Chapter 1: Decision Support Systems and Business Intelligence

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)
- Describe the business intelligence (BI) methodology and concepts and relate them to DSS
- List the major tools of computerized decision support
- Understand the major issues in implementing computerized support systems

Changing Business Environments and Computerized Decision Support

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.

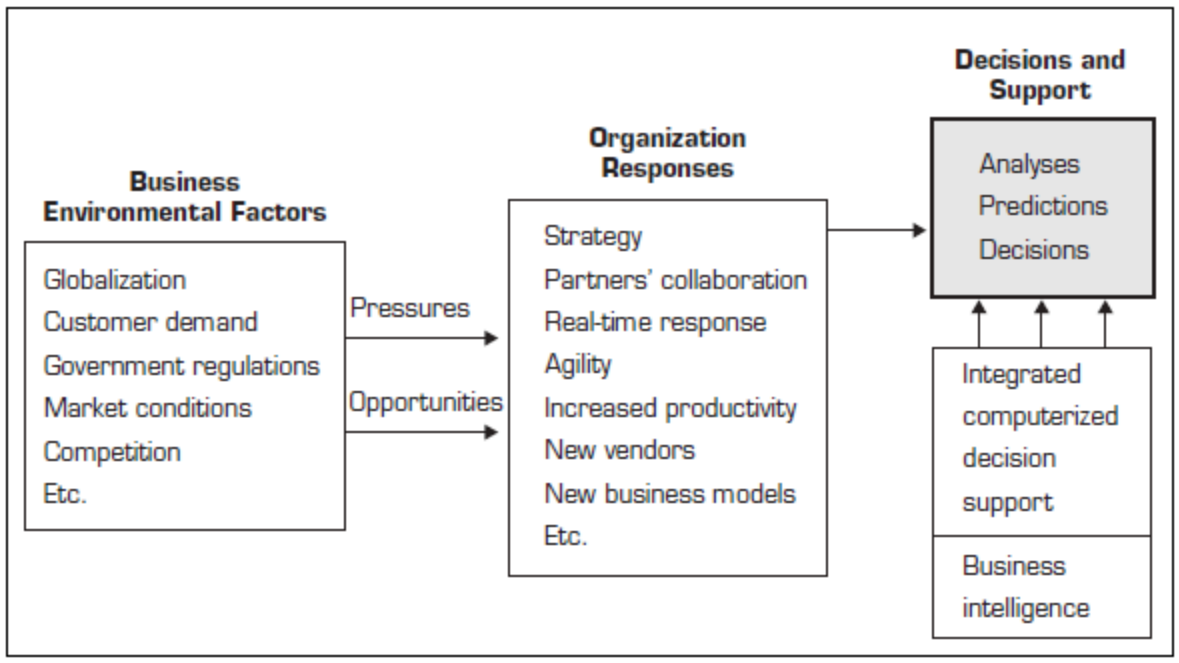


FIGURE 1.1 The Business Pressures–Responses–Support Model.

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.

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.

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

	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

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.
- 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.

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).

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.

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 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:

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-anderror 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. 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.

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 developments have clearly contributed to facilitating growth of decision support and analytics in a number of ways, including the following:

• **Group communication and collaboration.** Many decisions are made today by groups whose members may be in different locations. Groups can collaborate and communicate readily by using Web-based tools as well as the ubiquitous smartphones. Collaboration is especially important along the supply chain, where partners—all the way from vendors to customers—must share information. Assembling a group of decision makers, especially experts, in one place can be costly. Information systems can improve the collaboration process of a group and enable its members to be at different locations (saving travel costs).

• **Improved data management.** Many decisions involve complex computations. Data for these can be stored in different databases anywhere in the organization and even possibly at Web sites outside the organization. The data may include text, sound, graphics, and video, and they can be in different languages. It may be necessary to transmit data quickly from distant locations. Systems today can search, store,
and transmit needed data quickly, economically, securely, and transparently.

• **Managing giant data warehouses and Big Data.** Large data warehouses, like the ones operated by Walmart, contain terabytes and even petabytes of data. Special methods, including parallel computing, are available to organize, search, and mine the data. The costs related to data warehousing are declining. Technologies that fall under the broad category of Big Data have enabled massive data coming from a variety of sources and in many different forms, which allows a very different view into organizational performance that was not possible in the past.

• **Analytical support.** With more data and analysis technologies, more alternatives can be evaluated, forecasts can be improved, risk analysis can be performed quickly, and the views of experts (some of whom may be in remote locations) can be collected quickly and at a reduced cost. Expertise can even be derived directly from analytical systems. With such tools, decision makers can perform complex simulations, check many possible scenarios, and assess diverse impacts quickly and economically.

• **Overcoming cognitive limits in processing and storing information.** According to Simon (1977), the human mind has only a limited ability to process and store information. People sometimes find it difficult to recall and use information in an error-free fashion due to their cognitive limits. The term cognitive limits indicates that an individual's problem-solving capability is limited when a wide range of diverse information and knowledge is required. Computerized systems enable people to overcome their cognitive limits by quickly accessing and processing vast amounts of stored information.

• **Knowledge management.** Organizations have gathered vast stores of information about their own operations, customers, internal procedures, employee interactions, and so forth through the unstructured and structured communications taking place among the various stakeholders. Knowledge management systems (KMS) have become sources of formal and informal support for decision making to managers, although sometimes they may not even be called KMS.

• **Anywhere, any time support.** Using wireless technology, managers can access information anytime and from any place, analyze and interpret it, and communicate with those involved. This perhaps is the biggest change that has occurred in the last few years. The speed at which information needs to be processed and converted into decisions has truly changed expectations for both consumers and businesses.

These and other capabilities have been driving the use of computerized decision support since the late 1960s, but especially since the mid-1990s. The growth of mobile technologies, social media platforms, and analytical tools has enabled a much higher level of information systems support for managers. In the next sections we study a historical classification of decision support tasks. This leads us to be introduced to decision support systems. We will then study an overview of technologies that have been broadly referred to as business intelligence. From there we will broaden our horizons to introduce various types of analytics.

An Early Framework for Computerized Decision Support

An early framework for computerized decision support includes several major concepts that are used in forthcoming sections and chapters of this book. Gorry and Scott-Morton created and used this framework in the early 1970s, and the framework then evolved into a new technology called DSS.

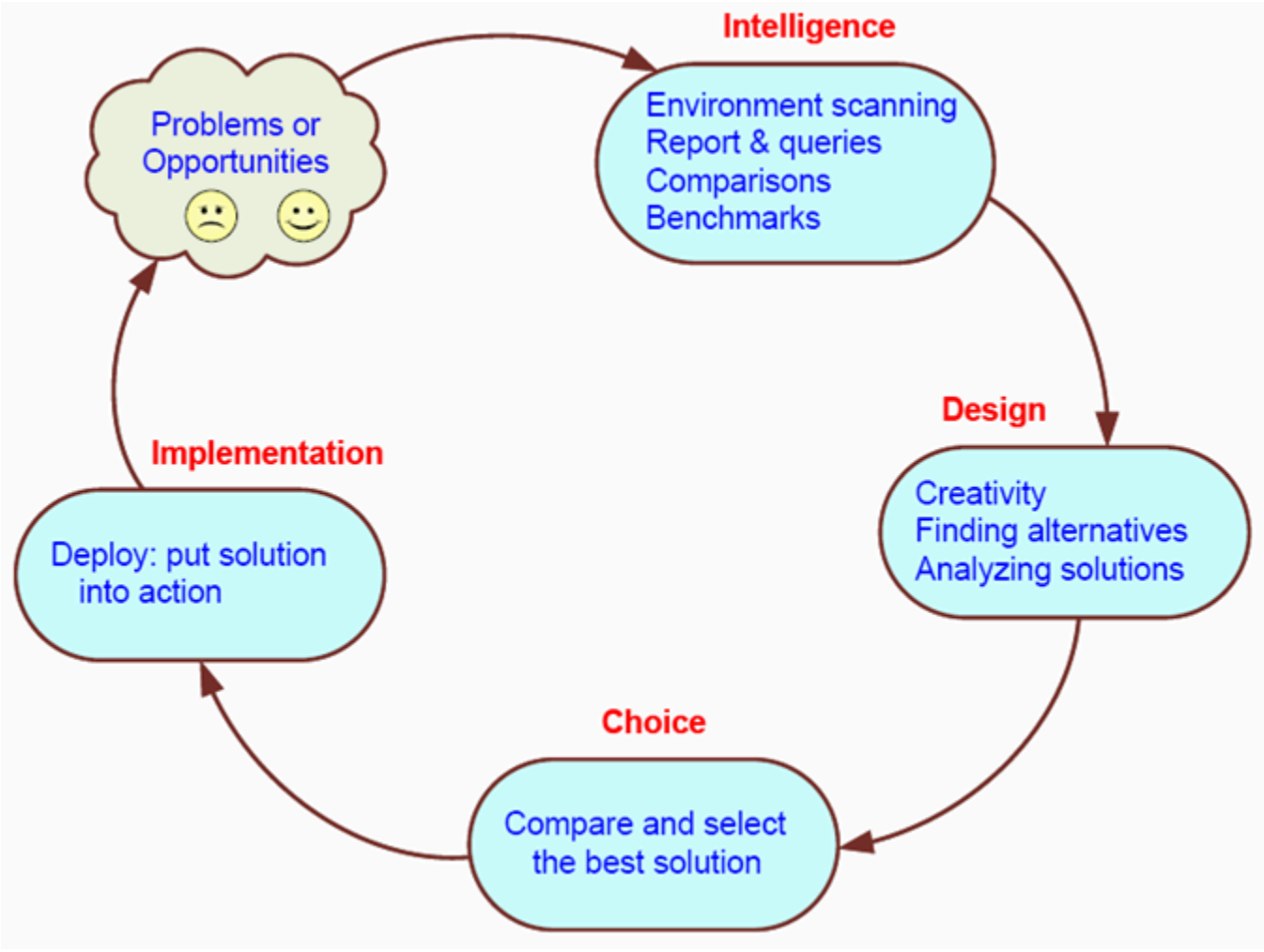
The Gorry and Scott-Morton Classical Framework

Gorry and Scott-Morton (1971) proposed a framework that is a 3-by-3 matrix, as shown in Figure 1.2. The two dimensions are the degree of structuredness and the types of control.

	Type of Control		
Type of Decision	**Operational Control**	**Managerial Control**	**Strategic Planning**
Structured	1 Accounts receivable Accounts payable Order entry	2 Budget analysis Short-term forecasting Personnel reports Make-or-buy	3 Financial management Investment portfolio Warehouse location Distribution systems
Semistructured	4 Production scheduling Inventory control	5 Credit evaluation Budget preparation Plant layout Project scheduling Reward system design Inventory categorization	6 Building a new plant Mergers & acquisitions New product planning Compensation planning Quality assurance HR policies Inventory planning
Unstructured	7 Buying software Approving loans Operating a help desk Selecting a cover for a magazine	8 Negotiating Recruiting an executive Buying hardware Lobbying	9 R & D planning New tech development Social responsibility planning

FIGURE 1.2 Decision Support Frameworks.

Degree of Structuredness The left side of Figure 1.2 is based on Simon's (1977) idea that decision-making processes fall along a continuum that ranges from highly structured (sometimes called programmed) to highly unstructured (i.e., nonprogrammed) decisions. Structured processes are routine and typically repetitive problems for which standard solution methods exist. Unstructured processes are fuzzy, complex problems for which there are no cut-and-dried solution methods.



- An **unstructured** problem is one where the articulation of the problem or the solution approach may be unstructured in itself.
- In a **structured problem**, the procedures for obtaining the best (or at least a good enough) solution are known. Whether the problem involves finding an appropriate inventory level or choosing an optimal investment strategy, the objectives are clearly defined. Common objectives are cost minimization and profit maximization.
- **Semistructured problems** fall between structured and unstructured problems, having some structured elements and some unstructured elements. Keen and Scott-Morton (1978) mentioned trading bonds, setting marketing budgets for consumer products, and performing capital acquisition analysis as semistructured problems.

Types of Control The second half of the Gorry and Scott-Morton framework (refer to Figure 1.2) is based on Anthony's (1965) taxonomy, which defines three
broad categories that encompass all managerial activities: strategic planning, which involves defining long-range goals and policies for resource allocation; management control, the acquisition and efficient use of resources in the accomplishment of organizational goals; and operational control, the efficient and effective execution of specific tasks.

The Decision Support Matrix Anthony's and Simon's taxonomies are combined in the nine-cell decision support matrix shown in Figure 1.2. The initial purpose of this matrix was to suggest different types of computerized support to different cells in the matrix. Gorry and Scott-Morton suggested, for example, that for semistructured decisions and unstructured decisions, conventional management information systems (MIS) and management science (MS) tools are insufficient. Human intellect and a different approach to computer technologies are necessary. They proposed the use of a supportive information
system, which they called a DSS.

Note that the more structured and operational control-oriented tasks (such as those in cells 1, 2, and 4) are usually performed by lower-level managers, whereas the tasks in cells 6, 8, and 9 are the responsibility of top executives or highly trained specialists.

Computer Support for Structured Decisions

Computers have historically supported structured and some semistructured decisions, especially those that involve operational and managerial control, since the 1960s. Operational and managerial control decisions are made in all functional areas, especially in finance and production (i.e., operations) management.

> **Structured problems**, which are encountered repeatedly, have a high level of structure. It is therefore possible to abstract, analyze, and classify them into specific categories. For example, a make-or-buy decision is one category. Other examples of categories are capital budgeting, allocation of resources, distribution, procurement, planning, and inventory control decisions. For each category of decision, an easy-to-apply prescribed model and solution approach have been developed, generally as quantitative formulas. Therefore, it is possible to use a scientific approach for automating portions of managerial decision making.

Management Science Approach

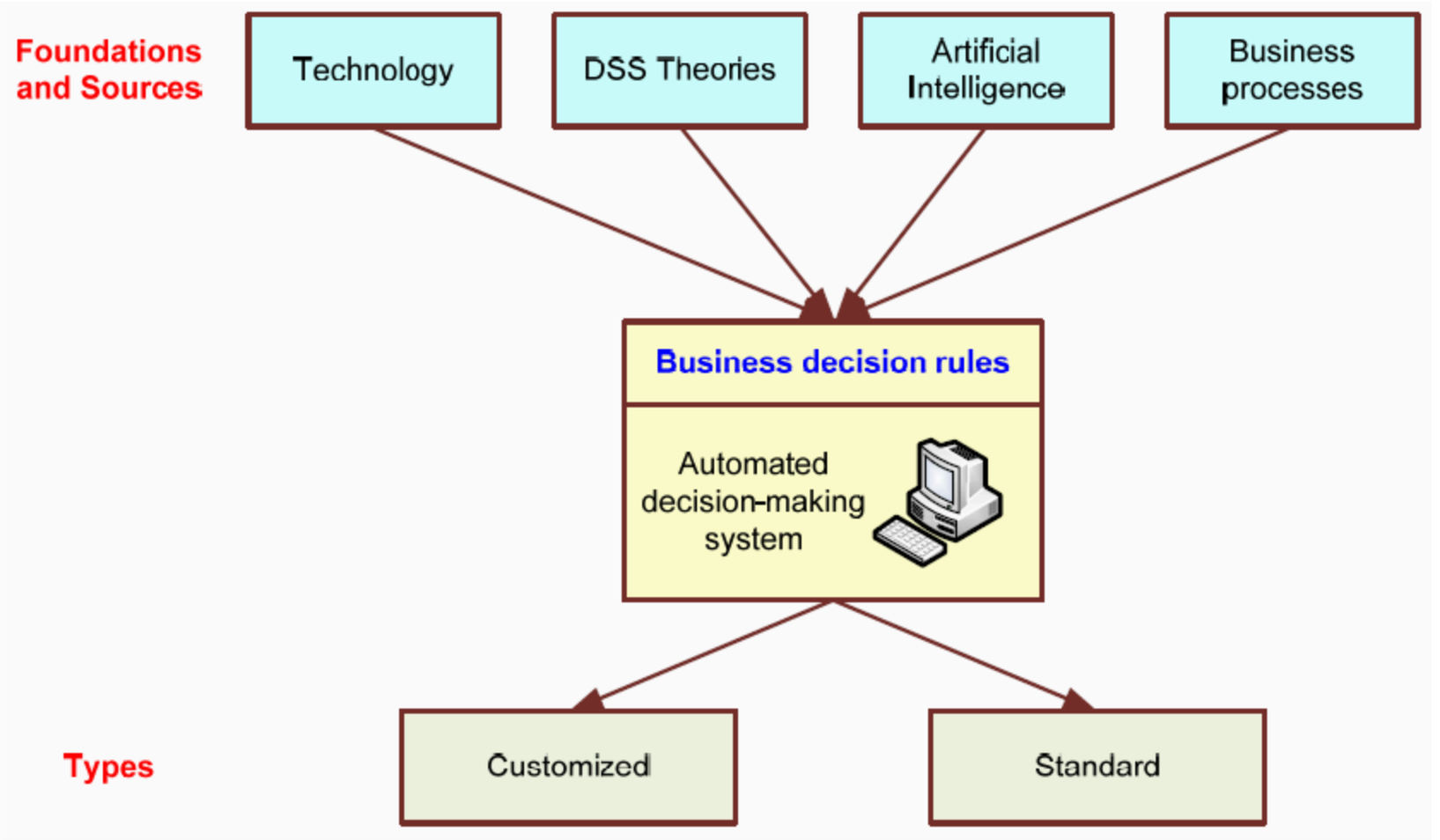
Also referred to as Operation Research

In solving problems, managers should follow the five-step MS approach

- Define the problem
- Classify the problem into a standard category (*)
- Construct a model that describes the real-world problem
- Identify possible solutions to the modeled problem and evaluate the solutions
- Compare, choose, and recommend a potential solution to the problem

Automated Decision Making

- A relatively new approach to supporting decision making
- Applies to highly structures decisions
- Automated decision systems (ADS)
- (or decision automation systems)
- An ADS is a rule-based system that provides a solution to a repetitive managerial problem in a specific area
- e.g., simple-loan approval system
- ADS initially appeared in the airline industry called revenue (or yield) management (or revenue optimization) systems dynamically price tickets based on actual demand
- Today, many service industries use similar pricing models
- ADS are driven by business rules!



Computer Support for Unstructured Decisions

Unstructured problems can be only partially supported by standard computerized quantitative methods. It is usually necessary to develop customized solutions. However, such solutions may benefit from data and information generated from corporate or external data sources. Intuition and judgment may play a large role in these types of decisions, as may computerized communication and collaboration technologies, as well as knowledge management.

Computer Support for Semistructured Problems

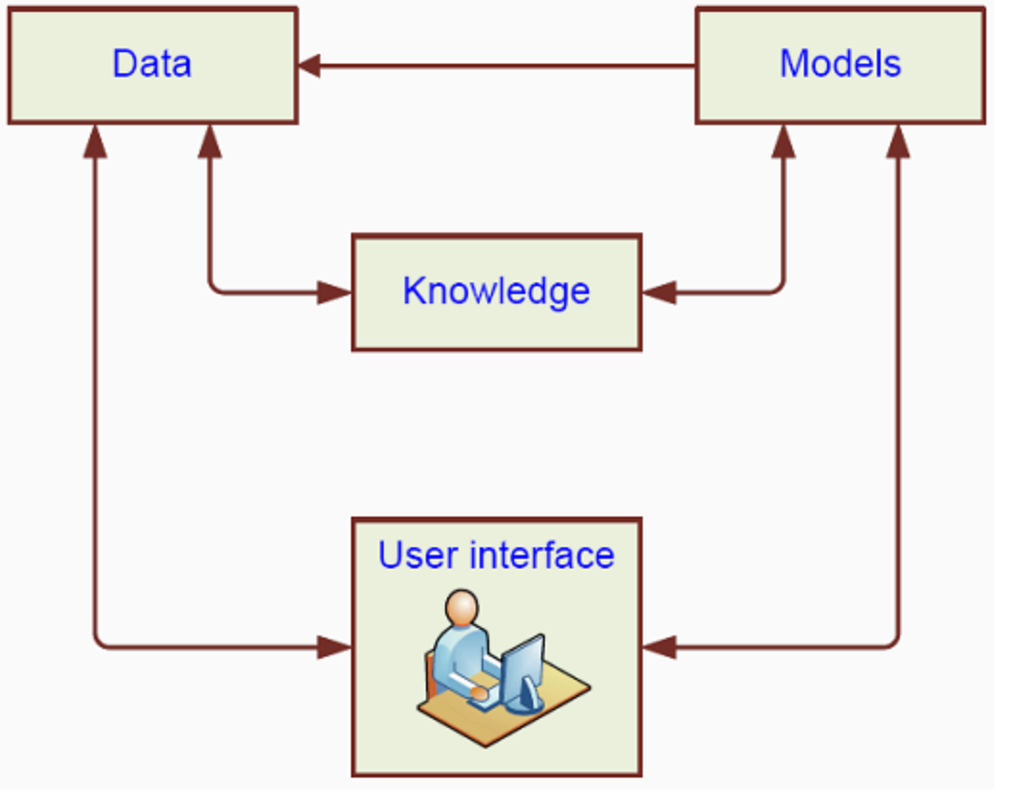
Solving semistructured problems may involve a combination of standard solution procedures and human judgment. Management science can provide models for the portion of a decision-making problem that is structured. For the unstructured portion, a DSS can improve the quality of the information on which the decision is based by providing, for example, not only a single solution but also a range of alternative solutions, along with their potential impacts. These capabilities help managers to better understand the nature of problems and, thus, to make better decisions.

The Concept of Decision support systems (DSS)

In the early 1970s, Scott-Morton first articulated the major concepts of DSS. He defined decision support systems (DSS) as "**interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems**" (Gorry and Scott-Morton, 1971). The following is another classic DSS definition, provided by Keen and Scott-Morton (1978):

> **Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semistructured problems.**

Note that the term decision support system, like management information system (MIS) and other terms in the field of IT, is a content-free expression (i.e., it means different things to different people). Therefore, there is no universally accepted definition of DSS. (We present additional definitions in Chapter 2.) Actually, DSS can be viewed as a conceptual methodology—that is, a broad, umbrella term. However, some view DSS as a narrower, specific decision support application.



DSS as an Umbrella Term

The term DSS can be used as an umbrella term to describe any computerized system that supports decision making in an organization. An organization may have a knowledg management system to guide all its personnel in their problem solving. Another organization may have separate support systems for marketing, finance, and accounting; a supply chain management (SCM) system for production; and several rule-based systems for product repair diagnostics and help desks. DSS encompasses them all.

DSS as a Specific Application

In a narrow sense DSS refers to a process for building customized applications for unstructured or semi-structured problems. Components of the DSS Architecture. Data, Model, Knowledge/Intelligence, User, Interface (API and/or user interface). DSS often is created by putting together loosely coupled instances of these components.

Evolution of DSS into Business Intelligence

In the early days of DSS, managers let their staff do some supportive analysis by using DSS tools. As PC technology advanced, a new generation of managers evolved—one that was comfortable with computing and knew that technology can directly help make intelligent business decisions faster. New tools such as OLAP, data warehousing, data mining, and intelligent systems, delivered via Web technology, added promised capabilities and easy access to tools, models, and data for computer-aided decision making. These tools started to appear under the names BI and business analytics in the mid-1990s. We introduce these concepts next, and relate the DSS and BI concepts in the following sections.

A Framework for Business Intelligence (BI)

The decision support concepts presented in Sections 1.5 and 1.6 have been implemented incrementally, under different names, by many vendors that have created tools and methodologies for decision support. As the enterprise-wide systems grew, managers were able to access user-friendly reports that enabled them to make decisions quickly. These systems, which were generally called executive information systems (EIS), then began to offer additional visualization, alerts, and performance measurement capabilities. By 2006, the major commercial products and services appeared under the umbrella term business
intelligence (BI).

Definitions of BI

Business intelligence (BI) is an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies. It is, like DSS, a content-free expression, so it means different things to different people. Part of the confusion about BI lies in the flurry of acronyms and buzzwords that are associated with it (e.g., business performance management [BPM]). BI's major objective is to enable interactive access (sometimes in real time) to data, to enable manipulation of data, and to give business managers and analysts the ability to conduct appropriate analyses. By analyzing historical and current data, situations, and performances, decision makers get valuable insights that enable them to make more informed and better decisions. The process of BI is based on the transformation of data to information, then to decisions, and finally to actions.

A Brief History of BI

The term BI was coined by the Gartner Group in the mid-1990s. However, the concept is much older; it has its roots in the MIS reporting systems of the 1970s. During that period, reporting systems were static, two dimensional, and had no analytical capabilities. In the early 1980s, the concept of executive information systems (EIS) emerged. This concept expanded the computerized support to top-level managers and executives. Some of the capabilities introduced were dynamic multidimensional (ad hoc or on-demand) reporting, forecasting and prediction, trend analysis, drill-down to details, status access, and critical

success factors. These features appeared in dozens of commercial products until the mid-1990s. Then the same capabilities and some new ones appeared under the name BI.

Today, a good BI-based enterprise information system contains all the information executives need. So, the original concept of EIS was transformed into BI. By 2005, BI systems started to include artificial intelligence capabilities as well as powerful analytical capabilities. Figure 1.3 illustrates the various tools and techniques that may be included in a BI system. It illustrates the evolution of BI as well. The tools shown in Figure 1.3 provide the capabilities of BI. The most sophisticated BI products include most of these capabilities; others specialize in only some of them.

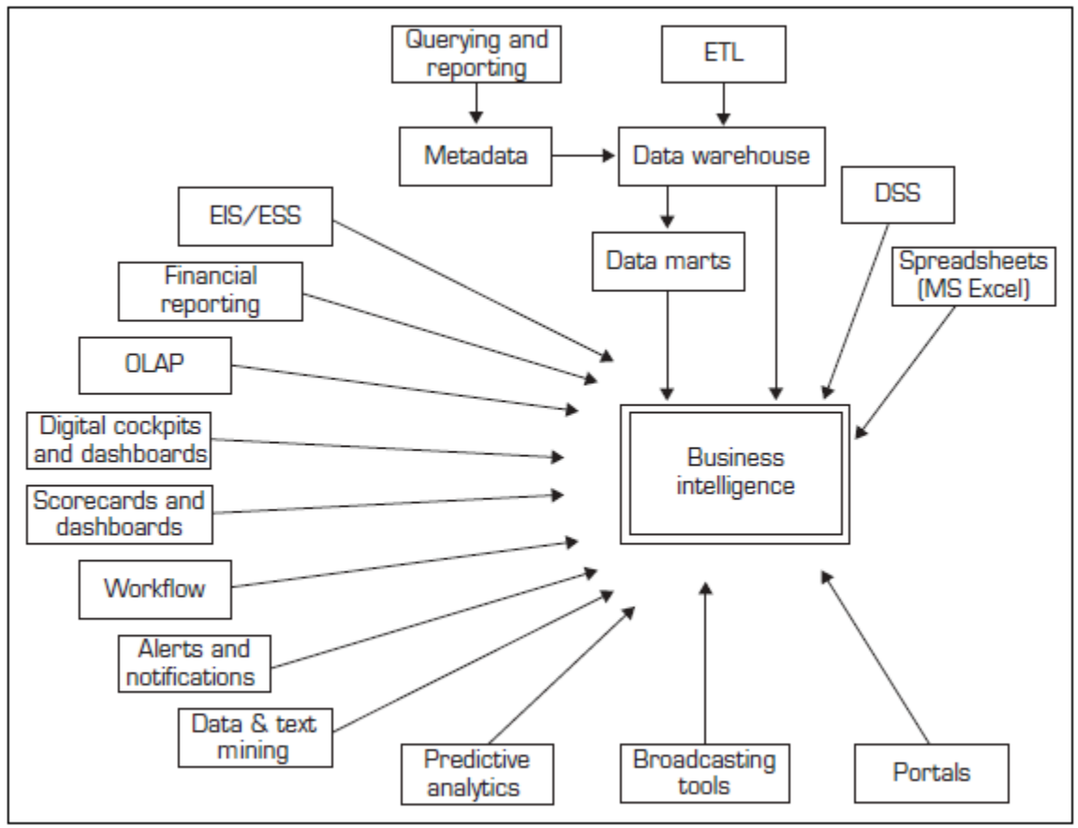


FIGURE 1.3 Evolution of Business Intelligence (BI).

The Architecture of BI

A BI system has four major components: a data warehouse, with its source data; business analytics, a collection of tools for manipulating, mining, and analyzing the data in the data warehouse; business performance management (BPM) for monitoring and analyzing performance; and a user interface (e.g., a dashboard). The relationship among these components is illustrated in Figure 1.4.

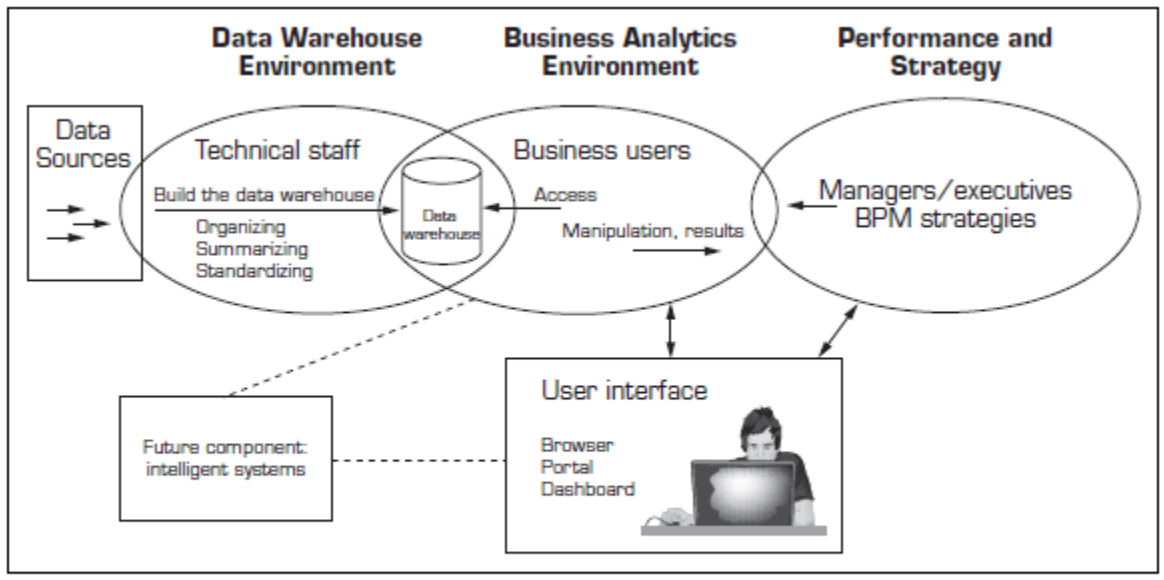


FIGURE 1.4 A High-Level Architecture of BI. *Source:* Based on W. Eckerson, *Smart Companies in the 21st Century: The Secrets of Creating Successful Business Intelligent Solutions.* The Data Warehousing Institute, Seattle, WA, 2003, p. 32, Illustration 5.

Styles of BI

The architecture of BI depends on its applications. MicroStrategy Corp. distinguishes five styles of BI and offers special tools for each. The five styles are:

1. **report delivery and alerting**;
2. **enterprise reporting** (using dashboards and scorecards);
3. **cube analysis** (also known as slice-and-dice analysis);
4. **ad hoc queries**; and
5. **statistics and data mining**.

The Origins and Drivers of BI

Where did modern approaches to data warehousing (DW) and BI come from? What are their roots, and how do those roots affect the way organizations are managing these initiatives today? Today's investments in information technology are under increased scrutiny in terms of their bottom-line impact and potential. The same is true of DW and the BI applications that make these initiatives possible.

Organizations are being compelled to capture, understand, and harness their data to support decision making in order to improve business operations. Legislation and regulation (e.g., the Sarbanes-Oxley Act of 2002) now require business leaders to document their business processes and to sign off on the legitimacy of the information they rely on and report to stakeholders. Moreover, business cycle times are now extremely compressed; faster, more informed, and better decision making is therefore a competitive imperative. Managers need the right information at the right time and in the right place. This is the mantra for modern approaches to BI.

Organizations have to work smart. Paying careful attention to the management of BI initiatives is a necessary aspect of doing business. It is no surprise, then, that organizations are increasingly championing BI. You will hear about more BI successes and the fundamentals of those successes in Chapters 3 through 9. Examples of many applications of BI are provided in Table 1.3. Application Case 1.1 illustrates one such application of BI that has helped many airlines, as well as the companies offering such services to the airlines.

The DSS–BI Connection

By now, you should be able to see some of the similarities and differences between DSS and BI.

First, their architectures are very similar because BI evolved from DSS. However, BI implies the use of a data warehouse, whereas DSS may or may not have such a feature. BI is, therefore, more appropriate for large organizations (because data warehouses are expensive to build and maintain), but DSS can be appropriate to any type of organization.

Second, most DSS are constructed to directly support specific decision making. BI systems, in general, are geared to provide accurate and timely information, and they support decision support indirectly. This situation is changing, however, as more and more decision support tools are being added to BI software packages.

TABLE 1.3 Business Value of BI Analytical Applications

Analytic Application	Business Question	Business Value
Customer segmentation	What market segments do my customers fall into, and what are their characteristics?	Personalize customer relationships for higher 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 the most likely to buy.
Customer profitability	What is the lifetime profitability of my customer?	Make individual business interaction decisions based on the overall profitability of customers.
Fraud detection	How can I tell which transactions are likely to be fraudulent?	Quickly determine fraud and take immediate action to minimize cost.
Customer attrition	Which customer is 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 customer in each segment?	Interact with customers based on their preference and your need to manage cost.

Source: A. Ziama and J. Kasher, *Data Mining Primer for the Data Warehousing Professional*. Teradata, Dayton, OH, 2004.

Third, BI has an executive and strategy orientation, especially in its BPM and dashboard components. DSS, in contrast, is oriented toward analysts.

Fourth, most BI systems are constructed with commercially available tools and components that are fitted to the needs of organizations. In building DSS, the interest may be in constructing solutions to very unstructured problems. In such situations, more programming (e.g., using tools such as Excel) may be needed to customize the solutions.

Fifth, DSS methodologies and even some tools were developed mostly in the academic world. BI methodologies and tools were developed mostly by software companies.

Sixth, many of the tools that BI uses are also considered DSS tools. For example, data mining and predictive analysis are core tools in both areas.

Although some people equate DSS with BI, these systems are not, at present, the same. It is interesting to note that some people believe that DSS is a part of BI—one of its analytical tools. Others think that BI is a special case of DSS that deals mostly with reporting, communication, and collaboration (a form of data-oriented DSS). Another explanation (Watson, 2005) is that BI is a result of a continuous revolution and, as such, DSS is one of BI's original elements. In this book, we separate DSS from BI. However, we point to the DSS–BI connection frequently. Further, as noted in the next section onward, in many circles BI has been subsumed by the new term analytics or data science.

Major Tool Categories for MSS

TOOL CATEGORY	TOOLS AND THEIR ACRONYMS
Data management	Databases and database management system (DBMS) Extraction, transformation, and load (ETL) systems Data warehouses (DW), real-time DW, and data marts
Reporting status tracking	Online analytical processing (OLAP) Executive information systems (EIS)
Visualization	Geographical information systems (GIS) Dashboards, Information portals Multidimensional presentations
Business analytics	Optimization, Web analytics Data mining, Web mining, and text mining
Strategy and performance management	Business performance management (BPM)/ Corporate performance management (CPM) Business activity management (BAM) Dashboards and Scorecards
Communication and collaboration	Group decision support systems (GDSS) Group support systems (GSS) Collaborative information portals and systems
Social networking Knowledge management	Web 2.0, Expert locating systems Knowledge management systems (KMS)
Intelligent systems	Expert systems (ES) Artificial neural networks (ANN) Fuzzy logic, Genetic algorithms, Intelligent agents
Enterprise systems	Enterprise resource planning (ERP), Customer Relationship Management (CRM), and Supply-Chain Management (SCM)

Hybrid (Integrated) Support Systems

The objective of computerized decision support, regardless of its name or nature, is to assist management in solving managerial or organizational problems (and assess opportunities and strategies) faster and better than possible without computers.
Every type of tool has certain capabilities and limitations. By integrating several tools, we can improve decision support because one tool can provide advantages where another is weak.

The trend is therefore towards developing hybrid (integrated) support system.

Type of integration

- Use each tool independently to solve different aspects of the problem
- Use several loosely integrated tools. This mainly involves transferring data from one tool to another for further processing.
- Use several tightly integrated tools. From the user's standpoint, the tool appears as a unified system.

In addition to performing different tasks in the problem-solving process, tools can support each other.