cannot be described as BI" (2010). When managers and workers have the intelligence they need to respond *correctly and quickly* to opportunities, threats, and mistakes, they and their companies significantly outperform those that don't.

You read in prior chapters that responsiveness maximizes revenues, efficiency minimizes costs, and not doing the wrong thing minimizes waste. In this chapter, we introduce another factor: proper resource allocation. **Proper resource allocation** is the optimal distribution of resources to a specific place at a specific time to achieve a specific purpose. Ineffective resource allocation—one symptom of which is long wait times—can prevent delivery of products or service when needed. This, in turn, frustrates customers and hurts revenues. BI, properly applied, can improve a company's allocation of resources and profitability—and show a clear return on investment (ROI).

We also introduce the latest topic in BI—mobile intelligence driven by the convergence of mobile computing and BI. We look at intriguing transformations such as changes in the functions of hardware. For example, smartphones are becoming PCs, PCs are becoming servers, servers are becoming the cloud, and the cloud is the new app source.

Why Would Companies Invest in Another Set of IT Apps?

Innovations in IT and real-time media, like Twitter and Foursquare, add to or leverage capabilities of smartphones, improving your ability to be well informed in real time. Many people are notified of live news via tweets or alerts to their mobiles (see Figure 11.1). This type of leveraging to get up-to-the-moment data also applies to BI and decision support apps. BI leverages existing

Figure 11.1 iPhone showing tweets on a mobile Twitter app. (*© ICP-UK/Alamy*)

reporting systems by delivering real-time information through dashboards, mashups, and reports to employees, managers, partners, and customers.

In this chapter, you learn about the tools for intelligence, prediction, operational responsiveness, and resource allocation. You read how BI and DSS collect data from various data sources that you are now familiar with—TPS, CRM, ERP, and POS databases—then compile and analyze the data using data mining and predictive models. Since the latest BI tools provide a high degree of self-sufficiency, reducing managers' dependence on analysts and tech staff, you can expect to be a hands-on user of these tools during your career.

DIRECTV Gets Rave Reviews with Operational BI

DIRECTV (*directv.com/*) is the world's leading provider of digital television entertainment services. Through its subsidiaries and affiliated companies in the United States, Brazil, Mexico, and other Latin American countries, DIRECTV provides digital TV service via satellite, as shown in Figure 11.2, to 18.7 million customers in the United States and 7.1 million customers in Latin America. The company reported quarterly revenues of $5.61 billion in the first quarter of 2010 and annual revenues of $21.6 billion in 2009. DIRECTV is composed of two main operating units—DIRECTV U.S. and Latin America as well as DIRECTV Regional Sports Networks.

Figure 11.2 DirecTV satellite dish on a rooftop in New York City. (*© Frances Roberts/Alamy*)

Rapid Customer Growth Creates Business Challenges

DIRECTV's business model is based on great customer service and competitive rates for TV service. Acquiring and retaining customers are priorities, which are done with aggressive advertising and various incentives depending on the situation. Accurate real-time information and the ability to take action are vital to this business model.

By successfully acquiring customers rapidly, the company faced the challenge of compiling huge volumes of transaction data, which is generated every day from customer calls, and making real-time reports available to call center representatives (reps). These reports would be used for providing or measuring customer service, attracting new customers, and preventing **customer churn,** in which customers switch to a competitor's service. Managers also needed access to reports that detailed the purpose and outcome of customer calls and other call center activity metrics.

The IT that could meet all of its data and reporting requirements was an *operational BI*. Operational BI is a key means of enabling front-line workers and operational managers to spend less time struggling to locate and access information and more time on activities that benefit the business, such as improving efficiency and customer service.

DIRECTV's Operational BI Solution

DIRECTV implemented data mining software from GoldenGate Software for real-time data integration, together with a Teradata data warehouse to achieve operational BI. GoldenGate reads data logs in near real time and, within seconds of a transaction, streams relevant data to the data warehouse over the wide area network (WAN). In essence, the software grabs transactional data in real time, as it is entered, and then delivers data to wherever it is needed within the IT infrastructure.

Their BI system handles data volumes averaging 45 million transactions per day, 1,500 customer service agents running 8,000 reports daily, and the logging of a million calls per day to its CRM application. Call center reps have access to detailed customer reports, which has reduced churn. For example, with fresh data at their fingertips listing customers who had moments earlier asked to be disconnected, sales reps contact and make them a new offer—within a few hours.

In addition, the company is using data mining and real-time operational reports for both order management and fraud detection. With real-time order information on brand new customers, fraud management investigators are able to identify and cancel fraudulent orders saving the cost of a driver/installer and the truck.

Performance Improvement, 2009–2010

The company significantly improved its call center performance, customer service, and customer reacquisition rate, which contributed to sales growth and net profit. In the United States, despite an increasingly competitive industry and economic downturn, DIRECTV added the most net subscribers in four years.

In 2009, DIRECTV posted the highest customer service rating in the *American Customer Satisfaction Index,* beating all major cable companies for the ninth consecutive year. In Latin America, performance was even more impressive. DIRECTV set new records for most of its key metrics, including net customer additions, revenues, and operating profit before depreciation and amortization.

Sources: Compiled from DIRECTV 2009 annual report, *investor.directv.com/* (2010), and Briggs (2009).

For Class Discussion and Debate

1. ***Scenario for Brainstorming and Discussion:*** Highly accurate and trusted reports are often the strongest argument in the business case for investing in operational BI.

a. What does *information accuracy* mean?

b. Does information accuracy differ depending on the level in the organization—strategic, managerial, or operational—or the type of organization? For example, in order for data to be considered "accurate," must it be refreshed every day or be in real time or some other timeframe? In your discussion, compare credit card companies and supply chain operations.

2. ***Debate:*** Proactive vs. reactive approaches to resource allocation.

Perhaps you've been in one or more of the following situations:

- Waiting in a very long checkout line (queue) at the store and noticing there were five other registers not being used
- Waiting to check in luggage at an airport counter being covered by only one attendant, while three other attendants talk on the phone or do other things unrelated to passengers trying to check in
- Deciding to go to a restaurant because it has been promoting a specialty meal only to find the kitchen had run out of it

These three situations were not due to lazy workers or incompetent supervisors. They were the result of poor resource allocation, which can be remedied with the implementation of an operational BI system. However, economic conditions have significantly impacted the budgets. Companies are being conservative about spending for fear of a deeper and extended recession. This has made it more difficult to gain funding for BI initiatives.

There are two approaches to the resource allocation problem:

1. Proactive approach: Companies can take a proactive approach and simply stock more products and/or hire more employees. In this approach, the company is prepared for the highest level of demand for service or products to prevent lost sales or poor customer service.

2. Reactive approach: Companies can take a reactive approach. After a resource runs short, employees are redistributed or more products are ordered. Additional resources are only deployed after they are needed. For example, when the line at the supermarket gets too long, workers are moved from other departments to the front registers. Or a restaurant may increase its food order for the next promotion—and be left with overstock if there's a poor turnout.

Select either the proactive or reactive approach to resource allocation. In the debate, present arguments explaining why your approach is better than the other approach. Make reasonable assumptions, as needed. In the debate, include a consideration of all relevant costs of labor and holding inventory, the state of the economy with tight credit and high interest rates on borrowing, and the benefits of customer satisfaction and loyalty.

Notice that each approach has high costs associated with it. The improper resource allocations that cause these costs can be minimized by implementing BI.

11.1 Business Intelligence (BI) for Profits and Nonprofits

Organizations are often overloaded with data, simultaneously having too much data but somehow not enough. Managers may not have the right data, may not have a way to interpret so much data, or may not be able to compile data to get reports out quickly enough. To combat these types of problems, many organizations use apps that fall under the BI umbrella. *Business intelligence* refers to a collection of ISs and technologies that support managerial decision making or operational control by providing information on internal and external operations.

Due to the complexity of BI implementations, most BI vendors offer highly integrated collections of apps—including connections to ERP and CRM systems—that are Web enabled.

It's tough to fully understand BI because BI apps are not stand-alone systems, nor do they support a specific objective, as do supply chain management (SCM) or customer relationship management (CRM). To help you appreciate the value of BI, in the next section you read about three cases representing diverse uses of BI by for-profit and nonprofit organizations—and then how to recognize the need for BI.

BI CASES

The performance of nonprofits and the profitability of for-profit enterprises depend on the quality and timeliness of information. Enterprises are getting more value from BI by extending information to all managerial levels and to employees, maximizing the use of existing data assets. Visualization tools, including dashboards and mashups, are the user interfaces that help people understand the numbers. Dashboards are apps that pull data from a data warehouse or other data store and then graphically depict the data in meaningful displays. The term *mashup* started in the music world but has been adopted by IT to mean an application that combines data from different sources into a new application. BI systems are very good at filtering and aggregating huge data volumes into information. By combining mapping mashup capabilities with aggregated data, the result is a **data mashup** that can improve the understandability of the information.

In the examples and cases throughout this chapter, you learn how industry-specific analytical tools support analysis and informed decision making from the top level to the user level. BI takes advantage of existing IT technologies to help companies leverage their IT investments and use their legacy and real-time data. In many instances, BI implementation is a competitive or operational necessity. Here are three such cases.

WildTrack (*wildtrack.org/*) Monitors and Verifies Endangered Rhinos in Africa. WildTrack is using a noninvasive footprint identification technique and BI data analysis solution from SAS (*sas.com/*) to track and monitor their constantly changing inventory—endangered African rhinos. Like for-profit businesses, the organization uses BI as a means to cut costs and to make better-informed decisions. Using SAS BI software, WildTrack has already helped save the black rhino population in Zimbabwe and has provided a census of white rhinos in Namibia (see Figure 11.3). In addition, the use of BI solutions has generated ROI in terms of providing local employment for the indigenous workers of Namibia's Waterberg Plateau.

"Increasingly, governments and authorities require hard evidence of the existence of endangered animals before they will listen to guidance about protecting its habitat. Moving forward, we hope to incorporate biometrics and other technology into our projects to help speed up the identification of animals," said Zoe Jewell, cofounder of WildTrack.

Figure 11.3 Endangered black rhinoceroses are tracked using BI. (*© Photoshot Holdings Ltd/Alamy*)

United Way (*unitedway.org/*) Monitors Fund-Raising Campaigns and Generates Reliable Reports. The United Way is dedicated to improving lives by raising money for local groups that address community issues. Fund-raising is an essential component. The United Way has a mandate to closely monitor and track fund-raising campaign profits and make that information available to the public. Problems with its previous data management platform included inflexible reporting practices and the inability to perform important analytics on campaign results. Staff would manipulate large spreadsheets and require several months to complete their reporting after the yearly campaign ended. Each office conducted its own

Figure 11.4 Jamba Juice store managers rely on BI to perform marketing and accounting. (© *David Zanzinger/Alamy*)

reporting, but there was no standardized process and reports required significant effort to produce.

After the United Way implemented an integrated BI solution, it was able to ensure consistent measurement of fund-raising results throughout the organization. Workers can easily track and monitor donor data and make better sense of data analysis. With a 360-degree view of internal processes, staff can better track trends and opportunities, allowing for better future fund-raising planning and initiatives.

Jamba Juice (*jambajuice.com/*) Monitors Customers' Preferences and Captures Data for Fast, Reliable P&L and Financial Reporting. Jamba Juice (see Figure 11.4) is a provider of healthy, on-the-go food and beverages. When the economic downturn slowed its growth, managers decided to implement newer IT across Jamba Juice stores as a way to support increased productivity and, ultimately, profitability.

Store managers had trouble finding information they needed to effectively run their stores. The company maintained what it called an "originals" folder on the company-wide shared network drive, which contained more than 1,000 documents. Everything—equipment manual, store directories, tax forms, and marketing guides—was in the *originals* folder. Every week or two, Jamba Juice corporate employees would push out necessary information to those in the field (in this case, the store managers) by placing it into the originals folder. This process was cumbersome and unreliable because there was no version control on the documents. Store managers had no way of knowing if the document they found was the most accurate. They had to spend at least two hours each week gathering and typing in data that Jamba Juice corporate wanted for analysis purposes. Store managers also struggled to manually update their stores' profit-and-loss (P&L) and other accounting data that their district and regional managers needed.

Even when the information was in the Jamba Juice system, employees were uncertain about the integrity of the data gathered because of conflicting sets of metrics between store and corporate resources. Poor-quality data was damaging profits, so traditional BI was deployed at the corporate level and operational BI was deployed at the store level.

- By deploying BI tools at the corporate level, data about everything from the popularity of each smoothie flavor to regional sales trends are tracked and analyzed to identify trends and to determine how to make the most of customer behavior patterns.
- Deploying BI at the store level to inform marketing decisions, such as promoting certain menu items in certain markets and/or during a specific time period, enabled store managers to be more strategic in their marketing efforts.

These three organizations, as well as DIRECTV (opening case), the military, and disease research centers that you read about in this chapter, recognized the need for BI and could justify their BI investments. They were under pressure to be informed; to make frequent, quick, and/or complex decisions; and to compile trusted data in order to report quickly and frequently to internal or external entities.

TYPES OF BI

BI technology has progressed to the point where companies are implementing BI for various types of users, as shown in Table 11.1 and explained next.

Traditional BI and Operational BI. Strategic BI and tactical BI are referred to as **traditional BI.** Most companies use traditional BI for strategic and tactical decision making where the decision-making cycle spans several weeks or months. Competitive pressures, however, were forcing companies to react on a daily or real-time basis to

TABLE 11.1 Strategic, Tactical, and Operational BI: Business Focus and Users

	Strategic BI	Tactical BI	Operational BI
Primary business focus	To achieve long-term enterprise goals and objectives	To analyze data; deliver alerts and reports regarding the achievement of enterprise goals	To manage day-to-day operations
Primary users	Executives, analysts	Executives, analysts, line-of-business managers	Line-of-business managers, operations
Measures	Measures are a feedback mechanism to track and understand how the strategy is progressing and what adjustments need to be made to the plan.	Measures are a feedback mechanism to track and understand how the strategy is progressing and what adjustments need to be made to the plan.	Measures are individualized so each line manager gets insight into performance of his or her business processes.
Timeframe	Monthly, quarterly, yearly	Daily, weekly, monthly	Immediately, intraday
Data types or uses	Historical, predictive	Historical, predictive modeling	Real time or near real time

Sources: Adapted from Oracle (2007) and Imhoff (2006).

changing business conditions and customer demands—and to extend BI systems to their operational employees.

Operational BI is relatively new and can be implemented in several ways. One way is by improving the responsiveness of traditional data warehouse and BI processing. Another way is to embed the BI directly into operational processes. These approaches are often used together.

HOW TO RECOGNIZE THE NEED FOR BI

You can better understand BI by learning how to recognize the need for it. The following list represents seven difficult situations—common in companies, government agencies, the military, healthcare, research, and nonprofits—that could benefit from improved intelligence.

- **Competing and conflicting versions of the truth:** Interdepartmental meetings turn contentious as participants argue whose spreadsheet has the correct figures and blame others for not providing the latest data.
- **Lagging reports:** IT cannot meet managers' requests for custom reports when they want them. Or accounting cannot do the reconciliations and financial reporting because sales can't figure out their numbers. Or, as in the case at Jamba Juice, store managers don't have access to the data they need for their reporting duties.
- **Can't perform in-depth analysis:** Management knows which of its retail outlets have the greatest sales volume but cannot identify which products have the highest sales.
- **Difficulty finding crucial data:** Managers recently heard that a report showing year-over-year growth for each customer has been posted to the intranet but have no idea how to find it.
- **Need simple-to-use production reporting technology:** Managers compile financial reports using spreadsheets from data they acquire via numerous e-mail and text messages.
- **Delay and difficulty consolidating data:** Reports that require data from multiple operational systems involve generating separate reports from each and then combining the results in a spreadsheet.
- **Not able to comply with government and regulatory reporting mandates:** Sarbanes-Oxley, Basel III, privacy legislation, or other regulatory agency mandates reliable and proper audit trails to attest to financial accuracy.

When companies get to the point where they can no longer perform their analyses with spreadsheets, they tend to migrate to more powerful BI tools. Now we discuss the components of BI.

THE BUSINESS CASE FOR BI

In a tight economy with high interest and unemployment rates, any project requiring a large investment needs to be economically justified. Justifying an IT investment is also known as *making a business case* for it. A **business case** is required to document your initiative and to move it through the approval and funding process.

A successful business case must be well written, compelling, and able to withstand challenges from individuals who do not support or oppose your project. Convincing others that your IT project—or any project—should be funded is a challenging job. Typically many projects are competing for limited organizational resources. Another challenge with justifying BI is that the implementation may start off small and then expand. At one large government agency, BI was first installed as a means for human resources (HR) to keep track of military personnel but then evolved into an enterprise-wide effort, including a build-out of a large Teradata data warehouse and the installation of SAP's Business Objects BI platform. Trying to justify the enterprise-wide BI was easier after the success of the HR BI system.

Three Key Business Goals. Building a business case for BI is the key step in obtaining business sponsorship, commitment, and involvement. The three key business goals used to sell a BI consolidation program are:

1. Lowering total cost of ownership (TCO)
2. Enabling businesspeople to analyze information rather than gathering and reconciling data
3. Improving consistency of and trust in information and analytics

Each of the above business goals has associated costs that need to be estimated in preparing a cost-benefit analysis. It would be great if you could just obtain a set of formulas to calculate the business ROI, but it is just not that simple. You need to quantify some benefits. In order to obtain a truly valid cost-benefit and ROI calculation, IT needs to work very closely with business decision makers.

Eliminating Blindspots. Justifying a BI project involves identifying key strategic, tactical, or operational decisions and business processes that affect performance and would benefit from more comprehensive data and better reporting capabilities. For example, it's tough to identify costs that are saved by using real-time metrics instead of wait-and-see lagging metrics. Justification focuses on improving specific business processes that are hampered by lack of data, or blindspots. **Blindspots** are areas in which managers fail to notice or to understand important information—and as a result make bad decisions or do nothing when action is necessary.

Integrating Data Silos. Before the introduction of BI in the 1980s, managers often complained that they couldn't get the information they needed, at the right level of detail or precision, or at the time when they needed it. Many IT investments had not translated into more sales. And when it came to understanding customers and their buying decisions, there was much more data than there were answers. As a result, when trying to develop a complete view of each customer across all product lines, managers hit a brick wall. For many companies, years of data were, in effect, *locked up* in transactional data silos. Data silos, nonstandardized data, and disparate information systems made getting a unified view of individual customers impossible.

Data silos limit what companies can do, as AT&T's experience demonstrates. Each time a customer called in for service or to complain, AT&T wanted its customer service reps (CSRs) to up-sell the caller by offering a higher level of service, such as an upgraded plan, or to cross-sell by offering a complementary service. But up-selling or cross-selling cannot be done unless the CSR can access reports online

showing all services and plans the caller already had and thus know what to try to up- or cross-sell. Customers are not going to wait for the CSR to read off a long list of extras to buy. Typically, CSRs get one chance to make an offer, so it has to be the right one.

OVERVIEW OF BI COMPONENTS AND CORE FUNCTIONS

When you examine the components of BI, you realize that it is not an entirely new set of ITs. BI capabilities depend on an integration of several ITs that you read about in earlier chapters. BI incorporates data warehousing, data mining, online analytical processing (OLAP), dashboards, the use of the Web, and, increasingly, social media. Other requirements are wired and wireless broadband networks.

Three core functions of BI are query, reporting, and analytics. Queries are one way to access a particular view of the data or to analyze what is happening or has happened. For operational BI, data is typically accessed or distributed via reports. Data mining and predictive analytic tools are used to find relationships that are hidden or not obvious, or to predict what is going to happen. For instance, data mining can identify correlations, such as which factors—a prospect's income, education, age, last purchase amount, and so forth—were most closely related to a successful response in a marketing campaign. Some data mining, predictive analytics, and other analytical tools can be used directly by users, but some are too complex for them to understand and use. Knowing how to interpret and act on the results of queries, reports, or analytics depends on human expertise.

The ability to quickly and easily access data that you couldn't trust would be a total waste. Therefore, BI also includes processes and tools to accurately and consistently consolidate data from multiple sources and to ensure data quality.

Other BI components include the following:

- **Search** is a familiar concept to you. Powerful search engines and indexing are needed to locate data, reports, schematics, messages, and other electronic records.
- **Data visualization tools,** such as dashboards and mashups, display data in summarized, easy-to-understand formats. **Dashboards** are user interfaces that enable managers and other workers to measure, monitor, and manage business performance effectively. The importance of data visualization cannot be overestimated.
- **Scorecards** and **performance management** help to monitor business metrics and key performance indicators (KPIs). Examples of KPIs are customer satisfaction, profitability, and sales per employee.

A **scorecard** is a methodology for measuring an organization's performance. A dashboard is a means of presenting measurements from whatever source. Thus, a dashboard could be used to present a scorecard. The two concepts are complementary, not competitive. Visit *iDashboards.com* to preview live dashboards by industry or by function. You read about these components throughout this chapter.

INTEGRATING DISPARATE DATA STORES

With constantly changing business environments, companies want to be responsive to competitors' actions, regulatory requirements, mergers and acquisitions, and the introduction of new channels for the business. As you've read, responsiveness requires intelligence, which in turn requires having trusted data and reporting systems. Like many companies, global securities firm J.P. Morgan Chase had suffered from a patchwork of legacy reporting systems that could not be easily integrated because of their lack of standardization. When data is not integrated into a unified reporting system, there is no trusted real-time view.

Product data for international retailers in particular is a problem. Countries use different barcodes, but they need to be linked so that retailers can optimize product availability and revenues. Other deficiencies that have frustrated decision makers because of disparate ISs are:

- Getting information too late
- Getting data at the wrong level of detail—either too detailed or too summarized

- Getting too many directionless data
- Not being able to coordinate with other departments across the enterprise
- Not being able to share data in a timely manner

Faced with those deficiencies, decision makers had to rely on the IT department to extract data to create a report, which usually took too long. Or they extracted data and created their own decision support spreadsheets, which were subject to data errors and calculation mistakes. Making matters worse, if spreadsheets were not shared or updated, then decisions were being made based on old or incomplete data. BI was the solution to many data problems.

POWER OF PREDICTIVE ANALYTICS, ALERTS, AND DECISION SUPPORT

BI technology evolved beyond being primarily a reporting system when the following features were added: sophisticated predictive analytics, event-driven (real-time) alerts, and operational decision support. Using a BI system for reporting alone was like driving a car looking through the rear-view mirror. The view was always of the past. The greatest strength of a company's predictive analytical technology is that it allows a company to react to things as they happen and to be proactive with respect to their future.

Predictive Analytics. **Predictive analytics** is the branch of data mining that focuses on forecasting trends (e.g., regression analysis) and estimating probabilities of future events. The top five business pressures driving the adoption of predictive analytics are shown in Figure 11.5. **Business analytics,** as it is also called, provides the models, which are formulas or algorithms, and procedures to BI. An **algorithm** is a set of rules or instructions for solving a problem in a finite number of steps. Algorithms can be represented with a flow chart, as in Figure 11.6. There are predictive analytic tools designed for hands-on use by managers who want to do their own forecasting and predicting. Demand for this capability to predict grew out of frustration with BI that helped only managers understand what had happened.

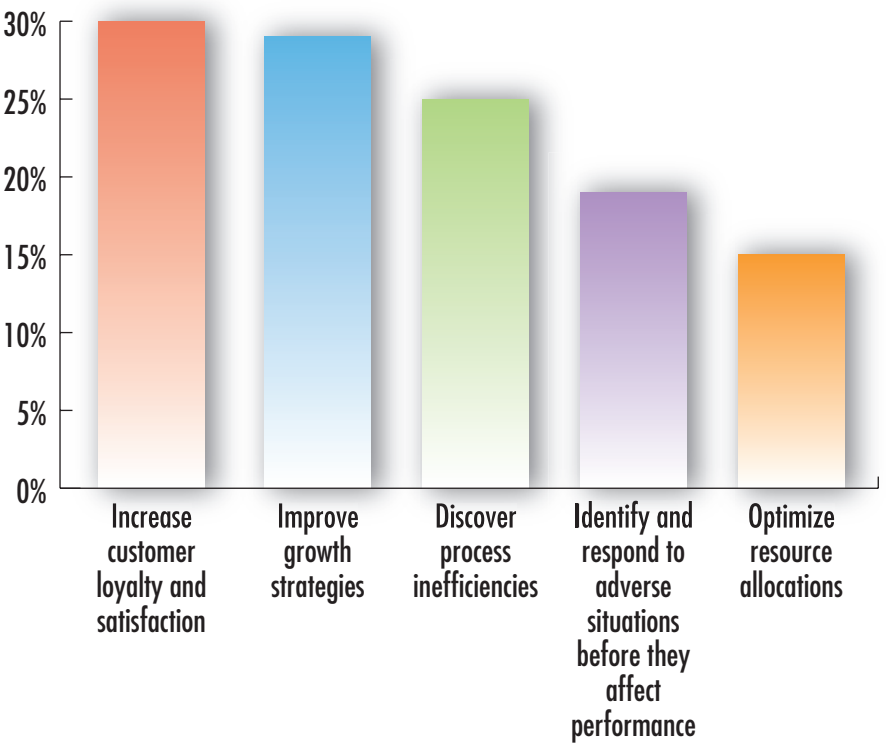

Figure 11.5 Top five business pressures driving the adoption of predictive analytics. (*Data from Aberdeen Group.*)

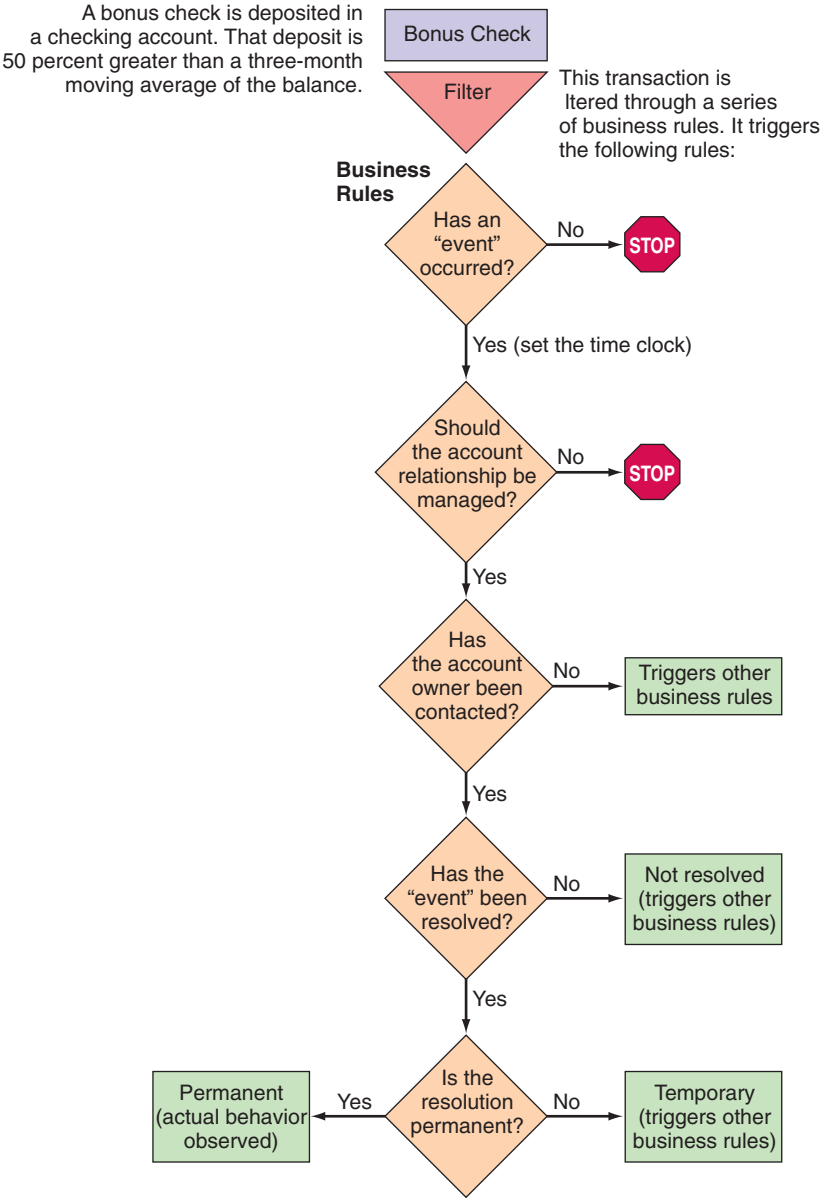

Figure 11.6 Real-time alerts triggered by customer-driven events.

While there were many query, reporting, and analysis tools to view what had happened, managers wanted tools to predict what would happen and where their businesses were going. The value of predictive analytics at eHarmony is discussed in *IT at Work 11.1*.

Building predictive analytic capabilities requires computer software and human modeling experts. Experts in advanced mathematical modeling build and verify the integrity of the models and interpret the results. This work is done is two phases. The first phase involves identifying and understanding the business metrics that the enterprise wants to predict, such as compatibility matches, customer churn, or best cross-sell or up-sell marketing opportunities by customer segment. While an advanced degree is not needed to identify metrics, PhD-level expertise is necessary for the second phase—defining the predictors (variables) and analytical models to accurately predict future performance.

Event-Driven Alerts. As the name implies, **event-driven alerts** are real-time alerts or warnings that are broadcast when a predefined event, or unusual event, occurs. Figure 11.6 shows the processing that occurs when a predefined event occurs—in this

IT at Work 11.1

eHarmony Uses Predictive Analytics for Compatibility Matching

Founded in 2000, eHarmony was the first relationship Web service to use a scientific approach to match compatible singles. eHarmony markets itself based on its ability to predict compatibility between two people. In 2006, with 11 million registered members, eHarmony turned to more advanced analytics and proprietary algorithms to improve its matchmaking capabilities.

The company purchased predictive analytics software from SPSS (*spss.com*) to build models that would more accurately measure compatibility variables. In addition to model building, the software supports scientific research, brand development, and customer satisfaction and retention. One research objective was to start tracking couples from the time before they were married in order to monitor relationships that lasted and those that did not— and to use that data to develop models to predict successful outcomes. eHarmony states that its analytic approach is successful, as measured by its claim that it is responsible for over 90 members marrying each day.

Sources: Compiled from Hatch (2008), *spss.com* (2008), and *aberdeen.com*.

Discussion Questions: Explain the purpose and value of predictive analytics at eHarmony. What are the data sources for model building? Is eHarmony's proprietary algorithm a competitive advantage? Explain your answer.

case, an unusually large deposit. Since events need to be quantified, an unusually large deposit is considered a deposit that is 50 percent greater than a three-month moving average of the balance. Notice that the deposit is the event that triggers an analysis of the event. The analysis is done according to predefined business rules to determine what type of action would improve profitability.

Of course, alerts require real-time monitoring to know when an event of interest has occurred and business rules to know what to monitor and what to do. In Figure 11.6, the business rules are in the diamonds. In this scenario, when a deposit is made that is more than double the amount of the average deposit over the past three months, it triggers a series of business rules. The bank may contact the customer with offers for a one-year CD, investment plan, insurance product, and so on. Based on the answers to the business rules, further processing may stop or other rules leading to an alert to take action may be triggered.

For a credit card company, a customer's sudden payoff of the entire balance might trigger a business rule that leads to an alert because the payoff could be a signal that the customer is planning to cancel the card. There may be intervention, such as a special low interest rate offering, to reduce the risk of losing the customer.

Event-driven alerts can also be built into a business process or application. For example, the process could be programmed to predict the impact of events such as sales, orders, trades, shipments, and out-of-stock items on the company's performance. Typically, the results would be presented through a portal or Web-based dashboard. Figure 11.7 shows a sample performance dashboard, which includes KPIs. Note that the dashboard is configurable by using the drop-list controls to select period and product, and by using the tabs across the top of the dashboard. Dashboards are discussed later in the chapter. The software can be configured to alert staff to unusual events and to automatically trigger defined corrective actions.

Event-driven alerts are an alternative to more traditional (non-real-time) BI systems that extract data from applications, load it into databases or data warehouses, and then run analytics against the data stores. While demand for near-real-time information always existed in customer-facing departments like marketing, the costs and complexity of loading data in traditional BI systems several times per day kept data out of their reach. Those technological BI limitations have been resolved to a large extent.

Figure 11.8 shows how the components come together in a BI app. Consider a national retail chain that sells everything from grills and patio furniture to paper products. This company stores data about inventory, customers, past promotions, and sales numbers in various databases. Even though this data is scattered across multiple systems—and may seem unrelated—ETL tools can bring the data together to

Figure 11.7 Sample performance dashboard.

the data warehouse (DW). **ETL** stands for extraction, transformation, and load processes that are performed on the data. In the DW, tables can be linked, and *data cubes* (another term for multidimensional databases) are formed. For instance, inventory data is linked to sales numbers and customer databases, allowing for extensive analysis of information. Some DWs have a dynamic link to the databases; others are static.

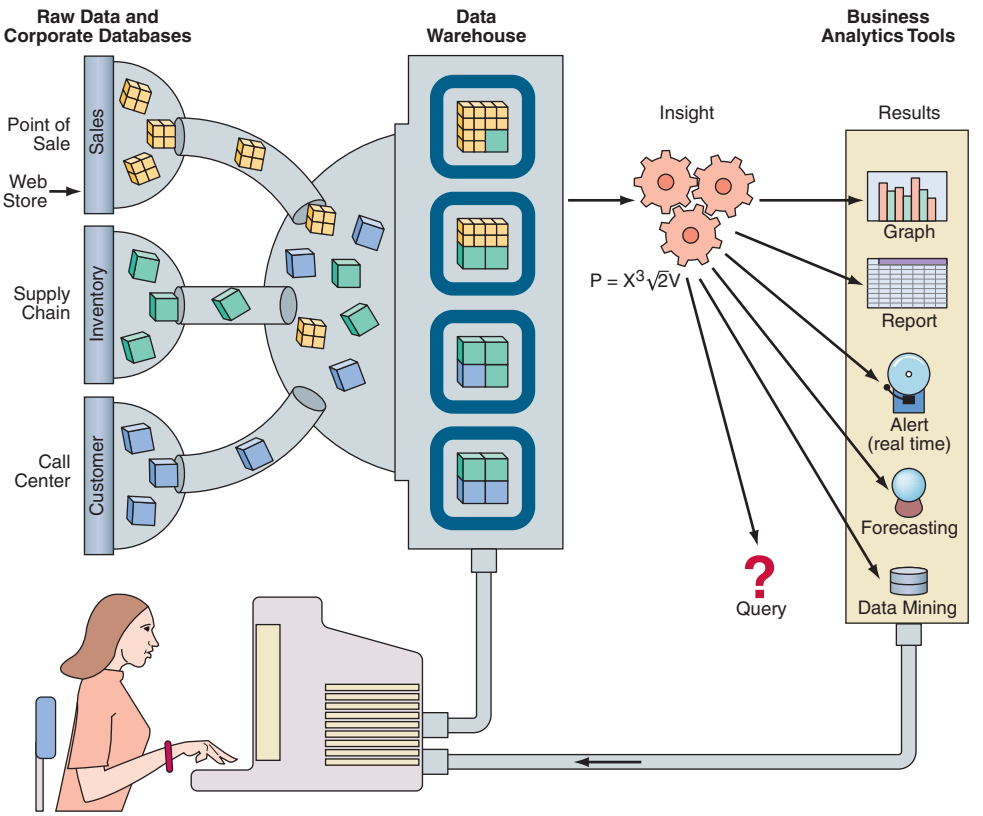

Figure 11.8 How a BI system works.

From an IT perspective, BI is a collection of software and tools, as we have just described. Next, we discuss BI flaws, mostly from a business perspective.

BI FLAWS THAT CONTRIBUTE TO BI FAILURES

Research firm Gartner says most failed BI efforts suffer from one or more fatal flaws, generally revolving around people and processes rather than technology. The following seven flaws apply not only to BI but also to other enterprise IT implementations.

Flaw #1. Believing That "If You Build It, They Will Come." Often IT implementations, including BI, are treated as technical projects. The danger with this approach is that BI's value is not obvious to the business, so all the hard work does not result in massive adoption by business users. Gartner recommends that the BI project team include significant representation from the business side. In addition, IT and communication skills are required for successful BI initiatives.

Flaw #2. Being Locked into an "Excel Culture." Microsoft Excel is the most widely used software for data analysis and reporting. Users extract data from internal systems, load it to spreadsheets, and perform their own calculations without sharing them company-wide. The result of these multiple, competing frames of reference is confusion and even risk from unmanaged and unsecured data held locally by individuals on their PCs. This *Excel culture* will interfere with the success of BI. Executive sponsorship is needed to motivate and transition users to believe in a transparent, fact-based approach to management and have the strength to cut through political barriers and change culture. Table 11.2 lists other BI-relevant organizational culture factors.

Flaw #3. Ignoring Data Quality and Relevance Issues. People won't use BI apps that are based on irrelevant, incomplete, or questionable data. To avoid this, firms should establish a process or set of automated controls to identify data quality issues in incoming data and block low-quality data from entering the data warehouse or BI platform. No matter how spectacular the dashboard interface is, it means little unless it is being fed with trusted data.

Flaw #4. Treating BI as a Static System. Many organizations treat BI as a series of departmental projects, focused on delivering a fixed set of requirements. However, BI is a moving target. During the first year of any BI implementation, as people use the system, they think of changes to suit their needs better or to improve underlying business processes. These changes can affect 35 percent to 50 percent of the application's functions. Organizations should expect and encourage changes to the BI portfolio.

Flaw #5. Pressing BI Developers to Buy or Build Dashboards Quickly and with a Small Budget. Managers don't want to fund expensive BI tools that they think are risky. Many of the dashboards delivered are of very little value because they are

TABLE 11.2 Organizational Culture Factors That Contribute to BI Success

These elements of organizational culture impact the degree of BI success.

- The enterprise is comfortable with fact-based analysis.
- Operational measures of transparency exist.
- Analysis and facts flow freely throughout the company.
- The enterprise is not limited by traditional hierarchal structures.
- Fact-based decision making is an integrated process that maximizes the ROI.
- Quantitative practitioners are considered by their leadership and peers to be sources of new insights.

TABLE 11.3 Defining KPIs

To report on key performance indicators (KPIs), those KPIs must be identified and agreed to. For example, managers typically need answers to the following questions. However, answers to these queries depend on how metrics are defined and measured.

1. Which of our customers are most profitable and least profitable?
2. Which products or services can be cross-sold and up-sold to which customers most profitably?
3. Which sales and distribution channels are most effective and least effective for which products?
4. What are the response rates and profit contributions of current marketing campaigns?
5. How can we improve customer loyalty?
6. What is the full cost of retaining a satisfied customer?

Some agreement as to how to define and measure customer profitability, costs to retain a customer, and so forth is needed to define the benchmarks or metrics.

silo-specific and not founded on a connection to corporate objectives. Gartner recommends that IT organizations make reports as pictorial as possible.

Flaw #6. Trying to Create a "Single Version of the Truth" When One Doesn't Exist. This flaw seems contradictory because *single version of the truth* is one of the benefits most often mentioned. The "single version" concept is a flaw for organizations that haven't agreed on definitions of fundamentals, such as revenues and expenses. Achieving one version of the truth requires cross-departmental agreement on how business entities—customers, products, key performance indicators, metrics, and so on—are defined. Many organizations end up creating siloed BI implementations that perpetuate the disparate definitions of their current systems. See Table 11.3 for challenges in defining *one truth*.

Flaw #7. Lack of a BI Strategy. The biggest flaw is the lack of a documented BI strategy or the use of a poorly developed or implemented one. Gartner recommends creating a team tasked with writing or revising a BI strategy document, with members from the IT, other functions, and/or the BI project team (see Flaw #1).

BI Vendors. Until 2007, the BI market was dominated by Cognos and Business Objects. In 2008, three multibillion-dollar acquisitions helped consolidate the BI vendor market and intensified competition among the megavendors. SAP acquired Business Objects for $7 billion, IBM acquired Cognos for $4.9 billion, and Oracle acquired Hyperion for $3.3 billion. These acquisitions highlighted two important trends in modern business: (1) BI has evolved into one of the hottest segments in the software market, and (2) major software corporations are integrating BI capabilities into their product mix.

Although they're not pure-play BI vendors, in 2010, IBM, Microsoft, Oracle Corp., and SAP AG owned two-thirds of the $6 billion BI market. They've captured huge market share because they optimized their BI platforms to work well with their enterprise and information management applications. This integrated approach, as well as the fact that many enterprises already have these vendors' ERP and information management apps in place, is motivating customers to standardize on one of their BI platforms.

However, according to Gartner, these four vendors innovate slowly and are facing greater competition from newer companies, such as Tableau Software Inc. and QlikTech International AB, and from pure-play BI vendors, such as Information Builders and Microstrategy. To compete against the Big 4 in BI, the pure-play and niche vendors offer a better product mix and features (Torode, 2010). They offer newer interfaces with interactive visualization tools, scenario modeling, and data

mashups, which are changing the way information is collected and analyzed. Also helping niche and pure-play vendors gain market share is the fact that enterprises usually introduce more than one BI platform to meet their varying business needs.

Review Questions

1. Explain how to recognize the need for BI.
2. Describe the components of BI.
3. Explain the cause of blindspots.
4. What is meant by a trusted view of data? Why wouldn't data be trusted?
5. Distinguish between traditional and operational BI.
6. Explain predictive analytics. List three business pressures driving adoption of predictive analytics.
7. Explain how an event-driven alert system functions.
8. Explain four BI flaws that contribute to BI failure.
9. Why is organizational culture important to BI success?

11.2 BI Architecture, Analytics, Reporting, and Data Visualization

The Data Warehousing Institute's (TDWI) definition of BI is *to gain insight from data for the purpose of taking action*. The ability to take action is closely tied to the topics in this section: analytics, reporting, alerts, dashboards, scorecards, and other visualization tools. Data visualization is often critical to conveying status and other information quickly so users know what action to take. For example, UPS uses data analysis and visualization as part of its tactical and strategic planning process. In an industry where delivery time is critical, UPS leverages BI tools that make it possible to make *game-time* decisions and quickly adjust operations as new information is received.

All types of organizations are using BI analytics, reporting, and visualization. It's not surprising that leading retailers, manufacturers, and finance and service companies, such as Sears, Walmart, Whirlpool, Ford Motors, Dow Chemical, UPS, and Citi, rely on these tools. BI tools are also used in much less known situations, such as transport of wounded soldiers to treatment facilities worldwide, as discussed in *IT at Work 11.2,* and in anti-HIV therapy research, which is discussed in the EuResist Nonprofit Case at the end of the chapter.

A CLOSER LOOK AT BI ARCHITECTURE

The IT architecture that is needed for BI depends on the number and type of data sources or ISs, the volume of data, how much data extraction and transformation needs to be done, and the reporting timeline that's needed. For example, near-real-time reporting that needs to capture POS data and integrate data from several data marts, as at Jamba Juice, is going to need a complex architecture.

In this section, you read about BI architecture in greater detail. This section describes data extraction and integration; reporting and user interfaces; query, data mining, and analysis tools; and then business performance management (BPM). Table 11.4 lists the elements of a BI strategic project plan.

Data Extraction and Integration. To begin, tools extract data of interest from various data sources such as ERP, CRM, SCM, legacy systems, data marts or warehouses, and/or the Web. Extracted data, particularly when it's extracted from multiple sources, is not in usable format. Another problem is that different systems use their own field names, for example, *CUST_NUMBER* vs. *CUSTOMER_NUM*. Data extraction tools have to map the field names of the same data types and then reformat the data itself into a standard format. It is impossible to integrate data until the data transformation process is done. The third process is to load the standardized data into a data warehouse, or other data store, where it can be analyzed or used as the source of data for reports.

To summarize, the three data integration processes, **extraction, transformation, and load (ETL),** move data from multiple sources, reformat it, and load it into a central data store. Standardized data can be analyzed, loaded into another operational

IT at Work 11.2

BI Saves Lives of Wounded Soldiers from Battlefield to Treatment

When soldiers are wounded in battle, the military needs to be able to quickly diagnose their condition and provide efficient medical transport, which require real-time information, pinpoint accuracy, and visualizations that are easy to use and understand. The United States Transportation Command (U.S. TRANSCOM), under the Department of Defense (DoD), uses Information Builders' WebFocus BI software to optimize patient-movement plans based on key factors such as urgent medical needs and available facilities—and to measure enterprise-wide costs and performance. These apps are part of TRAC2ES, a comprehensive BI reporting and analysis system that helps sick or injured personnel reach the optimal destination via the most expedient transport method. TRAC2ES (TRANSCOM Regulating and Command and Control Evacuation System) supports patient movement from the battlefield to the treatment facility and, when necessary, to rehabilitative care in hospitals, such as Walter Reed Hospital in Washington, D.C.

TRAC2ES: Intelligence for Coordinating Patient Care. TRAC2ES tracks and coordinates patient information throughout the U.S. military's worldwide network of healthcare facilities. Figure 11.9 presents an overview of TRAC2ES. TRAC2ES's decision support information supported the troops during operations Enduring Freedom and Iraqi Freedom by providing 100 percent patient-in-transit visibility for more than 73,000 patient movements.

Prior to TRAC2ES, the transport of wounded and sick soldiers was often wrong and delayed. Mistakes during Operation Desert Storm highlighted the need for improved coordination of medical care for injured soldiers. In some cases, wounded soldiers were directed to the wrong hospital or to facilities that didn't provide the necessary specialties and treatments. The need for a more efficient patient-movement process led to the implementation of TRAC2ES.

Reports Distributed to U.S. President and Congress. TRANSCOM reports created by senior command officers are sent to the president and Congress; they include data about the number of patients and movements, the number of missions, and related costs. Authorized users can generate more detailed reports to monitor the status of patients from the beginning of transport to the outcome of treatment.

Performance Metrics. TRAC2ES also provides critical patient safety metrics. For example, it ensures that an injured person won't be adversely affected by a long flight. When a 21-year-old active duty army specialist sustained blast and burn injuries in a car bombing on the Iraqi battlefield, the system helped ensure he was rapidly evacuated. Using TRAC2ES, the military team transmitted vital patient information from the 31st Combat Support Hospital in Baghdad to surgeons at Landstuhl Regional Medical Center in Germany, then on to the USAISR Burn Center in San Antonio, Texas. Well-orchestrated communication and evacuation ensured that the patient received critical care at each step of the process. The BI capabilities integrate data, giving decision makers a clear view of all the paths leading toward resolving resource allocation challenges.

Sources: Compiled from *cs.amedd.army.mil/, trac2es.transcom.mil/* and Information Builders (2009).

Discussion Questions: Explain the intelligence provided by TRAC2ES. Explain the resource allocation process—given that many of the resources do not move, but rather troops are moved to the resources. Describe the performance metrics. What inefficiencies has TRAC2ES minimized or eliminated? In your opinion, how important are the data visualization tools? Explain your answer.

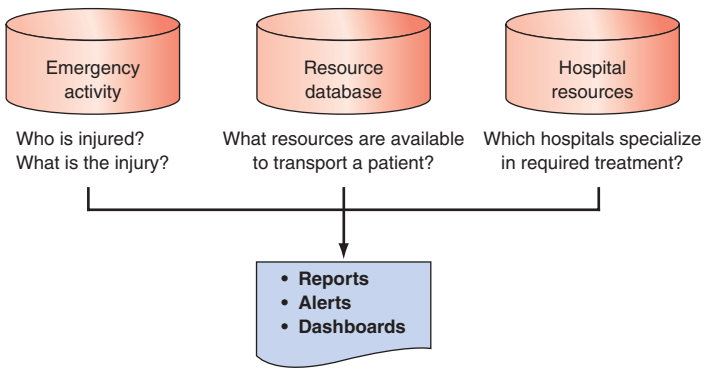

Figure 11.9 Overview of the BI architecture of TRAC2ES to calculate the best transport method to the most appropriate medical center for treatment.

TABLE 11.4 Elements of a BI Plan

Planning a BI implementation is a complex project and includes typical project management steps. Here is an overview of the steps of a BI project plan. Concepts mentioned, for instance *making a business case for BI*, are described in the chapter. It would be valuable to consider the seven flaws described in Section 11.1 as you read these steps.

1. Define the scope of the BI implementation. Specify what is included in the scope and what is not. Key questions to be answered:
   - **a.** Is the BI just reporting, analytics, and dashboards?
   - **b.** Or does the BI also require ETL, data warehousing, Web portals, broadband wireless networks, and other advanced IT?

   BI projects range from relatively simple if only (a) is *yes* to enormous projects if both (a) and (b) are *yes*.
2. Obtain senior management commitment and a champion. No IT project can succeed without the financial support of top management. Getting commitment and a champion may require making the business case for BI or showing the ROI of other companies.
3. Organize a BI project team.
4. Document the current status of and problems with reporting, analysis, data quality, and other data-related issues.
5. Define the BI requirements, including who will be affected and supported, data latency tolerances, whether the BI will be traditional or operational, reporting and delivery (desktop, mobile, portal, extranet), and training needs.
6. Create a list of vendors and consultants that can meet the BI requirements. Review demos and case studies, and make use of free trials and downloads.
7. Select BI and data warehousing software vendors, consultants, and systems integrators, as needed.

Sources: Adapted from Evelson (2010) and *Teradata.com*.

system, or used for reporting or other business process. The central data repository, data security, and administrative tools form the **information infrastructure.**

Reporting. Enterprise reporting systems provide standard, ad hoc, or custom reports that are populated with data from trusted sources. Almost all companies that implement BI have installed self-service data delivery and reporting. Users access the information and reports they need directly. The self-service approach reduces costs, improves control, and reduces **data latency.** Technically, the speed with which data is captured is referred to as data latency.

Routine reports are generated automatically and distributed periodically to internal and external subscribers on mailing or distribution lists. Examples are weekly sales figures, units produced each day and each week, and monthly hours worked—and transport of wounded troops as described in *IT at Work 11.2*.

Here is an example of BI reporting: A store manager receives store performance reports generated weekly by the BI software. After a review of one weekly report on store sales, the manager notices that sales for computer peripherals have dropped off significantly from previous weeks. She clicks on her report and immediately drills down to another enterprise report for details, which shows her that the three best-selling hard drives are surprisingly underselling. Now the manager needs to investigate why. Further drill-down by individual day may reveal that bad weather on two days caused the drop in sales for that week.

User Interfaces: Dashboards and Scorecards. Dashboards and scorecards are interactive user interfaces and reporting tools. Dashboards, like a vehicle's dashboard, display easy-to-understand data. Business users like these tools for monitoring and analyzing critical information and metrics. Information is presented in graphs, charts, and tables that show actual performance vs. desired metrics for at-a-glance status reports. Table 11.5 lists capabilities of dashboards.

TABLE 11.5 Digital Dashboards Capabilities

Capability	Description
Drill-down	Ability to go to details at several levels; can be done by a series of menus or by query.
Critical success factors (CSFs)	The factors most critical for the success of business. These factors can be organizational, industry, departmental, etc.
Key performance indicators (KPIs)	The specific measures of CSFs.
Status access	The latest data available on KPI or some other metric, ideally in real time.
Trend analysis	Short-, medium-, and long-term trend of KPIs or metrics, which are projected using forecasting methods.
Ad hoc analysis	Analyses made any time, upon demand, and with any desired factors and relationships.
Exception reporting	Reports that highlight deviations larger than certain thresholds. Reports may include only deviations.

The more advanced dashboards present KPIs, trends, and exceptions using Adobe Flash animation. With Microstrategy Dynamic Enterprise Dashboards (*microstrategy.com/dashboards/),* dashboard designers can integrate data from various sources to provide performance feedback in multiple dimensions and optimize decision making in an interactive Flash mode. Figure 11.10 is an example of a multidimensional view of sales revenue data.

Dashboards are designed to support a specific function. For example, marketing dashboards report the traditional metrics—customer acquisition costs, customer retention rates, sales volume, channel margins, and the ROI of marketing campaigns. Accounting dashboards report on cash flows, accounts receivables and payables, and profitability metrics.

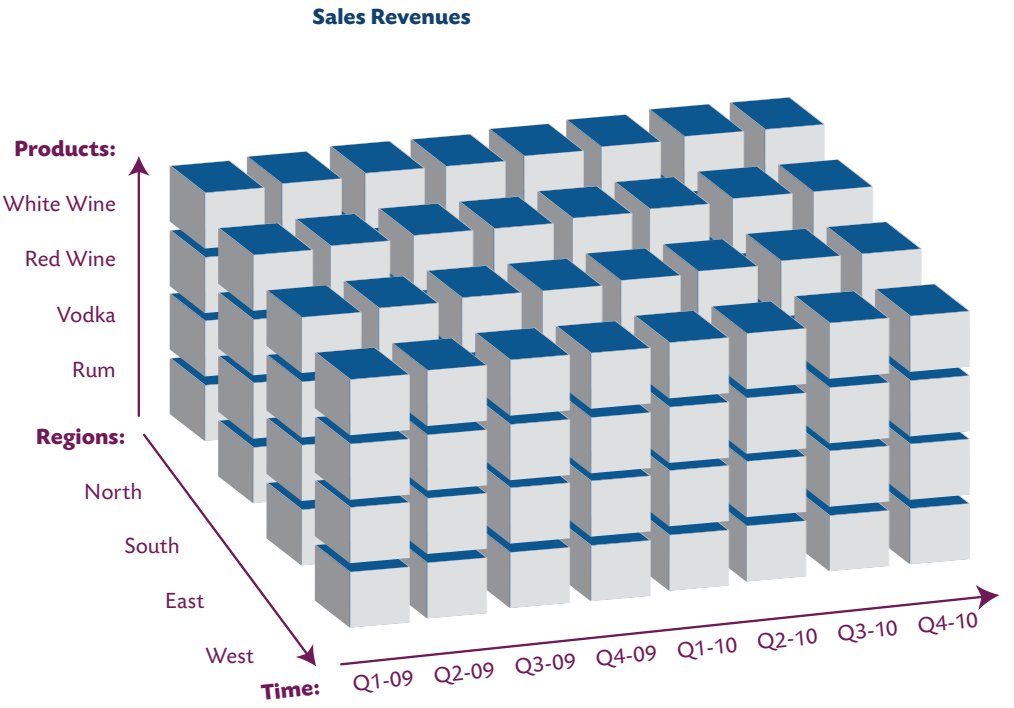

Figure 11.10 Multidimensional (3-D) view of sales revenue data.

Dashboards are also part of green IT initiatives. Because of demands from customers, employees, shareholders, and policymakers for environmentally friendly business practices, companies use dashboards instead of paper.

The **balanced scorecard methodology** is a framework for defining, implementing, and then managing an enterprise's business strategy by linking objectives with factual measures. In other words, it is a way to link top-level metrics, such as the financial information created by the chief financial officer (CFO), with actual performance.

DATA MINING, QUERY, AND ANALYSIS

Data mining, ad hoc and planned queries, and analysis tools help people "understand the numbers." These tools convert data to information and knowledge. The trend toward self-sufficiency applies to these tools also. BI prepares and provides the data for real-time reporting, decision support, and detailed analysis by end users. Users are able to explore the data to learn from it themselves.

To avoid confusion, here is the general difference between analysis and analytics: *Analysis* is the more general term referring to a process; *analytics* is a method that uses data to learn something. Analytics always involves historical or current data.

Query Example. An example of a multidimensional business query is: *For each of the four sales regions, what was the percent change in sales revenue for the top four products per quarter year compared to the same quarters for the three past years*?

This business question (query) identifies the data—*sales revenues*—that the user wants to examine. That data can be viewed in three dimensions: *sales regions, products*, and *time* in quarters. The results of this query would be shaped like the multidimensional cube shown in Figure 11.10.

Any query that's not predefined is an *ad hoc query.* Ad hoc queries allow users to request information that is not available in periodic reports, as well as to generate new queries or modify old ones with significant flexibility over content, layout, and calculations. These answers expedite decision making. Simple ad hoc query systems are often based on menus for self-service.

BUSINESS PERFORMANCE MANAGEMENT (BPM)

Business performance management (BPM) requires that managers have methods to quickly and easily determine how well the organization is achieving its goals and objectives, and whether or not the organization is aligned with the strategic direction. BPM relies on BI analysis reporting, queries, dashboards, and scorecards. The relationship between BPM and other components is shown in Figure 11.11.

The objective of BPM is strategic—to optimize the overall performance of an enterprise. By linking performance to corporate goals, decision makers can use the

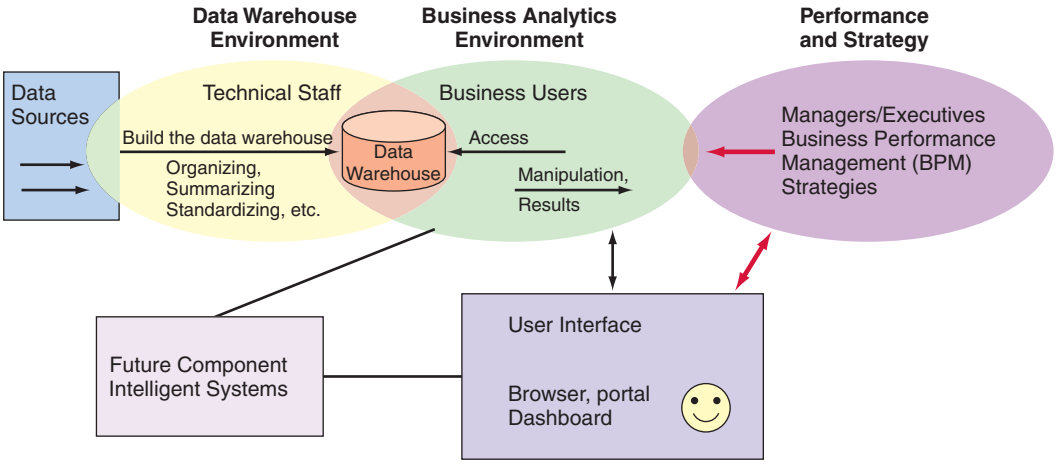

Figure 11.11 BPM for monitoring and assessing performance.

IT at Work 11.3

U.K. Fashion Chain Uses BI and DSS to Predict and Replenish Intelligently

The fashion chain Bank, with headquarters in the United Kingdom, doubled the number of branches and believes this growth is due to better stock availability, faster replenishment, more accurate forecasting, minimal merchandising and buying costs, and the use of sophisticated BI and DSS tools.

The retail system's efficiency has improved sell-through by 5 percent and increased staff efficiency. Only seven merchandising and buying staff were needed to manage the extra volume of work. Also, warehousing staff have been reduced by 15 percent despite 15 more stores being added.

Intelligent Product Ordering. A key reason cited by Bank for its expansion is **real-time visibility**—the ability to consistently have the right customer sizes in stock. Bank's buyers have used BI tools to analyze which trends are taking off and to take full advantage of this knowledge to make sure the goods are in stock.

The system forecasts future buying patterns based on historical data. Buyers use *what-if* analysis to understand the effects of different buying ranges. For instance, when Bank analyzed its customers' size profiles, it found it was buying too many large sizes. The retailer altered its size ratios for appropriate styles and estimates doing so has increased sell-through by 5 percent.

Buyers and managers quickly see current stock levels, product performance, and profitability in real time on dashboards and, equally important, what customers are not buying. By comparing sales with previous years' figures, buyers can establish when sales patterns are different to determine price elasticity, so stock items can be priced correctly and mid-season promotions can be changed overnight when necessary.

Intelligent Replenishment. Merchandisers' minimum stock levels are predefined for each store. When new stock arrives in the warehouse, it is sorted quickly and dispatched in a very smooth operation. This allocation/replenishment method is extremely efficient.

Other Benefits. The management uses Futura's (*futurauk.com/*) performance management and analytical tools to model future sales, costs, cash and inventories, then define the top-level budget.

Sources: Compiled from *Futurauk.com*, Goulden (2006), and Perry (2007).

Discussion Questions: What is the impact of real-time visibility on managers' performance at Bank? What efficiencies have BI and DSS capabilities provided Bank? How do these efficiencies create a competitive advantage? Why was Bank able to increase the number of stores and reduce the number of employees?

day-to-day data generated throughout their organization to monitor KPIs and make decisions that make a difference.

BI PAYOFFS AND APPLICATIONS

BI has paid big dividends for companies in competitive marketplace environments, as illustrated in *IT at Work 11.3* at Bank, a retailer in the United Kingdom.

BI ranked near the top of many companies' IT purchase plans in 2010 and 2011. An underlying reason for this interest is that companies cannot afford mistakes or waste. At a time when inflation and energy prices are cutting into profit margins and consumers' disposable income, managers need to make smarter, more informed decisions. Exxon/Mobil and Cigna Insurance credit their profitability and explosive growth to BI. Using balanced scorecards, they precisely gauge their market opportunities and position their companies to become financial and performance leaders in their market niches. Examples of other common BI apps are listed in Table 11.6.

INDUSTRY-SPECIFIC BI

Because BI needs vary among business sectors, many BI tools are highly industry-specific. Using business analytics software, the user can make queries, request ad hoc reports, or conduct analyses. For example, because all of the databases are linked, you can search for which products are overstocked in a particular store. You can then determine which of these products commonly sell with popular items, based on previous sales. After planning a promotion to move the excess stock along with the popular products (e.g., bundling them together), you can dig deeper into the data to see where this promotion would be most popular and most profitable. The results of your request can be reports, predictions, alerts, and/or graphical presentations.

TABLE 11.6 Business Value of BI Analytical Apps

Analytical Application	Business Questions	Business Value
Customer segmentation	What market segments do my customers fall into and what are their characteristics?	Personalize customer relationships for higher customer satisfaction and retention.
Propensity to buy	Which customers are most likely to respond to my promotion?	Target customers based on their need to increase their loyalty to your product line. Also, increase campaign profitability by focusing on those most likely to buy.
Customer profitability	What is the lifetime profitability of my customers?	Make business interaction decisions based on the overall profitability of customers or customer segments.
Fraud detection	How can I detect which transactions are likely to be fraudulent?	Quickly detect fraud and take immediate action to minimize cost.
Customer attrition	Which customers are at risk of leaving?	Prevent loss of high-value customers and let go of lower-value customers.
Channel optimization	What is the best channel to reach my customers in each segment?	Interact with customers based on their preference and your need to manage cost.

Review Questions

1. Define *data extraction* and *data integration*, and explain why they are needed.
2. What is data latency? How does giving users the ability to create their own reports reduce data latency? What is the age of fresh data?
3. Explain the capabilities of dashboards and scorecards. Why are they important BI tools?
4. What is the benefit to end users of having ad hoc query capabilities?
5. What is a multidimensional view of data? Sketch such a view in 3-D and label the multiple dimensions for a service company.
6. Define *business performance management* (BPM). What is the objective of BPM?

11.3 Data, Text, and Web Mining

Data is not the only type of content that can be mined for insights, although it is certainly the easiest. Textual information, or simply *text,* from documents, electronic communications, and e-commerce activities can be mined. Content that is mined includes unstructured data from documents, unstructured text from e-mail, and Web log data. Organizations recognize that a major source of competitive advantage is their unstructured knowledge. Text needs to be codified, typically with XML (eXtensible Markup Language), and extracted so that predictive data mining tools can be used to generate real value. Given that perhaps 80 percent of all collected/stored information is in text, or at least *nonnumeric,* format, text mining and Web mining are major growth areas. **Web mining,** or *Web-content mining*, is used to understand customer behavior, evaluate a Web site's effectiveness, and quantify the success of a marketing campaign. Text mining is not the same thing as a search engine on the Web. In a search, you are trying to find what others have prepared. With text mining, you are trying to discover new patterns that may not be obvious or known.

Documents containing unstructured data can contribute to the decision making of BI, but they cannot be used directly in data-driven reports and analyses unless facts discovered in unstructured data are extracted and transformed into structured data that are conducive to reporting and analysis. Tools to accomplish this are **text analytics.** Text analytics transforms unstructured text into structured "text data." This text data can then be searched, mined, or discovered. Text search, mining, and discovery address two of today's most pressing data management problems: customer and product data management.

BENEFITS OF DATA MINING

Data mining is a process that uses statistical, mathematical, artificial intelligence, and machine-learning techniques to extract and identify useful information and subsequent knowledge from large databases, including data warehouses. This information includes patterns usually extracted from large sets of data. These patterns can be rules, affinities, correlations, trends, or prediction models. The following are the major characteristics and objectives of data mining:

- Data is often buried deep within very large databases, which sometimes contain data from several years. In many cases, the data is cleaned and consolidated in a data warehouse.
- Sophisticated new tools, including advanced visualization tools, help to remove the information buried in corporate files or archival public records. Finding it involves massaging and synchronizing this data to get the right results.
- The miner is often an end user, empowered by data drills and other power query tools to ask ad hoc questions and obtain answers quickly with little or no programming skill.
- Striking it rich often involves finding an unexpected result and requires end users to think creatively.
- Data mining tools are readily combined with spreadsheets and other software development tools. Thus, the mined data can be analyzed and processed quickly and easily.
- Because of the large amounts of data and massive search efforts, it is sometimes necessary to use parallel processing or supercomputers to execute data mining.
- The data mining environment is usually a client/server architecture or a Web-based architecture.

POWER USERS OF DATA MINING TOOLS

Business sections that most extensively use data mining are finance, retail, and healthcare. For example, in the financial sector, data mining is used by banks, investment funds, hedge funds, and insurance companies as well as sophisticated private investors and traders. Financial data is structured and is often in time series, such as stock market prices, commodity prices, utility prices, or currency exchange rates observed over time. Data mining techniques are well suited to analyze financial time series data to find patterns, detect anomalies and outliers, recognize situations of chance and risk, and predict future demand, prices, and rates.

That's why data mining supports analysts, investors, and traders in their decisions when trading stocks, options, commodities, utilities, or currencies. Data mining is also important in detecting fraudulent behavior, especially in insurance claims and credit card use; identifying buying patterns of customers; reclaiming profitable customers; identifying trading rules from historical data; and aiding in market basket analysis.

DATA MINING APPS

The following examples of data mining apps can identify business opportunities in order to create a competitive advantage:

- **Retailing and sales.** Predicting sales, determining correct inventory levels and distribution schedules among outlets, and preventing loss
- **Banking.** Forecasting levels of bad loans and fraudulent credit card use, credit card spending by new customers, and which kinds of customers will best respond to and qualify for new loan offers
- **Manufacturing and production.** Predicting machinery failures; finding key factors that control optimization of manufacturing capacity
- **Healthcare.** Correlating demographics of patients with critical illnesses; developing better insights into symptoms and their causes and how to provide proper treatments
- **Broadcasting.** Predicting which programs are best to air during prime time and how to maximize returns by interjecting advertisements
- **Marketing.** Classifying customer demographics that can be used to predict which customers will respond to a mailing or Internet banners, or buy a particular product, as well as to predict other consumer behavior

TEXT MINING AND WEB MINING

Text Mining. Documents are rarely structured, except for forms such as invoices or templates. **Text mining** helps organizations to do the following:

1. Find the meaningful content of documents, including additional useful relationships
2. Relate documents across previously unnoticed divisions; for example, discover that customers in two different product divisions have the same characteristics
3. Group documents by common themes; for example, find all of the customers of an insurance company who have similar complaints

In biomedical research, text analytics and mining have the potential to reduce the time it takes researchers to find relevant documents and to find specific factual content within documents that can help researchers interpret experimental data, clinical record information, and BI data contained in patents.

Web Mining with Predictive Analysis. Each visitor to a Web site, each search on a search engine, each click on a link, and each transaction on an e-commerce site create data. Analysis of this data can help us make better use of Web sites and provide a better relationship and value to visitors to our own Web sites. Web mining is the application of data mining techniques to discover actionable and meaningful patterns, profiles, and trends from Web resources. The term Web mining is used to refer to both Web-content mining and Web-usage mining. *Web-content mining* is the process of mining Web sites for information. *Web-usage mining* involves analyzing Web access logs and other information connected to user browsing and access patterns on one or more Web localities.

Web mining is used in the following areas: information filtering of e-mails, magazines, newspapers, social media; surveillance of competitors, patents, technological development; mining of Web-access logs for analyzing usage, or *clickstream analysis*; assisted browsing; and services that fight crime on the Internet.

In e-commerce, Web-content mining is critical. For example, when you search for a certain book on *Amazon.com,* the site uses mining tools to also present to you a list of books purchased by customers who had bought that book. Amazon has been extremely successful at cross-selling because it knows what to suggest to its customers at the critical point of purchase.

Predictive analytics is a component of Web mining that sifts through data to identify patterns of behavior that suggest, for example, what offers customers might respond to in the future or which customers you may be in danger of losing. For instance, when sifting through a bank's data warehouse, predictive analytics might *recognize* that customers who cancel an automatic bill payment or automatic deposit and are of a certain age often are relocating and will be moving to another bank within a certain period of time. Predictive analysis appears in many different formats, as illustrated in the following example and in *IT at Work 11.4*.

Example: Recognizing What Customers Want Even Before They Enter a Restaurant. HyperActive Technologies (*HyperActiveTechnologies.com*) developed a system in which cameras mounted on the roof of a fast-food restaurant track vehicles pulling into the parking lot or drive-through. Other cameras track the progress of customers moving through the ordering queue. Using predictive analysis, the system predicts what arriving customers might order. A database includes historical car-ordering data, such as "20 percent of cars entering the lot will usually order at least one cheeseburger at lunchtime." Based on the camera's real-time input and the database, the system predicts what customers will order 1.5 to 5 minutes before they actually order. This alert gives cooks a head start in food preparation to minimize customers' wait times.

The *core element* of predictive analytics is the *predictor,* a variable that can be measured for an individual or entity to predict future behavior. For example, a credit card company could consider age, income, credit history, and other demographics as predictors determining an applicant's risk factor.

IT at Work 11.4

Predictive Analysis Helps Save Gas and Protect Green

SVR OM

Traffic congestion across the United States continues to increase. The fallout from heavy traffic congestion hits Americans hard in terms of gas prices, traffic congestion, and pollution. Predictive analysis and numerous technologies discussed in this chapter are being deployed by INRIX (*inrix.com*) to reduce gas usage, frustration, and pollutants. INRIX is the leading provider of traffic information.

The INRIX National Traffic Scorecard measures U.S. traffic congestion problems by evaluating real-time traffic on almost every major metropolitan roadway. INRIX's Smart Dust Network collects data from 1 million anonymous, GPS-equipped commercial vehicles that report their speed and location continually. INRIX then processes and blends other relevant traffic-related data, such as road sensors, toll tags, traffic incident data, and other resources, to provide the most comprehensive and accurate traffic information available.

INRIX helps drivers make better decisions through real-time, historical, and predictive traffic data generated from a wide range of sources. INRIX can answer such questions as:

- When will traffic start to back up at the I-5/I-90 interchange?
- What will traffic be like at 6:00 tonight? How long will it take me to get home?
- How long will it take for the congestion on the bridge to clear up?
- What time should I leave for work in the morning to avoid rush-hour traffic?
- How long will it take me to get to the airport tomorrow morning?
- When I fly into JFK airport in two weeks, how long will it take me to get to my hotel in Manhattan?

As of July 2008, drivers along the I-95 corridor on the East Coast began benefiting from such information. In partnership with the 16 states representing the I-95 Corridor Coalition along the eastern seaboard, INRIX identifies where traffic is at its worst, enabling drivers to have access to real-time information on traffic flows, crashes, and travel times to help them anticipate and avoid delays. The systems' architecture is shown in Figure 11.12.

Sources: Compiled from *INRIX.com* and PRNewswire (2008).

Discussion Questions: What factors have increased demand for this information service? Which individuals may use this service? What are the immediate and long-term benefits to transportation (trucking) companies and emergency services? What are the green benefits? What are three personal benefits to drivers?

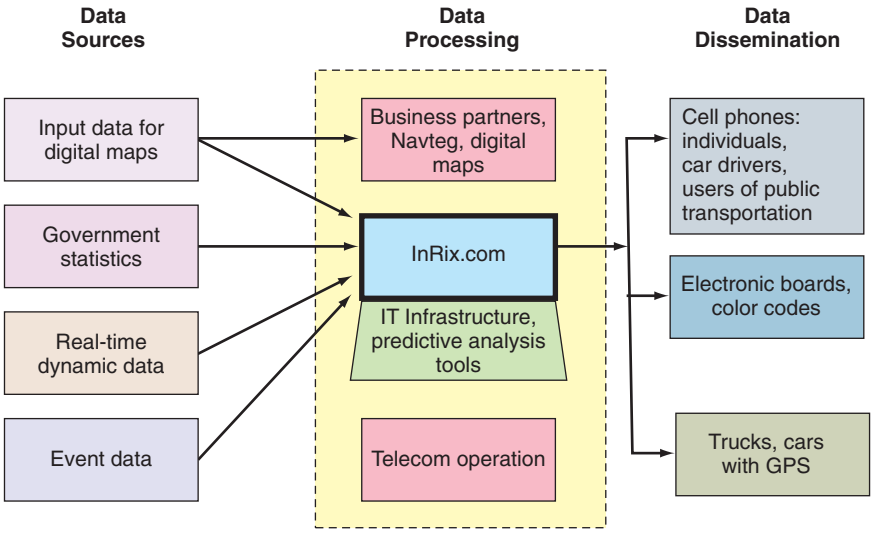

Figure 11.12 INRIX system architecture for one city. (*Compiled from* INRIX.com *and PRNewswire (2008).*)

Review Questions

1. What is text mining? Give three examples of text that would be mined for intelligence purposes.
2. How does text mining differ from search?
3. What is Web mining? Give three examples of Web content that would be mined for intelligence purposes.
4. Describe one advantage and one disadvantage of data mining tools.
5. List three data mining applications for identifying business opportunities.

11.4 Decision-Making Processes

To appreciate how and why ISs were designed to support managers, you need to understand what managers do. Managers' roles can be put into three categories based on Mintzberg (1973):

1. *Interpersonal roles:* Leader, figurehead, liaison, or coach
2. *Informational role:* Monitor, disseminator, or spokesperson
3. *Decisional role:* Entrepreneur, problem solver, resource allocator, or negotiator

Early ISs mainly supported informational roles because they were the easiest roles to support. With the introduction of ISs in organizations, managers would receive an avalanche of data about issues and problems, which led to information overload. Managers lacked ISs that could adequately support doing something about those issues and problems. The situation created was what we call the *inbox problem*, which is a metaphor for a growing inbox of problems that managers found out about but that remained in the inbox because they lacked tools for dealing with the problems and communicating results. Many new ITs emerge or are enhanced to solve problems of existing ITs. You can see that trend in BI as new features are added.

ISs have grown to support all managerial roles. In this section, we are mainly interested in IT that supports decisional roles. We divide the manager's work, as it relates to decisional roles, into two phases. Phase I is the identification of problems and/or opportunities. Phase II is the decision of what to do about them. Figure 11.13 provides a flowchart of this process and the flow of information in it.

DECISION PROCESS AND DECISION SUPPORT SYSTEMS (DSS)

Decision makers go through four systematic phases: *intelligence, design, choice*, and *implementation*, as diagrammed in Figure 11.14. Note that there is a continuous flow of information from intelligence to design to choice (bold lines), but at any time there may be a return to a prior phase (broken lines).

The decision-making process starts with the *intelligence phase*, in which managers examine a situation, then identify and define the problem. In the *design phase*, decision makers construct a model that represents and simplifies the problem or

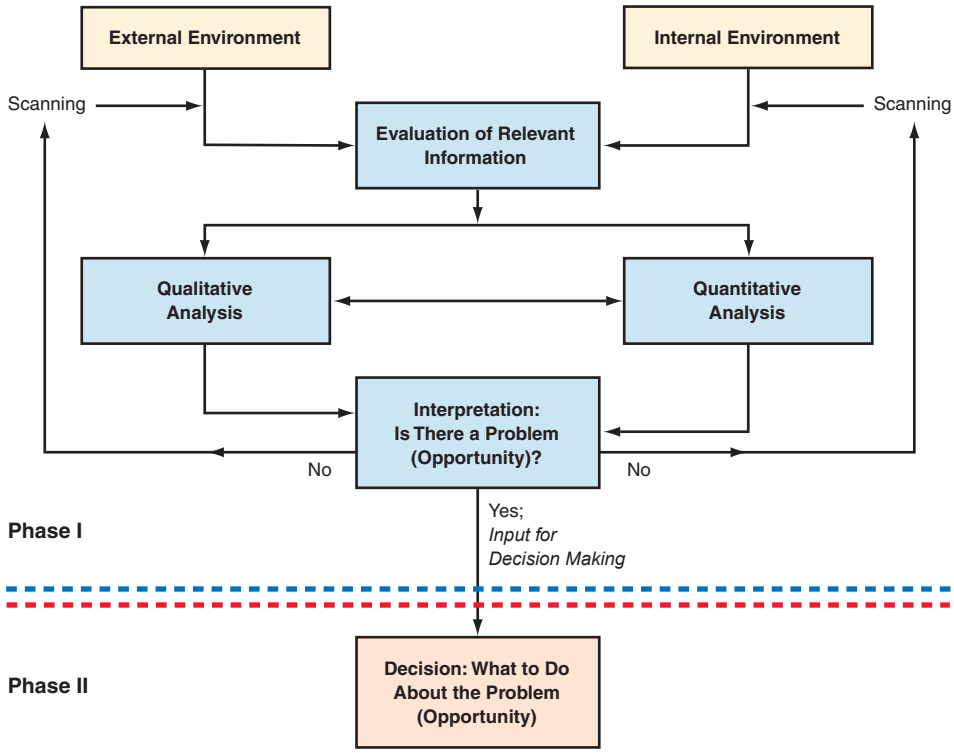

Figure 11.13 Manager's decision roles.

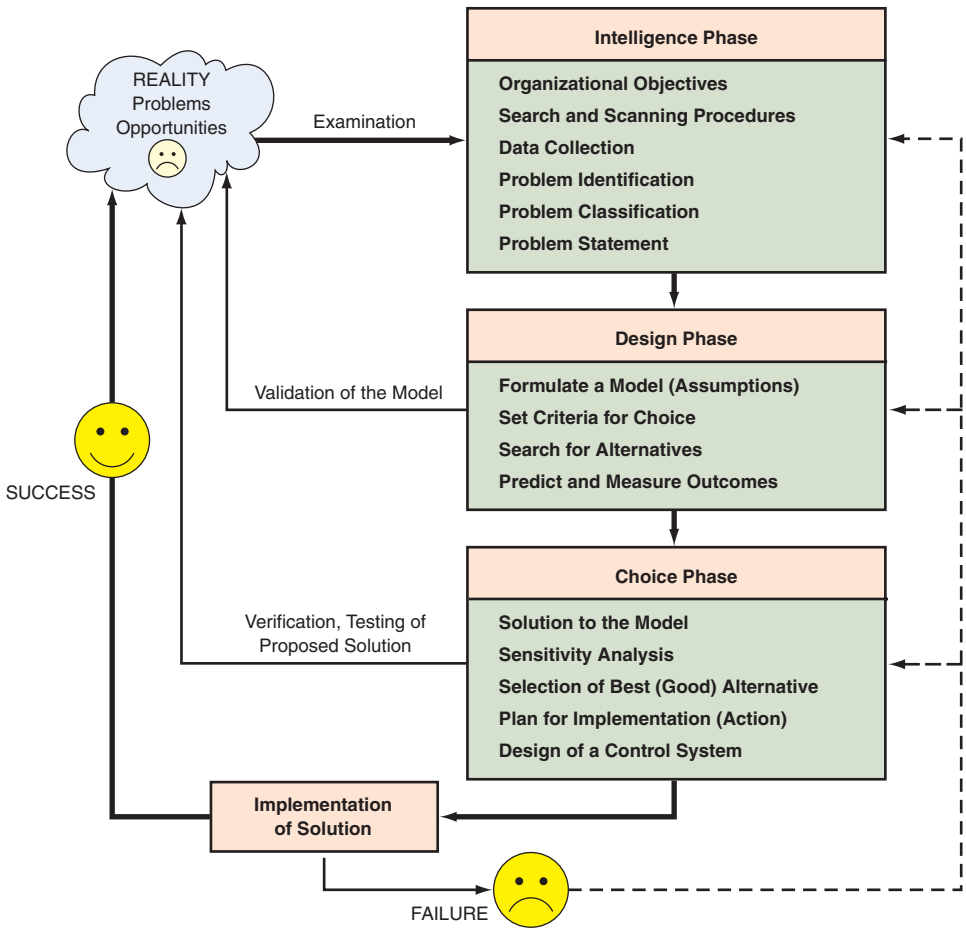

Figure 11.14 Phases in the decision-making process.

opportunity. This is done by making assumptions and expressing the relationships among all variables. The model is then validated, and decision makers set criteria for the evaluation of alternative potential solutions that are identified. The process is repeated for each sub-decision in complex situations. The output of each sub-decision is an input for the main decision. The *choice phase* involves selecting a solution, which is tested "on paper." Once this proposed solution seems to be feasible, we are ready for the last phase—implementation. Successful *implementation* results in resolving the original problem or opportunity. Failure leads to a return to the previous phases. A DSS automates several tasks in this process.

Decision Modeling and Models. A decision model is a simplified representation, or abstraction of reality. Simplicity is helpful because a lot of complexity may be irrelevant to a specific problem. One simplification method is making assumptions, such as assuming that growth in customer demand in the next quarters will be the same as the current quarter. The risk when using assumptions is if they are wrong, then the foundation for the analysis is flawed. For example, in July 2008, General Motors' (GM) sales of SUVs, minivans, and trucks had plunged due to very high gas prices that consumers knew were not going to drop. Since GM selects its models three years in advance, in 2005, GM's managers had assumed that the demand for large vehicles would remain at 2005 levels. That highly inaccurate assumption had a devastating influence on the company's sales and profits.

The benefits of modeling in decision making are as follows:

- The cost of virtual experimentation is much lower than the cost of experimentation conducted with a real system.
- Models allow for the simulated compression of time. Years of operation can be simulated in seconds of computer time.

- Manipulating the model by changing variables is much easier than manipulating the real system. Experimentation is therefore easier to conduct, and it does not interfere with the daily operation of the organization.
- Today's environment holds considerable uncertainty. Modeling allows a manager to better deal with the uncertainty by introducing many *what-ifs* and calculating the risks associated with various alternatives.

A FRAMEWORK FOR DECISION ANALYSIS

Decision-making activities fall along a continuum ranging from highly structured to highly unstructured, as you read in earlier chapters. Here we describe them in more detail.

1. **Structured decisions** involve routine and repetitive problems for which standard solutions exist. Examples are formal business procedures, cost minimization, profit maximization, and algorithms (such as those used by eHarmony to match its members). Whether the solution means finding an appropriate inventory level or deciding on an optimal investment strategy, the solution's criteria are clearly defined.
2. **Unstructured decisions** involve a lot of uncertainty, meaning that there are no definitive or clear-cut solutions. With unstructured decisions, for example, each decision maker may use different data, assumptions, and processes to reach a conclusion. Unstructured decisions rely on intuition, judgment, and experience. Typical unstructured problems include planning new services to be offered, hiring an executive, predicting markets, or choosing a set of research and development projects for next year.
3. **Semistructured decisions** fall between the polar positions. Most of what are considered to be true decision support systems are focused on semistructured decisions. Semistructured problems, in which only some of the phases are structured, require a combination of standard solution procedures and individual judgment. Examples of semistructured problems are trading bonds, setting marketing budgets for consumer products, and performing capital acquisition analysis. Here, a DSS is most suitable. It can provide not only a single solution but also a range of what-if scenarios.

Review Questions

1. What are the three roles of management?
2. What is meant by the inbox problem?
3. Identify and explain the three phases of decision making.
4. Why are models used in decision making? What is an inherent risk of using models in decision making?
5. Give an example of a structured, an unstructured, and a semistructured decision. Which of these types of decisions can be optimized? Why?

11.5 Decision Support Systems (DSS)

Decision support systems (DSS) are a class of ISs that combine models and data to solve semistructured and unstructured problems with intensive user involvement. A DSS is interactive, flexible, and adaptable—and supports the solution of unstructured or semistructured problems. DSSs have easy-to-use interfaces and allow for the decision maker' own insights.

Structured decisions are so well defined that they can be automated or become standard operating procedures (SOPs) that do not require a DSS to solve.

A properly designed DSS is an interactive application to help decision makers compile data and then analyze the data using business models. The central point is that the DSS should result in a better decision than was possible without it. The most popular software used to develop DSSs is Microsoft Excel.

Typical information that a decision support application might gather and present are:

- Comparative sales figures of a specific product between one week or month and the following week or month
- Projected revenue figures based on new product sales assumptions
- Projected consequences of different decision alternatives, given past experience and forecasted conditions.

SENSITIVITY ANALYSIS: *WHAT-IF* AND GOAL SEEKING

The mathematical models used in DSSs enable *sensitivity analysis*. **Sensitivity analysis** is the study of the impact that changes in one or more parts of a model have on other parts or the outcome. Usually, we check the impact that changes in input (*independent variables)* have on outcomes (*dependent variables)*. For example, quantity demanded is a dependent variable, whereas price, advertising, disposable income, and competitor's price are four examples of the independent variables in the classic economic model. The dependent variable changes in response to changes in the independent variables. An easy way to remember the relationship between dependent and independent variables is this example: The number of umbrellas sold (dependent variable) is determined by the amount of rainfall (independent variable). It's obvious that the reverse is not true.

Consider this product demand example: The value of each controllable independent variable is varied—price and advertising—to determine how sensitive quantity demanded is to those adjustments. A *sensitive model* means that small changes in conditions (variables) suggest a different solution. In a *nonsensitive model*, changes in conditions do not significantly change the recommended solution.

Sensitivity analysis is extremely valuable in DSSs because it makes the system flexible and adaptable to changing conditions and to the varying requirements of different decision-making situations. It allows users to enter their own data, including the pessimistic data, or worst-case scenario, and to view how systems will behave under varying circumstances. It provides better understanding of the model and the problem it purports to describe. It may increase users' confidence in the model, especially when the model is not very sensitive to changes.

STRUCTURE AND COMPONENTS OF DSS

Basic components of a DSS are a database, model base, user interface, and the users. An additional component is a knowledge base.

Database. A DSS database system, like any database, contains data from multiple sources. Some DSSs do not have a separate database; data are entered into the DSS model as needed (e.g., as soon as they are collected by sensors).

Model Base. A model base contains completed models and sets of rules, which are the building blocks necessary to develop DSS applications. Types of models include financial, statistical, management science, or economic. Model-building software, such as Excel, has built-in mathematical and statistical functions. These models provide the system's analytical capabilities.

User Interface. The user interface covers all aspects of the communications between a user and the DSS. A well-designed user interface can greatly improve the productivity of the user and reduce errors.

Users. A DSS is a tool for the user, the decision maker. The user is considered to be a part of the highly interactive DSS system. A DSS has two broad classes of users: managers and staff specialists, such as financial analysts, production planners, and market researchers.

Knowledge Base. Many unstructured and semistructured problems are so complex that they require expertise for their solutions. Such expertise can be provided by a

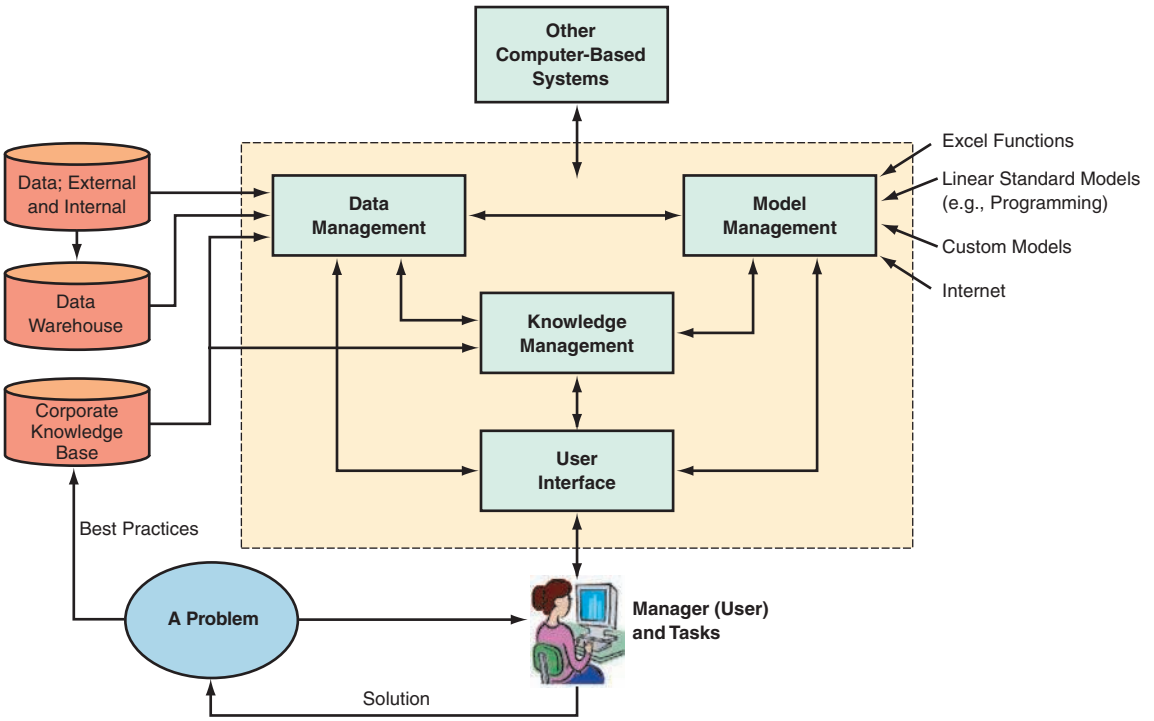

Figure 11.15 Conceptual model of DSS and its components.

knowledge-based system, such as an expert system. Therefore, the more advanced DSSs are equipped with a component called a knowledge base. A knowledge base provides the expertise to solve some part of the problem. For example, a knowledge base can estimate the cost of a massive construction job based on dimensions, materials, labor costs, weather delays, and numerous other cost factors. It is a complex process that requires models, a database, and judgment. Figure 11.15 shows how the components of a DSS interact.

DSS APPS

A large number of DSS apps can be found in any industry, including manufacturing and services, as shown in the following examples.

Example 1: Wells Fargo Targets Customers. Wells Fargo *(wellsfargo.com)* has become so good at predicting consumer behavior that it practically knows what customers want before they do. The bank developed a DSS in-house that collects data on every transaction—phone, ATM, bank branch, and online—and combines this data with personal data from the customer. The Wells Fargo DSS program then analyzes the data and models the customer's behavior to automatically come up with prospective offers, such as a home equity loan, just at the right time for the customer.

Example 2: Lowering Costs in Healthcare. Owens & Minor (*owens-minor.com/*), a Fortune 500 company, is a leading distributor of medical and surgical supplies to the acute-care market and a healthcare supply chain management company. The company was the winner of the 2010 Distributor of the Year Service Excellence Award from the University Health System Consortium (UHC). UHC is an alliance representing 90 percent of the nation's nonprofit academic medical centers. The award is given to the distributor that provides exceptional support and commitment in helping hospital members meet their supply chain goals.

One of those goals is driving down the price of thousands of hospital supplies. Owens & Minor uses its DSS to help customers hunt for bargains among hundreds of competing medical suppliers. The DSS pinpoints lower pricing on similar items,

helping customers take advantage of discounts already negotiated. Hospitals keep better tabs on their bills and cut costs an average of 2 to 3 percent. For Owens & Minor, the DSS attracts new customers, and when existing customers find lower prices, they order more.

These examples demonstrate the diversity of decisions that DSSs can support. In addition, many examples can be found at *sas.com* and *microstrategy.com*, where hundreds of apps and success stories are listed by industry.

Review Questions

1. Explain the two types of decisions that DSSs are used to solve. Why aren't DSSs used to support structured decisions?
2. Describe sensitivity analysis.
3. Explain the difference between what-if analysis and goal seeking.
4. Explain the difference between dependent and independent variables.
5. What are the components of a DSS?

11.6 Mobile Intelligence: Convergence of Mobile Computing and BI

Since the 1960s, there have been five major generations, or cycles, of computing: mainframes, miniframes, PCs, desktop Internet computing, and mobile Internet computing (or simply mobile computing), as shown in Figure 11.16. Mobile computing, the fifth computing generation, has already had a huge impact and adoption rate, as you read in Chapters 1, 7, and 8. Mobile devices are becoming the world's dominant computing platform.

Mobile computing is not just a U.S. phenomenon. Japan is leading the world in mobile computing, but the United States has the largest 3G subscriber base. China and other countries have broadband and 3G penetration equal to or greater than that in the United States, but those countries are deliberately encouraging deployment of new apps and services. Worldwide, cell coverage and more powerful wireless 3G and 4G technologies are expanding Internet connectivity.

MOBILE INTELLIGENCE INFRASTRUCTURE

The speed with which Apple's iPhone and iTouch have sold—roughly 57 million sold in 28 months—is an indicator that MI apps will be in high demand. According to Morgan Stanley's *Global Mobile Internet Report* (2009), mobile computing may be the fastest-growing and most disruptive technology launch we have ever seen because of the following:

- Scale of adoption—wireless global adoption was 4.1 billion subscriptions, compared to 1.6 billion Internet users.
- Accelerating rate of adoption.
- Confluence of powerful new technologies.
- New usage models that consumers and enterprises are enthusiastically adopting.

Redefining Hardware Functions. The functions of hardware are being redefined. For example, smartphones are becoming PCs, PCs are becoming servers, servers are becoming the cloud, and the cloud is the new app source. Your smartphone may be taking on more of the functions you used to do on your desktop or laptop, and you may be backing up content from smartphones onto your laptop or dropping it to the cloud. The cloud is the infrastructure for new generations of Web and mobile apps.

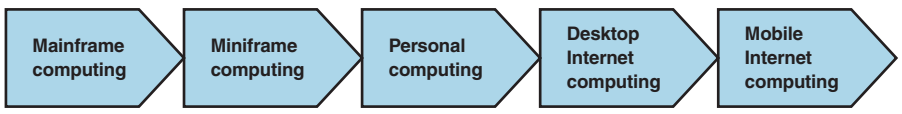

Figure 11.16 Five generations of computing from the 1960s to the 2010s.

Vendor Incentives. Vendors have enormous incentives to develop mobile business apps. The Apple ecosystem composed of iPhone and iTouch devices, the iTunes easy-to-use payment/distribution system, and the App Store—a developer-friendly environment for new apps—creates a cycle of incentives for more and better mobile Internet usage. Expect to see changes in everything mobile—social networking, music, video, games, books, commerce, messaging, and location-based GPS apps.

Unifying Communications in the Cloud. The topology of the Internet itself is changing. Powerful devices using IP-based infrastructure, such as 4G networks, combined with easy-to-use software are unifying communications. And always-on connectivity is increasing demand for cloud-based computing.

Smartphones and other Internet-enabled mobile devices change how people stay informed, communicate, and in general manage their professional and personal lives. Accessing information at any time, in any location, on a handheld device on a regular basis has changed the way that managers and other workers expect to make decisions. Business apps that were fairly successful when used on a desktop become more successful and valuable when they can be used on the go, whenever and wherever business is conducted. Information access via mobiles may soon far exceed desktop or laptop information access in the near future, creating an era of **mobile intelligence (MI).** MI functionality is critical to companies that have a mobile workforce or teams of field representatives.

MOBILE INTELLIGENCE

Recall the discussion on interactivity in Chapter 1. Those interactive apps on mobile devices are revolutionizing information dissemination and consumption. And the alignment of business data, analytics, and mobile computing is transforming business processes.

MI is positioned to change how organizations deliver, consume, and act on information. Without 24/7 convenient access to business information, decisions and actions get postponed, causing bottlenecks and delays. These restrictions and delays are blown away with MI, which allows heuristic analysis and decision making wherever a decision is required.

Here are two concepts related to MI:

- **Decision sweet spots:** These spots are locations, such as a commuter train, an aisle in a store, a line in a factory, or a retail floor. Businesspeople need to be able to make data-driven decisions in the sweet spot, rather than delay due to a lack of information or analysis capabilities.
- **Decision windows of opportunity:** This window exists when a choice or action can be made to maximize an impact. The longer it takes someone to get to the information and completely evaluate the situation, the greater the chance of missing an opportunity. And delays risk the loss of a sale or customer.

Mobile technology makes it possible for people to make immediate decisions. Users can sift through enormous volumes of data on their handheld devices and convert this data into actionable insight. Within moments, information is accessible without sitting down and finding a place to plug in a laptop. And rapid decision making is key to accelerating the profitability of business. In today's fast-changing, competitive business environment, it is imperative to provide immediate answers to both internal and external customers. With MI, decision makers now have the power to make these decisions immediately. In the mobile intelligence era, businesses that don't yet exist may evolve into industry leaders. Moderately valuable apps that run on desktops may become hugely successful apps when fully applied to the mobile Internet.

The next Facebook, YouTube, or Twitter hasn't been invented yet, but it will be designed as a mobile app. Organizations that stay with today's desktop-based information distribution models may become obsolete, outpaced by those organizations that choose to thrive on the mobile Internet. Organizations that embrace MI will become leaner, faster, and be able to make smarter decisions resulting in more business, revenues, and competitive advantage.

Review Questions

1. What are the five computing generations?
2. How are hardware devices being redefined?
3. Explain the incentives to vendors to further develop mobile apps.
4. Explain the importance of people being able to make immediate decisions.
5. What might be the impact on organizations that exploit mobile intelligence?

Key Terms

algorithm *331*
balanced scorecard methodology *341*
blindspot *329*
business case *329*
business performance management (BPM) *341*
customer churn *324*
dashboard *330*
data latency *339*
data mining *344*
data visualization *330*
decision support system (DSS) *349*
ETL (extract, transform, and load) tools *334*
event-driven alert *332*
information infrastructure *339*
mobile intelligence (MI) *353*
operational BI *328*
performance management *330*
predictive analytics *331*
proper resource allocation *323*
real-time visibility *342*
sensitivity analysis *350*
text analytics *343*
text mining *345*
traditional BI *327*
Web mining *343*

Chapter Highlights and Insights

(Numbers refer to Learning Objectives)

1 Business intelligence is driven by the need to get accurate and timely information in an easy way, and to analyze it, sometimes in minutes, possibly by the end users.

1 BPM is an umbrella term covering methodologies, metrics, processes, and systems used to drive the performance of the enterprise. It encompasses a closed-loop set of processes such as strategize, plan, monitor, analyze, and act (adjust).

2 The major components of BI are data warehouses and/or marts, predictive analytics, data mining, data visualization software, and a business performance management system.

3 Predictive analysis uses different algorithms to forecast results and relationships among variables as well as to identify data patterns. Data mining is one of the tools.

3 Scorecards and dashboards are a common component of most, if not all, performance management systems, performance measurement systems, and BPM suites.

3 The fundamental challenge of dashboard design is to display all of the required information on a single screen, clearly and without distraction, in a manner that can be assimilated quickly.

3 Decision making involves four major phases: intelligence, design, choice, and implementation.

4 Models allow fast and inexpensive virtual experimentations with new or modified systems.

5 A DSS is an approach that can improve the effectiveness of decision making, decrease the need for training, improve management control, facilitate communication, reduce costs, and allow for more objective decision making. DSSs deal mostly with unstructured problems. Structured decisions are solved with management science models.

5 The major components of a DSS are a database and its management, the model base and its management, and the user-friendly interface.

6 Mobile intelligence (MI) is the result of the convergence of mobile computing, powerful smart mobile devices, and BI capabilities that are Web-accessible. MI and analytics *in the cloud* are expected to define the future of BI.

Questions for Discussion

1. Discuss what John Wanamaker meant by his remark: "Half the money I spend on advertising is wasted; the trouble is I don't know which half."
2. Discuss the meanings of intelligence and uncertainty.
3. Discuss how your experiences with customer service could have been better or more productive.
4. What are the trade-offs in terms of cost and service involved in deciding the allocation of resources?
5. Differentiate the three types of BI.
6. What are the key types of support provided by BI?
7. Differentiate predictive analysis from data mining. What do they have in common?
8. Describe the concepts underlying Web mining and Web analytics.
9. When is real-time BI critical?

10. What could be the biggest advantages of a mathematical model that supports a major investment decision?
11. How is the term *model* used in this chapter? What are the strengths and weaknesses of modeling?
12. What ITs have contributed to the emergence of data mashups for BI?
13. What ITs have contributed to the emergence of mobile intelligence?

Exercises and Projects

You need to register for exercises that involve the Teradata University Network at *http://academicprograms.teradata.com/tun/*. Also see directions on the textbook's companion Web site.

1. Visit Teradata University Network and find the Powerpoint presentation *Why is Data Quality Important,* by Lori Roets, Teradata, 6-5-2010. Download and read the presentation and answer the following questions:
   a. Why and to what extent is data quality important?
   b. How should companies address data quality?
   c. What are five other lessons you learned about data quality?
2. Visit Teradata University Network and find the research report *TDWI Best Practices Report: Transforming Finance*, by Wayne Eckerson, 5-28-2010.
   a. Describe current practices of how finance uses BI.
   b. In the report is a discussion on "Single Version of Truth." In this chapter, you learned that, in practice, managers or supervisors may not agree on a single version of the truth. Discuss how the author defines a single version of the truth. Do you agree?
   c. What are five other lessons you learned about the use of BI by finance?
3. Visit the textbook's Web site and download *Harrah's High Payoff from Customer Information,* by H.J. Watson and Linda Volonino. Answer the following:
   a. What were the objectives of the project?
   b. What was the role of the DW?
   c. What kinds of analyses were used?
   d. What strategic advantages does the BI provide?
   e. What are the role and importance of an executive innovator?
4. Visit Teradata University Network and search recent developments in the field of BI.
   a. Watch the Webinar on information visualization. What are the capabilities of Tableau Software's products?
   b. Find the assignment "AdVent Technology" and use the Microstrategy "Sales Analytical Model." Answer the three questions. Ask your instructor for directions.
5. West 88 (fictitious name) is an ice cream and yogurt dessert take-out or eat-in chain. There are 12 West 88 locations in busy tourist areas. Jen K, the CEO, asked that you research and make a recommendation for a BI reporting and visualization tool.
   a. Prepare a list of the BI reporting and visualization tools of three vendors to consider.
   b. Prepare a table that compares the key advantages and costs of each tool as it relates to this specific case.
   c. Make a recommendation based on available information.
6. Consider this perspective on BI and BPM. Conceptually, BI is simple: Data produced by an organization's transactional processing and operational IT systems can be collected and summarized into totals and reports that give managers an immediate view of how they are doing. Business performance management (BPM) is about people and culture, and it should involve every knowledge worker in an organization, but there are some behavioral hurdles that still need to be overcome.

   Respond to the following points:
   a. Prepare a table that lists the BI technologies involved in each step of the process, from data production to reports that give managers an immediate view of how they are doing. List the process (e.g., extraction from TPS) in the first column and the BI technology in the second column.
   b. Using the table produced in (a), search for two vendors that provide a BI tool for each process. Put the results of your research in the third column. Include the brand name of the BI tool, the vendor's name, and the URL to the BI tool.
   c. Find one vendor, white paper, or article that addresses potential behavioral problems associated with BI or BPM. How do they respond to or address such obstacles? (*intelligententerprise.com/* may be a good place to research.) Report what you learn.
7. Search and visit a blog focused on BI or predictive analytics. Verify that the blog has current content. What are the BI-related topics discussed in five of the posts?

Group Assignments and Projects

1. Data visualization tools are offered by major BI vendors and niche vendors. These vendors are listed in the *Chapter 11 Link Library* and mentioned in the chapter. Each group is assigned to one or two vendors to research its data visualization products. Each group summarizes those products and their capabilities.
2. Search the BI vendors listed in the *Chapter 11 Link Library*. Each group finds a demo related to BI. View the demo and report what you learned.
3. Visit *sas.com* and look for success stories related to BI. Find five that include an SAS video and prepare a summary of each for a class presentation.
4. Search for vendors in Web analytics and prepare a report on their products and capabilities. Each group presents the capabilities of two companies.

Internet Exercises

1. Visit *microstrategy.com/dashboards/* to see the kinds of better business insights possible, in the section Real-life Dashboards from Microstrategy Customers. Explain how the dashboards can lead to better business insights. What are the limitations dashboards?
2. Visit *microstrategy.com/dashboards/* to see how your organization can improve business operations, in the section Cutting-Edge Industry and Role-Based Dashboards. Explain how the dashboards can improve business operations.
3. Find a case study about the benefits of a DSS implementation at a nonprofit or government agency. Briefly describe the organizations, the reasons for the DSS, and the benefits.
4. Visit *spss.com*, *informatica.com* or *accure.com* and identify their Internet analytical solutions. Compare and comment. Relate your findings to business performance measurement.
5. Access the Web and online journals to find at least three articles or white papers on the use of predictive analytics. Identify the vendor or enterprise, the predictive analytic software product, and the benefits gained.
6. Find two cases published after January 2011 of successful business analytics applications. Try BI vendors and look for cases or success stories. What do you find in common in their case stories? How do they differ?

BUSINESS CASE

BI-Supported Budgeting, Planning, and Control at McNICHOLS

McNICHOLS (*mcnichols.com/*) is a worldwide leader in the custom fabrication of a wide variety of perforated and mesh metal products. (Visit the Web site to better understand the business.) Its customers are universities, government agencies, municipalities, commercial construction, manufacturers, wholesalers, and retailers. Dino DePaolis, finance director at McNICHOLS, described the pressures the company was under by stating: "Customers want everything right now or they need things yesterday, and we have to ensure that we have the right inventory at the right time." Real-time metrics showing profitability, sales success, and inventory availability are critical to success because McNICHOLS guarantees 24-hour turnaround time.

Cumbersome Planning Process

McNICHOLS's manual quarterly budget process had become unmanageable. The manual method involved various MS Access databases for different pieces of the budget and spreadsheets scattered throughout the organization. DePaolis compared the former budgeting life cycle to an octopus with far-reaching tentacles. The body was an Access database and the tentacles were Excel spreadsheets that reached throughout the organization's districts that were tasked with contributing daily sales data. The budget life cycle took weeks to manage, and given limited resources to handle it, the company was in rush mode at the end of every quarter. Collecting sales data and moving it into other spreadsheets to feed into Access was very cumbersome and required constant review to ensure the accuracy of the data.

McNICHOLS needed a solution that could provide visibility and a trusted forecast to senior managers, enabling them to make quick and effective decisions. DePaolis identified his requirements for a financial planning solution: data accuracy, integrity of the financials, a tool to answer complex financial scenarios, flexibility, ease of use, speed and performance.

Benefits of BI

In 2008, McNICHOLS implemented IBM Cognos 8 BI to replace its older system composed of Microsoft Access, Excel, and a variety of other apps. Cognos 8 BI integrates and consolidates transactional data into executive dashboards to deliver information to district managers, the CFO, CEO, and vice presidents. The BI helps them to quickly measure all key performance indicators (KPIs), including sales, gross profit, margins, customer inquiries, and invoice counts. At the end of 2009, BI reporting capabilities were extended to the finance department.

The budget process that had taken 7 to 10 days at the end of each quarter and several hours each month is now done in seconds. The CFO saves nearly two weeks every quarter just in labor hours. Other key benefits of their BI implementation are:

- Sales analytics are linked budgeting modules, making it easier for managers to monitor KPIs.
- Integrated views of all business and financial data are provided in a single Web-based portal.
- The accuracy and quality of the data have been improved.
- Marketing, production, and order dashboards enable real-time tracking of the profitability of all aspects of the business.
- Managers have a good handle on actual transactions, forecasts, and targets.

Every day, managers are challenged to do more and accomplish more with less. With BI, they can provide the highest level of service to customers internally and externally and do so with greater functionality with fewer resources allocated to reporting and analytics.

Sources: Compiled from *mcnichols.com/* and IBM Cognos BI 8 (2010).

Questions

1. Describe McNICHOLS's data and reporting problems.
2. Why do you think the company was using Access and Excel for its intelligence and reporting requirements?
3. Describe McNICHOLS's business strategy, or how it defines its competitive advantage. How important is customer loyalty?
4. Were resources improperly allocated under the manual system? How has the BI system reallocated resources?
5. What might have been the business case for BI at McNICHOLS?

NONPROFIT CASE

EuResist Applies Model-Based DSS to HIV Research

Development of antiretroviral drug resistance is a major cause of treatment failure in HIV-infected patients. When EuResist(*euresist.org/*), a European network dedicated to improving the success rate of HIV treatments, wanted to develop a smarter way to predict the most effective drug combinations for patients, it worked with IBM to create an integrated data analytics solution.

Business Need

EuResist Network GEIE wanted to help physicians determine the optimal combination of HIV treatment drugs that would help patients while limiting the evolution of drug resistance. Previously, physicians had based much of their decision making on personal experience with HIV cases and limited prediction tools. But EuResist hoped to introduce a better modeling solution that would better reflect patient reactions.

Solution and Benefits

Working with IBM Research, EuResist developed a drug interaction modeling tool that lets users predict the success rate and impact on virus evolution of various drug combinations via an online portal. The prediction engine, operating within an IBM WebSphere Application Server environment, leverages medical data (e.g., viral gene sequences, patient histories) from seven sources hosted within an IBM DB2 data server.

Based on IBM DB2 and WebSphere, the solution processed and correlated clinical and genomic data from many sources, consolidating more than 39,000 patient records, 109,000 therapies, and 449,000 viral load measurements—predicting patient responses to therapy with over 75 percent accuracy. Additionally, in a head-on competition with human clinical experts, EuResist outperformed the experts 9 out of 10 times. Other benefits included:

- Compares patient details against 33,000 previous cases and treatment data to help choose a therapy with a high probability of success
- Reduces incidents of treatment-related toxicity by pulling data from seven sources to create more accurate patient models

EuResist Combined Prediction Engine

The EuResist project had received a grant from the European Commission to develop an integrated European system for computer-based clinical management of antiretroviral drug resistance. The resulting system, the *EuResist prediction engine* (*engine.euresist.org/*), provides clinicians with Internet-based prediction of clinical response to antiretroviral treatment in HIV patients. This engine helps medical experts to choose the best drugs and drug combinations for any given HIV genetic variant. To this end, a large integrated data set has been created, uniting several of the largest existing resistance databases. Access to the database and prediction engine are provided at no cost.

Sources: Compiled from euresist.org/, engine.euresist.org/, IBM (2010), and IBM Cognos BI 8 (2010).

Questions

1. Predictive analytics can improve diagnosis and treatment in healthcare. Explain the need for a smarter way to predict the most effective drug combinations.
2. How can DSS and predictive analytics reduce the costs of healthcare treatments?
3. What have been the benefits of the DSS to the EuResist project?
4. What might be some types of resistance to the use of EuResist? From medical experts? From patients?
5. In your opinion, do you think that insurance companies that pay for drug treatments would be in favor of or against it? Explain your answer.
6. Visit the textbook's Web site to view the *Euresist_300k.wmv* audio/video (5.5 minutes). Explain the benefits of the prediction engine. Does EuResist's statistical approach replace or supplement the expertise of medical experts?

ANALYSIS USING SPREADSHEETS

Making the Business Case for BI

Refer to the McNICHOLS Business Case at the end of this chapter. You have been asked to calculate the one-year cost savings from the BI. That calculation will be used in the business case to extend the BI's capabilities and invest in mobile intelligence (MI). You need to calculate monthly cost savings for January through December 201X, and then show the one-year total cost savings per category.

Cost issues:

- As the case states, real-time metrics showing profitability, sales success, and inventory availability are critical to success because McNICHOLS guarantees 24-hour turnaround time. It costs the company an average of $1,000 for each guarantee that it does not keep.
- For managers, the average hourly salary is $110 per hour.
- The cost of each lost customer is estimated at $500 per month.
- The cost of missing the deadline for a quarterly financial report is $2,000 per quarter.
- The reduction in operations waste and errors due to improved data quality is $1,800 per month.

Base your analysis on the following cost reductions in each of the following categories.

1. Labor costs. Review the case for the hours saved by the BI. Explain how you estimated the number of hours in a note or comment on the spreadsheet.
2. Guarantee costs.
3. Customer attrition.
4. Timely quarterly financial reports.
5. Waste and errors in operations.

Format the spreadsheet so that it is easy to understand. Do not use decimal places. Include your name and the date of your analysis.

Resources on the Book's Web Site

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

Cases for Chapter 11 available at wiley.com/college/turban

11.1 BudNet BI

11.2 Lexmark International Improves Operations with BI

11.3 Cigna Uses Business Rules to Support Treatment Request Approval

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