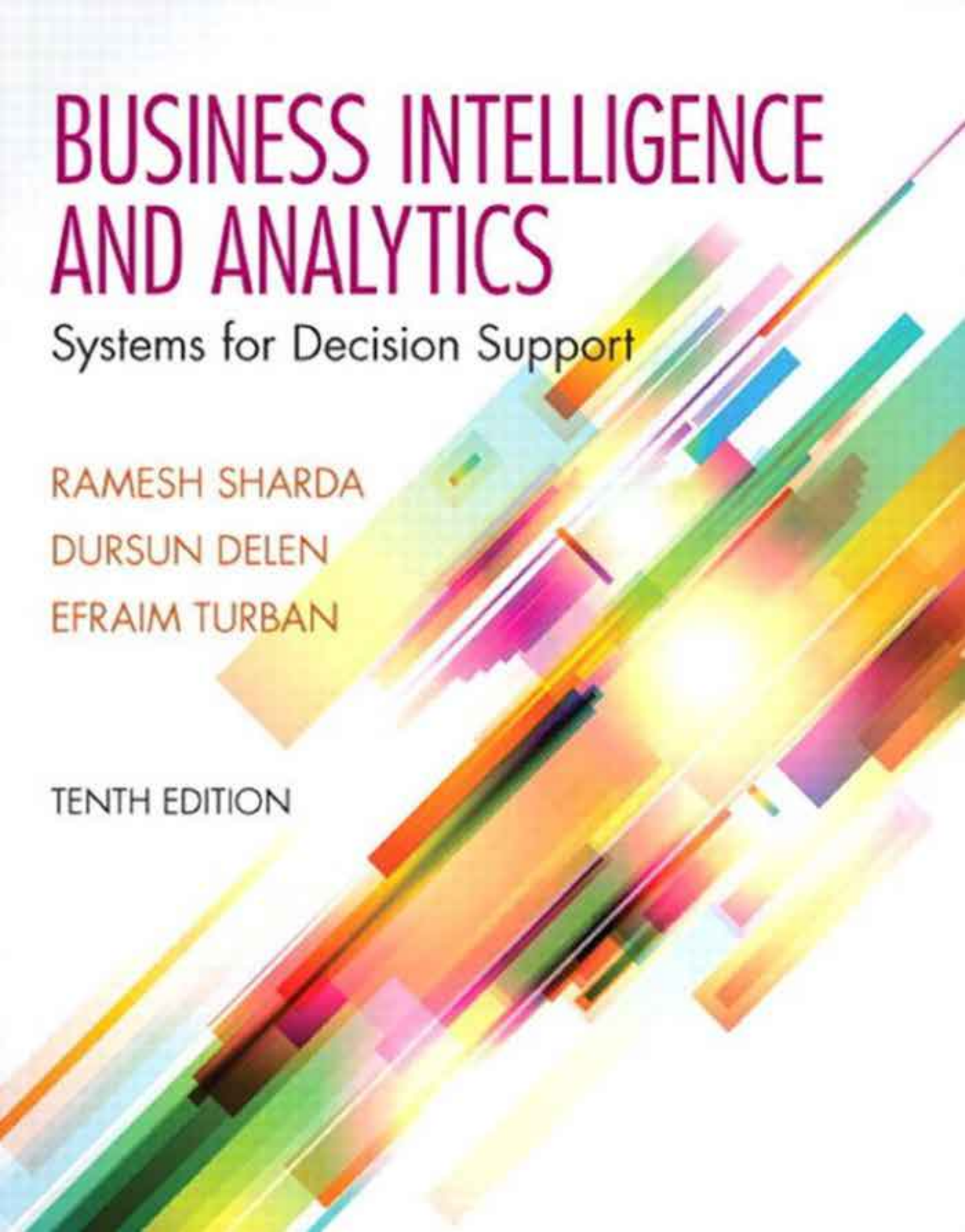
BUSINESS INTELLIGENCE AND ANALYTICS

Systems for Decision Support

RAMESH SHARDA
DURSUN DELEN
EFRAIM TURBAN

TENTH EDITION



Tenth Edition

Business Intelligence and Analytics:

Systems for Decision Support

Ramesh Sharda
Oklahoma State University

Dursun Delen
Oklahoma State University

Efraim Turban
University of Hawaii

With contributions by

J. E. Aronson
The University of Georgia

Ting-Peng Liang
National Sun Yat-sen University

David King
JDA Software Group, Inc.

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PREFACE

Analytics has become the technology driver of this decade. Companies such as IBM, Oracle, Microsoft, and others are creating new organizational units focused on analytics that help businesses become more effective and efficient in their operations. Decision makers are using more computerized tools to support their work. Even consumers are using analytics tools directly or indirectly to make decisions on routine activities such as shopping, healthcare, and entertainment. The field of decision support systems (DSS)/business intelligence (BI) is evolving rapidly to become more focused on innovative applications of data streams that were not even captured some time back, much less analyzed in any significant way. New applications turn up daily in healthcare, sports, entertainment, supply chain management, utilities, and virtually every industry imaginable.

The theme of this revised edition is BI and analytics for enterprise decision support. In addition to traditional decision support applications, this edition expands the reader's understanding of the various types of analytics by providing examples, products, services, and exercises by discussing Web-related issues throughout the text. We highlight Web intelligence/Web analytics, which parallel BI/business analytics (BA) for e-commerce and other Web applications. The book is supported by a Web site (**pearsonhighered.com/sharda**) and also by an independent site at **dssbibook.com**. We will also provide links to software tutorials through a special section of the Web site.

The purpose of this book is to introduce the reader to these technologies that are generally called *analytics* but have been known by other names. The core technology consists of DSS, BI, and various decision-making techniques. We use these terms interchangeably. This book presents the fundamentals of the techniques and the manner in which these systems are constructed and used. We follow an EEE approach to introducing these topics: **Exposure, Experience,** and **Explore**. The book primarily provides **exposure** to various analytics techniques and their applications. The idea is that a student will be inspired to learn from how other organizations have employed analytics to make decisions or to gain a competitive edge. We believe that such **exposure** to what is being done with analytics and how it can be achieved is the key component of learning about analytics. In describing the techniques, we also introduce specific software tools that can be used for developing such applications. The book is not limited to any one software tool, so the students can **experience** these techniques using any number of available software tools. Specific suggestions are given in each chapter, but the student and the professor are able to use this book with many different software tools. Our book's companion Web site will include specific software guides, but students can gain **experience** with these techniques in many different ways. Finally, we hope that this **exposure** and **experience** enable and motivate readers to **explore** the potential of these techniques in their own domain. To facilitate such **exploration,** we include exercises that direct them to Teradata University Network and other sites as well that include team-oriented exercises where appropriate. We will also highlight new and innovative applications that we learn about on the book's companion Web sites.

Most of the specific improvements made in this tenth edition concentrate on three areas: reorganization, content update, and a sharper focus. Despite the many changes, we have preserved the comprehensiveness and user friendliness that have made the text a market leader. We have also reduced the book's size by eliminating older and redundant material and by combining material that was not used by a majority of professors. At the same time, we have kept several of the classical references intact. Finally, we present accurate and updated material that is not available in any other text. We next describe the changes in the tenth edition.

WHAT'S NEW IN THE TENTH EDITION?

With the goal of improving the text, this edition marks a major reorganization of the text to reflect the focus on analytics. The last two editions transformed the book from the traditional DSS to BI and fostered a tight linkage with the Teradata University Network (TUN). This edition is now organized around three major types of analytics. The new edition has many timely additions, and the dated content has been deleted. The following major specific changes have been made:

- ***New organization.*** The book is now organized around three types of analytics: descriptive, predictive, and prescriptive, a classification promoted by INFORMS. After introducing the topics of DSS/BI and analytics in Chapter 1 and covering the foundations of decision making and decision support in Chapter 2, the book begins with an overview of data warehousing and data foundations in Chapter 3. This part then covers descriptive or reporting analytics, specifically, visualization and business performance measurement. Chapters 5–8 cover predictive analytics. Chapters 9–12 cover prescriptive and decision analytics as well as other decision support systems topics. Some of the coverage from Chapter 3–4 in previous editions will now be found in the new Chapters 9 and 10. Chapter 11 covers expert systems as well as the new rule-based systems that are commonly built for implementing analytics. Chapter 12 combines two topics that were key chapters in earlier editions—knowledge management and collaborative systems. Chapter 13 is a new chapter that introduces big data and analytics. Chapter 14 concludes the book with discussion of emerging trends and topics in business analytics, including location intelligence, mobile computing, cloud-based analytics, and privacy/ethical considerations in analytics. This chapter also includes an overview of the analytics ecosystem to help the user explore all of the different ways one can participate and grow in the analytics environment. Thus, the book marks a significant departure from the earlier editions in organization. Of course, it is still possible to teach a course with a traditional DSS focus with this book by covering Chapters 1–4, Chapters 9–12, and possibly Chapter 14.
- ***New chapters.*** The following chapters have been added:

  Chapter 8, *"Web Analytics, Web Mining, and Social Analytics."* This chapter covers the popular topics of Web analytics and social media analytics. It is an almost entirely new chapter (95% new material).
  Chapter 13, *"Big Data and Analytics."* This chapter introduces the hot topics of Big Data and analytics. It covers the basics of major components of Big Data techniques and charcteristics. It is also a new chapter (99% new material).
  Chapter 14, *"Business Analytics: Emerging Trends and Future Impacts."* This chapter examines several new phenomena that are already changing or are likely to change analytics. It includes coverage of geospatial in analytics, location-based analytics applications, consumer-oriented analytical applications, mobile platforms, and cloud-based analytics. It also updates some coverage from the previous edition on ethical and privacy considerations. It concludes with a major discussion of the analytics ecosystem (90% new material).
- ***Streamlined coverage.*** We have made the book shorter by keeping the most commonly used content. We also mostly eliminated the preformatted online content. Instead, we will use a Web site to provide updated content and links on a regular basis. We also reduced the number of references in each chapter.
- ***Revamped author team.*** Building upon the excellent content that has been prepared by the authors of the previous editions (Turban, Aronson, Liang, King, Sharda, and Delen), this edition was revised by Ramesh Sharda and Dursun Delen.

Both Ramesh and Dursun have worked extensively in DSS and analytics and have industry as well as research experience.

- ***A live-update Web site.*** Adopters of the textbook will have access to a Web site that will include links to news stories, software, tutorials, and even YouTube videos related to topics covered in the book. This site will be accessible at **http://dssbibook.com**.
- ***Revised and updated content.*** Almost all of the chapters have new opening vignettes and closing cases that are based on recent stories and events. In addition, application cases throughout the book have been updated to include recent examples of applications of a specific technique/model. These application case stories now include suggested questions for discussion to encourage class discussion as well as further exploration of the specific case and related materials. New Web site links have been added throughout the book. We also deleted many older product links and references. Finally, most chapters have new exercises, Internet assignments, and discussion questions throughout.

Specific changes made in chapters that have been retained from the previous editions are summarized next:

Chapter 1, "An Overview of Business Intelligence, Analytics, and Decision Support," introduces the three types of analytics as proposed by INFORMS: descriptive, predictive, and prescriptive analytics. A noted earlier, this classification is used in guiding the complete reorganization of the book itself. It includes about 50 percent new material. All of the case stories are new.

Chapter 2, "Foundations and Technologies for Decision Making," combines material from earlier Chapters 1, 2, and 3 to provide a basic foundation for decision making in general and computer-supported decision making in particular. It eliminates some duplication that was present in Chapters 1–3 of the previous editions. It includes 35 percent new material. Most of the cases are new.

Chapter 3, "Data Warehousing"

- 30 percent new material, including the cases
- New opening case
- Mostly new cases throughout
- NEW: A historic perspective to data warehousing—how did we get here?
- Better coverage of multidimensional modeling (star schema and snowflake schema)
- An updated coverage on the future of data warehousing

Chapter 4, "Business Reporting, Visual Analytics, and Business Performance Management"

- 60 percent of the material is new—especially in visual analytics and reporting
- Most of the cases are new

Chapter 5, "Data Mining"

- 25 percent of the material is new
- Most of the cases are new

Chapter 6, "Techniques for Predictive Modeling"

- 55 percent of the material is new
- Most of the cases are new
- New sections on SVM and *k*NN

Chapter 7, "Text Analytics, Text Mining, and Sentiment Analysis"

- 50 percent of the material is new
- Most of the cases are new
- New section (1/3 of the chapter) on sentiment analysis

Chapter 8, "Web Analytics, Web Mining, and Social Analytics" (New Chapter)
- 95 percent of the material is new

Chapter 9, "Model-Based Decision Making: Optimization and Multi-Criteria Systems"
- All new cases
- Expanded coverage of analytic hierarchy process
- New examples of mixed-integer programming applications and exercises
- About 50 percent new material

In addition, all the Microsoft Excel–related coverage has been updated to work with Microsoft Excel 2010.

Chapter 10, "Modeling and Analysis: Heuristic Search Methods and Simulation"
- This chapter now introduces genetic algorithms and various types of simulation models
- It includes new coverage of other types of simulation modeling such as agent-based modeling and system dynamics modeling
- New cases throughout
- About 60 percent new material

Chapter 11, "Automated Decision Systems and Expert Systems"
- Expanded coverage of automated decision systems including examples from the airline industry
- New examples of expert systems
- New cases
- About 50 percent new material

Chapter 12, "Knowledge Management and Collaborative Systems"
- Significantly condensed coverage of these two topics combined into one chapter
- New examples of KM applications
- About 25 percent new material

Chapters 13 and 14 are mostly new chapters, as described earlier.

We have retained many of the enhancements made in the last editions and updated the content. These are summarized next:

- ***Links to Teradata University Network (TUN).*** Most chapters include new links to TUN (**teradatauniversitynetwork.com**). We encourage the instructors to register and join **teradatauniversitynetwork.com** and explore various content available through the site. The cases, white papers, and software exercises available through TUN will keep your class fresh and timely.
- ***Book title.*** As is already evident, the book's title and focus have changed substantially.
- ***Software support.*** The TUN Web site provides software support at no charge. It also provides links to free data mining and other software. In addition, the site provides exercises in the use of such software.

THE SUPPLEMENT PACKAGE: PEARSONHIGHERED.COM/SHARDA

A comprehensive and flexible technology-support package is available to enhance the teaching and learning experience. The following instructor and student supplements are available on the book's Web site, **pearsonhighered.com/sharda**:

- ***Instructor's Manual.*** The Instructor's Manual includes learning objectives for the entire course and for each chapter, answers to the questions and exercises at the end of each chapter, and teaching suggestions (including instructions for projects). The Instructor's Manual is available on the secure faculty section of **pearsonhighered.com/sharda**.

- ***Test Item File and TestGen Software.*** The Test Item File is a comprehensive collection of true/false, multiple-choice, fill-in-the-blank, and essay questions. The questions are rated by difficulty level, and the answers are referenced by book page number. The Test Item File is available in Microsoft Word and in TestGen. Pearson Education's test-generating software is available from **www.pearsonhighered.com/irc**. The software is PC/MAC compatible and preloaded with all of the Test Item File questions. You can manually or randomly view test questions and drag-and-drop to create a test. You can add or modify test-bank questions as needed. Our TestGens are converted for use in BlackBoard, WebCT, Moodle, D2L, and Angel. These conversions can be found on **pearsonhighered.com/sharda**. The TestGen is also available in Respondus and can be found on **www.respondus.com**.
- ***PowerPoint slides.*** PowerPoint slides are available that illuminate and build on key concepts in the text. Faculty can download the PowerPoint slides from **pearsonhighered.com/sharda**.

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Anand S. Kunnathur, University of Toledo

Shao-ju Lee, California State University at Northridge
Yair Levy, Nova Southeastern University
Hank Lucas, New York University
Jane Mackay, Texas Christian University
George M. Marakas, University of Maryland
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Nick McGaughey, San Jose State University
Ido Millet, Pennsylvania State University–Erie
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Natalie Nazarenko, SUNY College at Fredonia
Souren Paul, Southern Illinois University
Joshua Pauli, Dakota State University
Roger Alan Pick, University of Missouri–St. Louis
W. "RP" Raghupaphi, California State University–Chico
Loren Rees, Virginia Polytechnic Institute and State University
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R.S.

D.D.

E.T.

Note that Web site URLs are dynamic. As this book went to press, we verified that all the cited Web sites were active and valid. Web sites to which we refer in the text sometimes change or are discontinued because companies change names, are bought or sold, merge, or fail. Sometimes Web sites are down for maintenance, repair, or redesign. Most organizations have dropped the initial "www" designation for their sites, but some still use it. If you have a problem connecting to a Web site that we mention, please be patient and simply run a Web search to try to identify the new site. Most times, the new site can be found quickly. Some sites also require a free registration before allowing you to see the content. We apologize in advance for this inconvenience.

ABOUT THE AUTHORS

Ramesh Sharda (M.B.A., Ph.D., University of Wisconsin–Madison) is director of the Ph.D. in Business for Executives Program and Institute for Research in Information Systems (IRIS), ConocoPhillips Chair of Management of Technology, and a Regents Professor of Management Science and Information Systems in the Spears School of Business at Oklahoma State University (OSU). About 200 papers describing his research have been published in major journals, including *Operations Research*, *Management Science*, *Information Systems Research*, *Decision Support Systems*, and *Journal of MIS*. He cofounded the AIS SIG on Decision Support Systems and Knowledge Management (SIGDSS). Dr. Sharda serves on several editorial boards, including those of *INFORMS Journal on Computing*, *Decision Support Systems*, and *ACM Transactions on Management Information Systems*. He has authored and edited several textbooks and research books and serves as the co-editor of several book series (Integrated Series in Information Systems, Operations Research/Computer Science Interfaces, and Annals of Information Systems) with Springer. He is also currently serving as the executive director of the Teradata University Network. His current research interests are in decision support systems, business analytics, and technologies for managing information overload.

Dursun Delen (Ph.D., Oklahoma State University) is the Spears and Patterson Chairs in Business Analytics, Director of Research for the Center for Health Systems Innovation, and Professor of Management Science and Information Systems in the Spears School of Business at Oklahoma State University (OSU). Prior to his academic career, he worked for a privately owned research and consultancy company, Knowledge Based Systems Inc., in College Station, Texas, as a research scientist for five years, during which he led a number of decision support and other information systems–related research projects funded by federal agencies such as DoD, NASA, NIST, and DOE. Dr. Delen's research has appeared in major journals including *Decision Support Systems, Communications of the ACM, Computers and Operations Research, Computers in Industry, Journal of Production Operations Management, Artificial Intelligence in Medicine,* and *Expert Systems with Applications*, among others. He recently published four textbooks: *Advanced Data Mining Techniques* with Springer, 2008; *Decision Support and Business Intelligence Systems* with Prentice Hall, 2010; *Business Intelligence: A Managerial Approach*, with Prentice Hall, 2010; and *Practical Text Mining*, with Elsevier, 2012. He is often invited to national and international conferences for keynote addresses on topics related to data/text mining, business intelligence, decision support systems, and knowledge management. He served as the general co-chair for the 4th International Conference on Network Computing and Advanced Information Management (September 2–4, 2008, in Seoul, South Korea) and regularly chairs tracks and mini-tracks at various information systems conferences. He is the associate editor-in-chief for *International Journal of Experimental Algorithms*, associate editor for *International Journal of RF Technologies* and *Journal of Decision Analytics*, and is on the editorial boards of five other technical journals. His research and teaching interests are in data and text mining, decision support systems, knowledge management, business intelligence, and enterprise modeling.

Efraim Turban (M.B.A., Ph.D., University of California, Berkeley) is a visiting scholar at the Pacific Institute for Information System Management, University of Hawaii. Prior to this, he was on the staff of several universities, including City University of Hong Kong; Lehigh University; Florida International University; California State University, Long

Beach; Eastern Illinois University; and the University of Southern California. Dr. Turban is the author of more than 100 refereed papers published in leading journals, such as *Management Science*, *MIS Quarterly*, and *Decision Support Systems*. He is also the author of 20 books, including *Electronic Commerce: A Managerial Perspective* and *Information Technology for Management*. He is also a consultant to major corporations worldwide. Dr. Turban's current areas of interest are Web-based decision support systems, social commerce, and collaborative decision making.

PART

I

Decision Making and Analytics

An Overview

LEARNING OBJECTIVES FOR PART I

- Understand the need for business analytics
- Understand the foundations and key issues of managerial decision making
- Understand the major categories and applications of business analytics
- Learn the major frameworks of computerized decision support: analytics, decision support systems (DSS), and business intelligence (BI)

This book deals with a collection of computer technologies that support managerial work—essentially, decision making. These technologies have had a profound impact on corporate strategy, performance, and competitiveness. These techniques broadly encompass analytics, business intelligence, and decision support systems, as shown throughout the book. In Part I, we first provide an overview of the whole book in one chapter. We cover several topics in this chapter. The first topic is managerial decision making and its computerized support; the second is frameworks for decision support. We then introduce business analytics and business intelligence. We also provide examples of applications of these analytical techniques, as well as a preview of the entire book. The second chapter within Part I introduces the foundational methods for decision making and relates these to computerized decision support. It also covers the components and technologies of decision support systems.

CHAPTER

1

An Overview of Business Intelligence, Analytics, and Decision Support

LEARNING OBJECTIVES

- Understand today's turbulent business environment and describe how organizations survive and even excel in such an environment (solving problems and exploiting opportunities)
- Understand the need for computerized support of managerial decision making
- Understand an early framework for managerial decision making
- Learn the conceptual foundations of the decision support systems (DSS[1]) methodology
- Describe the business intelligence (BI) methodology and concepts and relate them to DSS
- Understand the various types of analytics
- List the major tools of computerized decision support

The business environment (climate) is constantly changing, and it is becoming more and more complex. Organizations, private and public, are under pressures that force them to respond quickly to changing conditions and to be innovative in the way they operate. Such activities require organizations to be agile and to make frequent and quick strategic, tactical, and operational decisions, some of which are very complex. Making such decisions may require considerable amounts of relevant data, information, and knowledge. Processing these, in the framework of the needed decisions, must be done quickly, frequently in real time, and usually requires some computerized support.

This book is about using business analytics as computerized support for managerial decision making. It concentrates on both the theoretical and conceptual foundations of decision support, as well as on the commercial tools and techniques that are available. This introductory chapter provides more details of these topics as well as an overview of the book. This chapter has the following sections:

1.1 Opening Vignette: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely 3

1.2 Changing Business Environments and Computerized Decision Support 5

[1]The acronym *DSS* is treated as both singular and plural throughout this book. Similarly, other acronyms, such as *MIS* and *GSS*, designate both plural and singular forms. This is also true of the word *analytics*.

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1.4 Information Systems Support for Decision Making 9
1.5 An Early Framework for Computerized Decision Support 11
1.6 The Concept of Decision Support Systems (DSS) 13
1.7 A Framework for Business Intelligence (BI) 14
1.8 Business Analytics Overview 19
1.9 Brief Introduction to Big Data Analytics 27
1.10 Plan of the Book 29
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1.1 OPENING VIGNETTE: Magpie Sensing Employs Analytics to Manage a Vaccine Supply Chain Effectively and Safely

Cold chain in healthcare is defined as the temperature-controlled supply chain involving a system of transporting and storing vaccines and pharmaceutical drugs. It consists of three major components—transport and storage equipment, trained personnel, and efficient management procedures. The majority of the vaccines in the cold chain are typically maintained at a temperature of 35–46 degrees Fahrenheit [2–8 degrees Centigrade]. Maintaining cold chain integrity is extremely important for healthcare product manufacturers.

Especially for the vaccines, improper storage and handling practices that compromise vaccine viability prove a costly, time-consuming affair. Vaccines must be stored properly from manufacture until they are available for use. Any extreme temperatures of heat or cold will reduce vaccine potency; such vaccines, if administered, might not yield effective results or could cause adverse effects.

Effectively maintaining the temperatures of storage units throughout the healthcare supply chain in real time—i.e., beginning from the gathering of the resources, manufacturing, distribution, and dispensing of the products—is the most effective solution desired in the cold chain. Also, the location-tagged real-time environmental data about the storage units helps in monitoring the cold chain for spoiled products. The chain of custody can be easily identified to assign product liability.

A study conducted by the Centers for Disease Control and Prevention (CDC) looked at the handling of cold chain vaccines by 45 healthcare providers around United States and reported that three-quarters of the providers experienced serious cold chain violations.

A WAY TOWARD A POSSIBLE SOLUTION

Magpie Sensing, a start-up project under Ebers Smith and Douglas Associated LLC, provides a suite of cold chain monitoring and analysis technologies for the healthcare industry. It is a shippable, wireless temperature and humidity monitor that provides real-time, location-aware tracking of cold chain products during shipment. Magpie Sensing's solutions rely on rich analytics algorithms that leverage the data gathered from the monitoring devices to improve the efficiency of cold chain processes and predict cold storage problems before they occur.

Magpie sensing applies all three types of analytical techniques—descriptive, predictive, and prescriptive analytics—to turn the raw data returned from the monitoring devices into actionable recommendations and warnings.

The properties of the cold storage system, which include the set point of the storage system's thermostat, the typical range of temperature values in the storage system, and

the duty cycle of the system's compressor, are monitored and reported in real time. This information helps trained personnel to ensure that the storage unit is properly configured to store a particular product. All the temperature information is displayed on a Web dashboard that shows a graph of the temperature inside the specific storage unit.

Based on information derived from the monitoring devices, Magpie's predictive analytic algorithms can determine the set point of the storage unit's thermostat and alert the system's users if the system is incorrectly configured, depending upon the various types of products stored. This offers a solution to the users of consumer refrigerators where the thermostat is not temperature graded. Magpie's system also sends alerts about possible temperature violations based on the storage unit's average temperature and subsequent compressor cycle runs, which may drop the temperature below the freezing point. Magpie's predictive analytics further report possible human errors, such as failure to shut the storage unit doors or the presence of an incomplete seal, by analyzing the temperature trend and alerting users via Web interface, text message, or audible alert before the temperature bounds are actually violated. In a similar way, a compressor or a power failure can be detected; the estimated time before the storage unit reaches an unsafe temperature also is reported, which prepares the users to look for backup solutions such as using dry ice to restore power.

In addition to predictive analytics, Magpie Sensing's analytics systems can provide prescriptive recommendations for improving the cold storage processes and business decision making. Prescriptive analytics help users dial in the optimal temperature setting, which helps to achieve the right balance between freezing and spoilage risk; this, in turn, provides a cushion-time to react to the situation before the products spoil. Its prescriptive analytics also gather useful meta-information on cold storage units, including the times of day that are busiest and periods where the system's doors are opened, which can be used to provide additional design plans and institutional policies that ensure that the system is being properly maintained and not overused.

Furthermore, prescriptive analytics can be used to guide equipment purchase decisions by constantly analyzing the performance of current storage units. Based on the storage system's efficiency, decisions on distributing the products across available storage units can be made based on the product's sensitivity.

Using Magpie Sensing's cold chain analytics, additional manufacturing time and expenditure can be eliminated by ensuring that product safety can be secured throughout the supply chain and effective products can be administered to the patients. Compliance with state and federal safety regulations can be better achieved through automatic data gathering and reporting about the products involved in the cold chain.

QUESTIONS FOR THE OPENING VIGNETTE

1. What information is provided by the descriptive analytics employed at Magpie Sensing?
2. What type of support is provided by the predictive analytics employed at Magpie Sensing?
3. How does prescriptive analytics help in business decision making?
4. In what ways can actionable information be reported in real time to concerned users of the system?
5. In what other situations might real-time monitoring applications be needed?

WHAT WE CAN LEARN FROM THIS VIGNETTE

This vignette illustrates how data from a business process can be used to generate insights at various levels. First, the graphical analysis of the data (termed *reporting analytics*) allows

users to get a good feel for the situation. Then, additional analysis using **data mining** techniques can be used to estimate what future behavior would be like. This is the domain of predictive analytics. Such analysis can then be taken to create specific recommendations for operators. This is an example of what we call prescriptive analytics. Finally, this opening vignette also suggests that innovative applications of analytics can create new business ventures. Identifying opportunities for applications of analytics and assisting with decision making in specific domains is an emerging entrepreneurial opportunity.

Sources: Magpiesensing.com, "Magpie Sensing Cold Chain Analytics and Monitoring," **magpiesensing.com/wp-content/uploads/2013/01/ColdChainAnalyticsMagpieSensing-Whitepaper.pdf** (accessed July 2013); Centers for Disease Control and Prevention, Vaccine Storage and Handling, **http://www.cdc.gov/vaccines/pubs/pinkbook/vac-storage.html#storage** (accessed July 2013); A. Zaleski, "Magpie Analytics System Tracks Cold-Chain Products to Keep Vaccines, Reagents Fresh" (2012), **technicallybaltimore.com/profiles/startups/magpie-analytics-system-tracks-cold-chain-products-to-keep-vaccines-reagents-fresh** (accessed February 2013).

1.2 CHANGING BUSINESS ENVIRONMENTS AND COMPUTERIZED DECISION SUPPORT

The opening vignette illustrates how a company can employ technologies to make sense of data and make better decisions. Companies are moving aggressively to computerized support of their operations. To understand why companies are embracing computerized support, including business intelligence, we developed a model called the *Business Pressures–Responses–Support Model*, which is shown in Figure 1.1.

The Business Pressures–Responses–Support Model

The Business Pressures–Responses–Support Model, as its name indicates, has three components: business pressures that result from today's business climate, responses (actions taken) by companies to counter the pressures (or to take advantage of the opportunities available in the environment), and computerized support that facilitates the monitoring of the environment and enhances the response actions taken by organizations.

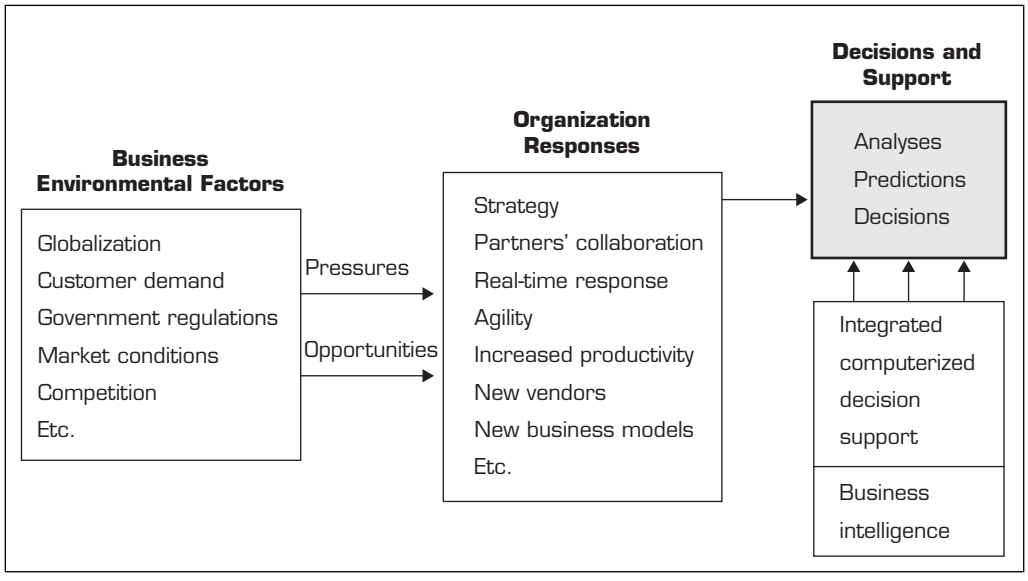

FIGURE 1.1 The Business Pressures–Responses–Support Model.

THE BUSINESS ENVIRONMENT The environment in which organizations operate today is becoming more and more complex. This complexity creates opportunities on the one hand and problems on the other. Take globalization as an example. Today, you can easily find suppliers and customers in many countries, which means you can buy cheaper materials and sell more of your products and services; great opportunities exist. However, globalization also means more and stronger competitors. Business environment factors can be divided into four major categories: *markets, consumer demands, technology*, and *societal*. These categories are summarized in Table 1.1.

Note that the *intensity* of most of these factors increases with time, leading to more pressures, more competition, and so on. In addition, organizations and departments within organizations face decreased budgets and amplified pressures from top managers to increase performance and profit. In this kind of environment, managers must respond quickly, innovate, and be agile. Let's see how they do it.

ORGANIZATIONAL RESPONSES: BE REACTIVE, ANTICIPATIVE, ADAPTIVE, AND PROACTIVE Both private and public organizations are aware of today's business environment and pressures. They use different actions to counter the pressures. Vodafone New Zealand Ltd (Krivda, 2008), for example, turned to BI to improve communication and to support executives in its effort to retain existing customers and increase revenue from these customers. Managers may take other actions, including the following:

- Employ strategic planning.
- Use new and innovative business models.
- Restructure business processes.
- Participate in business alliances.
- Improve corporate information systems.
- Improve partnership relationships.

TABLE 1.1 Business Environment Factors That Create Pressures on Organizations

Factor	Description
Markets	Strong competition
	Expanding global markets
	Booming electronic markets on the Internet
	Innovative marketing methods
	Opportunities for outsourcing with IT support
	Need for real-time, on-demand transactions
Consumer demands	Desire for customization
	Desire for quality, diversity of products, and speed of delivery
	Customers getting powerful and less loyal
Technology	More innovations, new products, and new services
	Increasing obsolescence rate
	Increasing information overload
	Social networking, Web 2.0 and beyond
Societal	Growing government regulations and deregulation
	Workforce more diversified, older, and composed of more women
	Prime concerns of homeland security and terrorist attacks
	Necessity of Sarbanes-Oxley Act and other reporting-related legislation
	Increasing social responsibility of companies
	Greater emphasis on sustainability

- Encourage innovation and creativity.
- Improve customer service and relationships.
- Employ social media and mobile platforms for e-commerce and beyond.
- Move to make-to-order production and on-demand manufacturing and services.
- Use new IT to improve communication, data access (discovery of information), and collaboration.
- Respond quickly to competitors' actions (e.g., in pricing, promotions, new products and services).
- Automate many tasks of white-collar employees.
- Automate certain decision processes, especially those dealing with customers.
- Improve decision making by employing analytics.

Many, if not all, of these actions require some computerized support. These and other response actions are frequently facilitated by computerized decision support (DSS).

CLOSING THE STRATEGY GAP One of the major objectives of computerized decision support is to facilitate closing the gap between the current performance of an organization and its desired performance, as expressed in its mission, objectives, and goals, and the strategy to achieve them. In order to understand why computerized support is needed and how it is provided, especially for decision-making support, let's look at managerial decision making.

SECTION 1.2 REVIEW QUESTIONS

1. List the components of and explain the Business Pressures–Responses–Support Model.
2. What are some of the major factors in today's business environment?
3. What are some of the major response activities that organizations take?

1.3 MANAGERIAL DECISION MAKING

Management is a process by which organizational goals are achieved by using resources. The resources are considered inputs, and attainment of goals is viewed as the output of the process. The degree of success of the organization and the manager is often measured by the ratio of outputs to inputs. This ratio is an indication of the organization's *productivity*, which is a reflection of the *organizational and managerial performance*.

The level of productivity or the success of management depends on the performance of managerial functions, such as planning, organizing, directing, and controlling. To perform their functions, managers engage in a continuous process of making decisions. Making a decision means selecting the best alternative from two or more solutions.

The Nature of Managers' Work

Mintzberg's (2008) classic study of top managers and several replicated studies suggest that managers perform 10 major roles that can be classified into three major categories: *interpersonal, informational*, and *decisional* (see Table 1.2).

To perform these roles, managers need information that is delivered efficiently and in a timely manner to personal computers (PCs) on their desktops and to mobile devices. This information is delivered by networks, generally via Web technologies.

In addition to obtaining information necessary to better perform their roles, managers use computers directly to support and improve decision making, which is a key task

TABLE 1.2 Mintzberg's 10 Managerial Roles

Role	Description
Interpersonal	
Figurehead	Is symbolic head; obliged to perform a number of routine duties of a legal or social nature
Leader	Is responsible for the motivation and activation of subordinates; responsible for staffing, training, and associated duties
Liaison	Maintains self-developed network of outside contacts and informers who provide favors and information
Informational	
Monitor	Seeks and receives a wide variety of special information (much of it current) to develop a thorough understanding of the organization and environment; emerges as the nerve center of the organization's internal and external information
Disseminator	Transmits information received from outsiders or from subordinates to members of the organization; some of this information is factual, and some involves interpretation and integration
Spokesperson	Transmits information to outsiders about the organization's plans, policies, actions, results, and so forth; serves as an expert on the organization's industry
Decisional	
Entrepreneur	Searches the organization and its environment for opportunities and initiates improvement projects to bring about change; supervises design of certain projects
Disturbance handler	Is responsible for corrective action when the organization faces important, unexpected disturbances
Resource allocator	Is responsible for the allocation of organizational resources of all kinds; in effect, is responsible for the making or approval of all significant organizational decisions
Negotiator	Is responsible for representing the organization at major negotiations

Sources: Compiled from H. A. Mintzberg, *The Nature of Managerial Work*. Prentice Hall, Englewood Cliffs, NJ, 1980; and H. A. Mintzberg, *The Rise and Fall of Strategic Planning*. The Free Press, New York, 1993.

that is part of most of these roles. Many managerial activities in all roles revolve around decision making. *Managers, especially those at high managerial levels, are primarily decision makers*. We review the decision-making process next but will study it in more detail in the next chapter.

The Decision-Making Process

For years, managers considered decision making purely an art—a talent acquired over a long period through experience (i.e., learning by trial-and-error) and by using intuition. Management was considered an art because a variety of individual styles could be used in approaching and successfully solving the same types of managerial problems. These styles were often based on creativity, judgment, intuition, and experience rather than on systematic quantitative methods grounded in a scientific approach. However, recent research suggests that companies with top managers who are more focused on persistent work (almost dullness) tend to outperform those with leaders whose main strengths are interpersonal communication skills (Kaplan et al., 2008; Brooks, 2009). It is more important to emphasize methodical, thoughtful, analytical decision making rather than flashiness and interpersonal communication skills.

Managers usually make decisions by following a four-step process (we learn more about these in Chapter 2):

1. Define the problem (i.e., a decision situation that may deal with some difficulty or with an opportunity).
2. Construct a model that describes the real-world problem.
3. Identify possible solutions to the modeled problem and evaluate the solutions.
4. Compare, choose, and recommend a potential solution to the problem.

To follow this process, one must make sure that sufficient alternative solutions are being considered, that the consequences of using these alternatives can be reasonably predicted, and that comparisons are done properly. However, the environmental factors listed in Table 1.1 make such an evaluation process difficult for the following reasons:

- Technology, information systems, advanced search engines, and globalization result in more and more alternatives from which to choose.
- Government regulations and the need for compliance, political instability and terrorism, competition, and changing consumer demands produce more uncertainty, making it more difficult to predict consequences and the future.
- Other factors are the need to make rapid decisions, the frequent and unpredictable changes that make trial-and-error learning difficult, and the potential costs of making mistakes.
- These environments are growing more complex every day. Therefore, making decisions today is indeed a complex task.

Because of these trends and changes, it is nearly impossible to rely on a trial-and-error approach to management, especially for decisions for which the factors shown in Table 1.1 are strong influences. Managers must be more sophisticated; they must use the new tools and techniques of their fields. Most of those tools and techniques are discussed in this book. Using them to support decision making can be extremely rewarding in making effective decisions. In the following section, we look at why we need computer support and how it is provided.

SECTION 1.3 REVIEW QUESTIONS

1. Describe the three major managerial roles, and list some of the specific activities in each.
2. Why have some argued that management is the same as decision making?
3. Describe the four steps managers take in making a decision.

1.4 INFORMATION SYSTEMS SUPPORT FOR DECISION MAKING

From traditional uses in payroll and bookkeeping functions, computerized systems have penetrated complex managerial areas ranging from the design and management of automated factories to the application of analytical methods for the evaluation of proposed mergers and acquisitions. Nearly all executives know that information technology is vital to their business and extensively use information technologies.

Computer applications have moved from transaction processing and monitoring activities to problem analysis and solution applications, and much of the activity is done with Web-based technologies, in many cases accessed through mobile devices. Analytics and BI tools such as data warehousing, data mining, online analytical processing (OLAP), **dashboards**, and the use of the Web for decision support are the cornerstones of today's modern management. Managers must have high-speed, networked information systems (wireline or wireless) to assist them with their most important task: making decisions. Besides the obvious growth in hardware, software, and network capacities, some