CHAPTER

1

Overview of Business Intelligence, Analytics, Data Science, and Artificial Intelligence: Systems for Decision Support

LEARNING OBJECTIVES

- Understand the need for computerized support of managerial decision making
- Understand the development of systems for providing decision-making support
- Recognize the evolution of such computerized support to the current state of analytics/data science and artificial intelligence
- Describe the business intelligence (BI) methodology and concepts
- Understand the different types of analytics and review selected applications
- Understand the basic concepts of artificial intelligence (AI) and see selected applications
- Understand the analytics ecosystem to identify various key players and career opportunities

The business environment (climate) is constantly changing, and it is becoming more and more complex. Organizations, both 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. As technologies are evolving, many decisions are being automated, leading to a major impact on knowledge work and workers in many ways.

This book is about using business analytics and artificial intelligence (AI) as a computerized support portfolio for managerial decision making. It concentrates on the

theoretical and conceptual foundations of decision support as well as on the commercial tools and techniques that are available. The book presents the fundamentals of the techniques and the manner in which these systems are constructed and used. We follow an EEE (*exposure, experience*, and *exploration*) approach to introducing these topics. The book primarily provides exposure to various analytics/AI techniques and their applications. The idea is that students will be inspired to learn from how various organizations have employed these technologies to make decisions or to gain a competitive edge. We believe that such exposure to what is being accomplished with analytics and that how it can be achieved is the key component of learning about analytics. In describing the techniques, we also give examples of specific software tools that can be used for developing such applications. However, the book is not limited to any one software tool, so students can experience these techniques using any number of available software tools. 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 the reader to Teradata University Network (TUN) and other sites that include team-oriented exercises where appropriate. In our own teaching experience, projects undertaken in the class facilitate such exploration after students have been exposed to the myriad of applications and concepts in the book and they have experienced specific software introduced by the professor.

This introductory chapter provides an introduction to analytics and artificial intelligence as well as an overview of the book. The chapter has the following sections:

1.1 OPENING VIGNETTE: How Intelligent Systems Work for KONE Elevators and Escalators Company

KONE is a global industrial company (based in Finland) that manufactures mostly elevators and escalators and also services over 1.1 million elevators, escalators, and related equipment in several countries. The company employs over 50,000 people.

THE PROBLEM

Over 1 billion people use the elevators and escalators manufactured and serviced by KONE every day. If equipment does not work properly, people may be late to work, cannot get home in time, and may miss important meetings and events. So, KONE's objective is to minimize the downtime and users' suffering.

The company has over 20,000 technicians who are dispatched to deal with the elevators anytime a problem occurs. As buildings are getting higher (the trend in many places), more people are using elevators, and there is more pressure on elevators to handle the growing amount of traffic. KONE faced the responsibility to serve users smoothly and safely.

THE SOLUTION

KONE decided to use IBM Watson IoT Cloud platform. As we will see in Chapter 6, IBM installed cognitive abilities in buildings that make it possible to recognize situations and behavior of both people and equipment. The Internet of Things (IoT), as we will see in Chapter 13, is a platform that can connect millions of "things" together and to a central command that can manipulate the connected things. Also, the IoT connects sensors that are attached to KONE's elevators and escalators. The sensors collect information and data about the elevators (such as noise level) and other equipment in real time. Then, the IoT transfers to information centers via the collected data "cloud." There, analytic systems (IBM Advanced Analytic Engine) and AI process the collected data and predict things such as potential failures. The systems also identify the likely causes of problems and suggest potential remedies. Note the predictive power of IBM Watson Analytics (using machine learning, an AI technology described in Chapters 4–6) for finding problems before they occur.

The KONE system collects a significant amount of data that are analyzed for other purposes so that future design of equipment can be improved. This is because Watson Analytics offers a convenient environment for communication of and collaboration around the data. In addition, the analysis suggests how to optimize buildings and equipment operations. Finally, KONE and its customers can get insights regarding the financial aspects of managing the elevators.

KONE also integrates the Watson capabilities with Salesforce's service tools (Service Cloud Lightning and Field Service Lightning). This combination helps KONE to immediately respond to emergencies or soon-to-occur failures as quickly as possible, dispatching some of its 20,000 technicians to the problems' sites. Salesforce also provides superb customer relationship management (CRM). The people–machine communication, query, and collaboration in the system are in a natural language (an AI capability of Watson Analytics; see Chapter 6). Note that IBM Watson analytics includes two types of analytics: *predictive*, which predicts when failures may occur, and *prescriptive*, which recommends actions (e.g., preventive maintenance).

THE RESULTS

KONE has minimized downtime and shortened the repair time. Obviously, elevators/escalators users are much happier if they do not have problems because of equipment downtime, so they enjoy trouble-free rides. The prediction of "soon-to-happen" can save many problems for the equipment owners. The owners can also optimize the schedule of their own employees (e.g., cleaners and maintenance workers). All in all, the decision makers at both KONE and the buildings can make informed and better decisions. Some day in the future, robots may perform maintenance and repairs of elevators and escalators.

Note: This case is a sample of IBM Watson's success using its cognitive buildings capability. To learn more, we suggest you view the following YouTube videos: (1) **youtube.com/watch?v=6UPJHyiJft0** (1:31 min.) (2017); (2) **youtube.com/watch?v=EVbd3ejEXus** (2:49 min.) (2017).

Sources: Compiled from J. Fernandez. (2017, April). "A Billion People a Day. Millions of Elevators. No Room for Downtime." IBM developer Works Blog. **developer.ibm.com/dwblog/2017/kone-watson-video/** (accessed September 2018); H. Srikanthan. "KONE Improves 'People Flow' in 1.1 Million Elevators with IBM Watson IoT." Generis. **https://generisgp.com/2018/01/08/ibm-case-study-kone-corp/** (accessed September 2018); L. Slowey. (2017, February 16). "Look Who's Talking: KONE Makes Elevator Services Truly Intelligent with Watson IoT." IBM Internet of Things Blog. **ibm.com/blogs/internet-of-things/kone/** (accessed September 2018).

QUESTIONS FOR THE OPENING VIGNETTE

1. It is said that KONE is embedding intelligence across its supply chain and enables smarter buildings. Explain.
2. Describe the role of IoT in this case.
3. What makes IBM Watson a necessity in this case?
4. Check IBM Advanced Analytics. What tools were included that relate to this case?
5. Check IBM cognitive buildings. How do they relate to this case?

WHAT CAN WE LEARN FROM THIS VIGNETTE?

Today, intelligent technologies can embark on large-scale complex projects when they include AI combined with IoT. The capabilities of integrated intelligent platforms, such as IBM Watson, make it possible to solve problems that were economically and technologically unsolvable just a few years ago. The case introduces the reader to several of the technologies, including advanced analytics, sensors, IoT, and AI that are covered in this book. The case also points to the use of "cloud." The cloud is used to centrally process large amounts of information using analytics and AI algorithms, involving "things" in different locations. This vignette also introduces us to two major types of analytics: predictive analytics (Chapters 4–6) and prescriptive analytics (Chapter 8).

Several AI technologies are discussed: machine learning, natural language processing, computer vision, and prescriptive analysis.

The case is an example of *augmented intelligence* in which people and machines work together. The case illustrates the benefits to the vendor, the implementing companies, and their employees and to the users of the elevators and escalators.

1.2 CHANGING BUSINESS ENVIRONMENTS AND EVOLVING NEEDS FOR DECISION SUPPORT AND ANALYTICS

Decision making is one of the most important activities in organizations of all kind—probably the most important one. Decision making leads to the success or failure of organizations and how well they perform. Making decisions is getting difficult due to internal and external factors. The rewards of making appropriate decisions can be very high and so can the loss of inappropriate ones.

Unfortunately, it is not simple to make decisions. To begin with, there are several types of decisions, each of which requires a different decision-making approach. For example, De Smet et al. (2017) of McKinsey & Company management consultants classify organizational decision into the following four groups:

- Big-bet, high-risk decisions.
- Cross-cutting decisions, which are repetitive but high risk that require group work (Chapter 11).
- Ad hoc decisions that arise episodically.
- Delegated decisions to individuals or small groups.

Therefore, it is necessary first to understand the nature of decision making. For a comprehensive discussion, see (De Smet et al. 2017).

Modern business is full of uncertainties and rapid changes. To deal with these, organizational decision makers need to deal with ever-increasing and changing data. This book is about the technologies that can assist decision makers in their jobs.

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 tend to outperform those with leaders whose main strengths are interpersonal communication skills. 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 the next section):

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.

A more detailed process is offered by Quain (2018), who suggests the following steps:

1. Understand the decision you have to make.
2. Collect all the information.
3. Identify the alternatives.
4. Evaluate the pros and cons.
5. Select the best alternative.
6. Make the decision.
7. Evaluate the impact of your decision.

We will return to this process in Section 1.3.

The Influence of the External and Internal Environments on the Process

To follow these decision-making processes, one must make sure that sufficient alternative solutions, including good ones, are being considered, that the consequences of using these alternatives can be reasonably predicted, and that comparisons are done properly. However, rapid changes in internal and external environments 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.
  - **Political factors.** Major decisions may be influenced by both external and internal politics. An example is the 2018 trade war on tariffs.
  - **Economic factors.** These range from competition to the genera and state of the economy. These factors, both in the short and long run, need to be considered.