Chapter 3: Components of Decision Support Systems

Learning Objectives

- Understand DSS components and how they integrate
- Describe the components and structure of each DSS component
- Explain Internet impacts on DSS (and vice versa)
- Explain the unique role of the user in DSS versus management information systems
- Describe DSS hardware and software platforms
- Become familiar with a DSS development language
- Understand current DSS issues

Components of Decision Support Systems

A DSS application can be composed of a data management subsystem, a model management subsystem, a user interface subsystem, and a knowledge-based management subsystem. We show these in Figure 3.1.

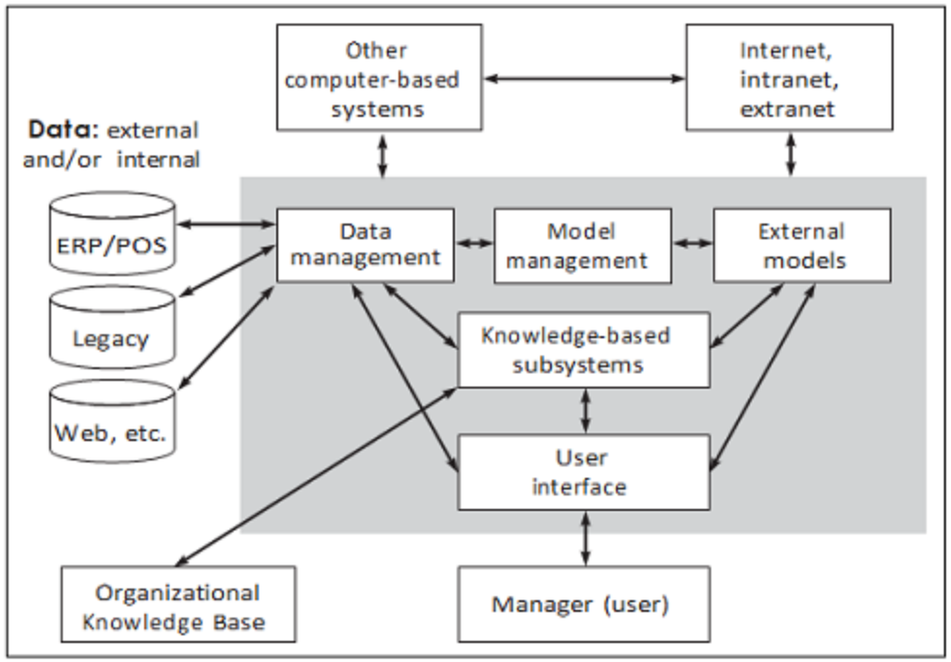

FIGURE 3.1 Schematic View of DSS.

The Data Management Subsystem

The data management subsystem includes a database that contains relevant data for the situation and is managed by software called the **database management system (DBMS)**. The data management subsystem can be interconnected with the corporate **data warehouse**, a repository for corporate relevant decision-making data. Usually, the data are stored or accessed via a database Web server. The data management subsystem is composed of the following elements:

- DSS database
- Database management system
- Data directory
- Query facility

These elements are shown schematically in Figure 3.2 (in the shaded area). The figure also shows the interaction of the data management subsystem with the other parts of the DSS, as well as its interaction with several data sources. Many of the BI or descriptive analytics applications derive their strength from the data management side of the subsystems.

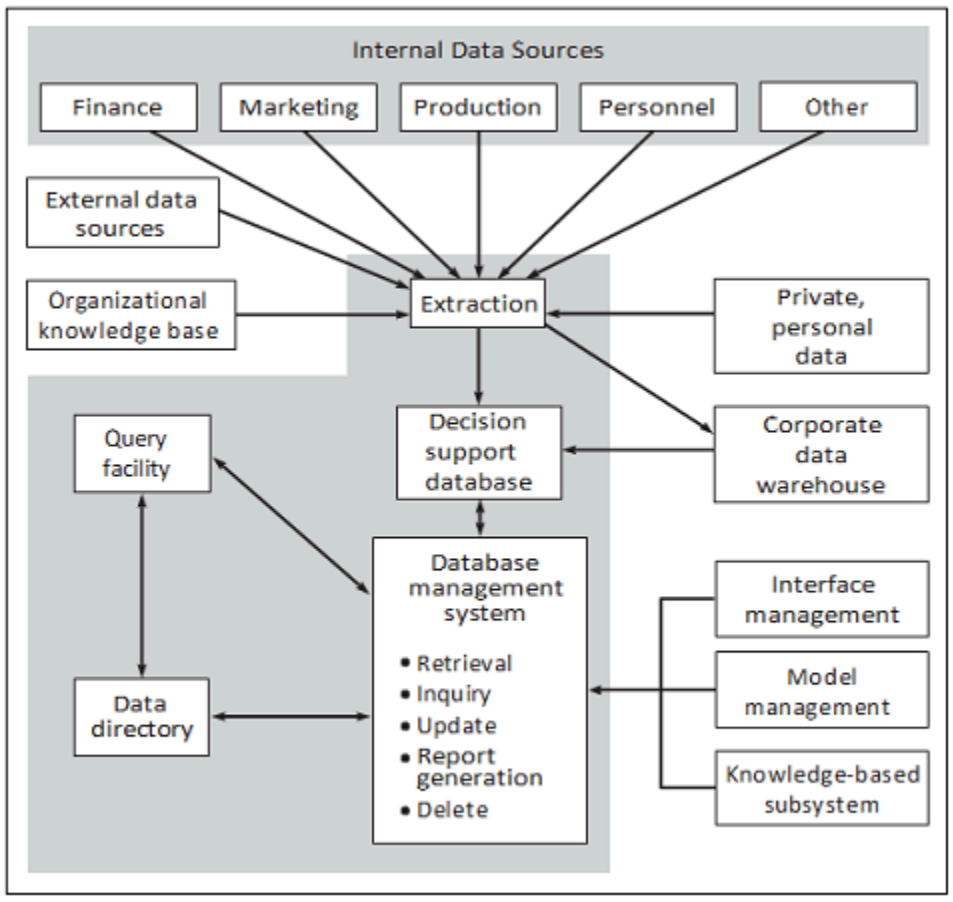

FIGURE 3.2 Structure of the Data Management Subsystem.

The Model Management Subsystem

The model management subsystem is the component that includes financial, statistical, management science, or other quantitative models that provide the system's analytical capabilities and appropriate software management. Modeling languages for building custom models are also included. This software is often called a **model base management system (MBMS)**. This component can be connected to corporate or external storage of models. Model solution methods and management systems are implemented in Web development systems (such as Java) to run on application servers. The model management subsystem of a DSS is composed of the following elements:

- Model base
- MBMS
- Modeling language
- Model directory
- Model execution, integration, and command processor

These elements and their interfaces with other DSS components are shown in Figure 3.3. At a higher level than building blocks, it is important to consider the different types of models and solution methods needed in the DSS. Often at the start of development, there is some sense of the model types to be incorporated, but this may change as more is learned about the decision problem. Some DSS development systems include a wide variety of components (e.g., Analytica from Lumina Decision Systems), whereas others have a single one (e.g., Lindo). Often, the results of one type of model component (e.g., forecasting) are used as input to another (e.g., production scheduling). In some cases, a modeling language is a component that generates input to a solver, whereas in other cases, the two are combined.

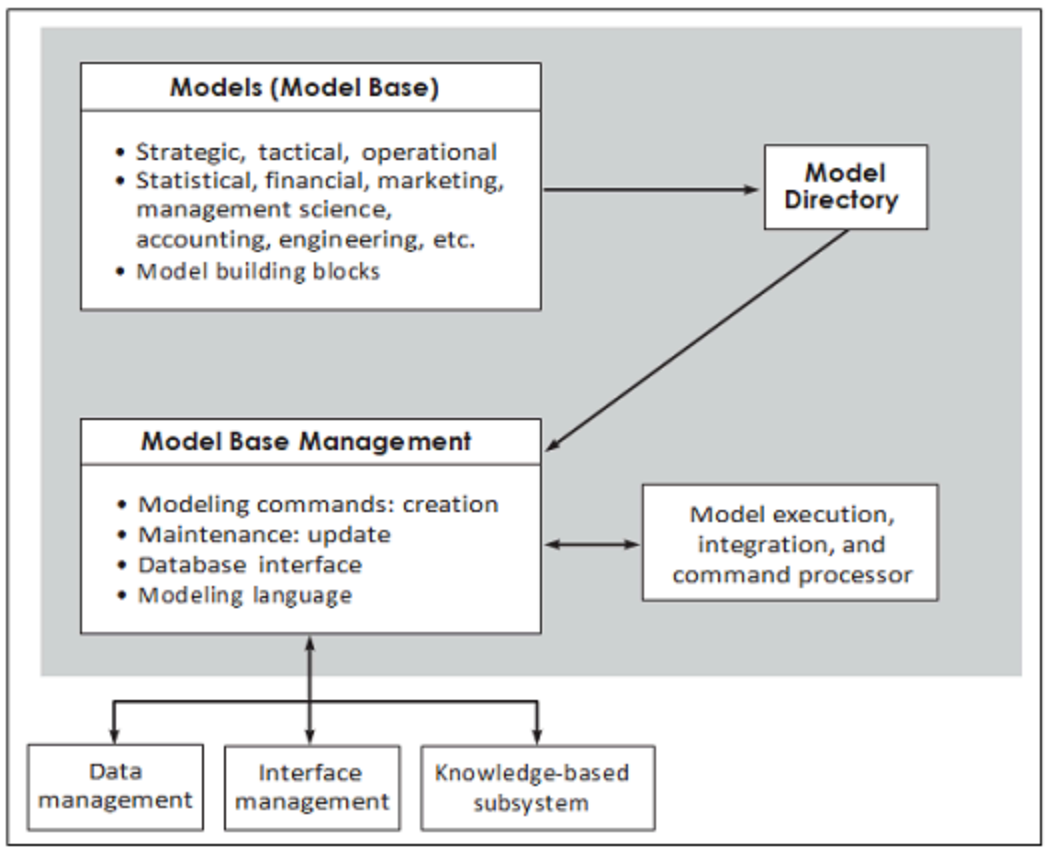

FIGURE 3.3 Structure of the Model Management Subsystem.

Because DSS deal with semistructured or unstructured problems, it is often necessary to customize models, using programming tools and languages. Some examples of these are .NET Framework languages, C++, and Java. OLAP software may also be used to work with models in data analysis. Even languages for simulation such as Arena and statistical packages such as those of SPSS offer modeling tools developed through the use of a proprietary programming language. For small and medium-sized DSS or for less complex ones, a spreadsheet (e.g., Excel) is usually used.

The User Interface Subsystem

The user communicates with and commands the DSS through the **user interface** subsystem. The user is considered part of the system. Researchers assert that some of the unique contributions of DSS are derived from the intensive interaction between the computer and the decision maker. The Web browser provides a familiar, consistent graphical user interface (GUI) structure for most DSS. For locally used DSS, a spreadsheet also provides a familiar user interface. A difficult user interface is one of the major reasons managers do not use computers and quantitative analyses as much as they could, given the availability of these technologies. The Web browser has been recognized as an effective DSS GUI because it is flexible, user friendly, and a gateway to almost all sources of necessary information and data. Essentially, Web browsers have led to the development of portals and dashboards, which front end many DSS. As shown in figure 3.4.

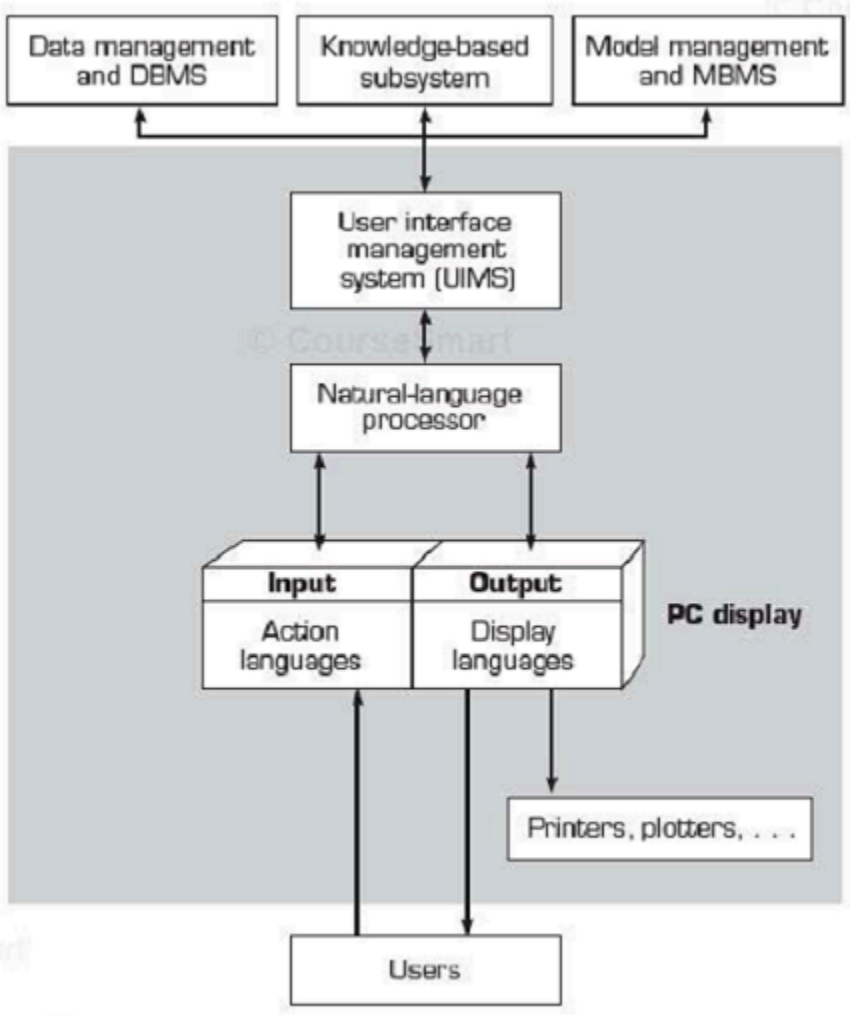

FIGURE 3.4 Structure of the User Interface Subsystem.

Explosive growth in portable devices including smartphones and tablets has changed the DSS user interfaces as well. These devices allow either handwritten input or typed input from internal or external keyboards. Some DSS user interfaces utilize natural-language input

(i.e., text in a human language) so that the users can easily express themselves in a meaningful way. Because of the fuzzy nature of human language, it is fairly difficult to develop software to interpret it. However, these packages increase in accuracy every year, and they will ultimately lead to accurate input, output, and language translators.

Cell phone inputs through SMS are becoming more common for at least some consumer DSS-type applications. For example, one can send an SMS request for search on any topic to GOOGL (46645). It is most useful in locating nearby businesses, addresses, or phone numbers, but it can also be used for many other decision support tasks. For example, users can find definitions of words by entering the word “define” followed by a word, such as “define extenuate.” Some of the other capabilities include:

- Translations: “Translate thanks in Spanish.”
- Price lookups: “Price 32GB iPhone.”
- Calculator: Although you would probably just want to use your phone’s built-in calculator function, you can send a math expression as an SMS for an answer.
- Currency conversions: “10 usd in euros.”
- Sports scores and game times: Just enter the name of a team (“NYC Giants”), and Google SMS will send the most recent game’s score and the date and time of the next match.

This type of SMS-based search capability is also available for other search engines, including Yahoo! and Microsoft’s new search engine Bing.

With the emergence of smartphones such as Apple’s iPhone and Android smartphones from many vendors, many companies are developing applications (commonly called *apps*) to provide purchasing-decision support. For example, Amazon.com’s app allows a user to take a picture of any item in a store (or wherever) and send it to Amazon. com. Amazon.com’s graphics-understanding algorithm tries to match the image to a real product in its databases and sends the user a page similar to Amazon.com’s product info pages, allowing users to perform price comparisons in real time. Thousands of other apps have been developed that provide consumers support for decision making on finding and selecting stores/restaurants/service providers on the basis of location, recommendations from others, and especially from your own social circles.

Voice input for these devices and PCs is common and fairly accurate (but not perfect). When voice input with accompanying speech-recognition software (and readily available text-to-speech software) is used, verbal instructions with accompanied actions and outputs can be invoked. These are readily available for DSS and are incorporated into the portable devices described earlier. An example of voice inputs that can be used for a general-purpose DSS is Apple’s Siri application and Google’s Google Now service. For example, a user can give her zip code and say “pizza delivery.” These devices provide the search results and can even place a call to a business.

Recent efforts in business process management (BPM) have led to inputs directly from physical devices for analysis via DSS. For example, radio-frequency identification (RFID) chips can record data from sensors in railcars or in-process products in a factory. Data from these sensors (e.g., recording an item’s status) can be downloaded at key locations and immediately transmitted to a database or data warehouse, where they can be analyzed and decisions can be made concerning the status of the items being monitored. Walmart and Best Buy are developing this technology in their SCM, and such *sensor networks* are also being used effectively by other firms.

The Knowledge-Based Management Subsystem

The knowledge-based management subsystem can support any of the other subsystems or act as an independent component. It provides intelligence to augment the decision maker's own. It can be interconnected with the organization's knowledge repository (part of a knowledge management system [KMS]), which is sometimes called the **organizational knowledge base**. Knowledge may be provided via Web servers. Many artificial intelligence methods have been implemented in Web development systems such as Java and are easy to integrate into the other DSS components. One of the most widely publicized knowledgebased DSS is IBM's Watson computer system.

We conclude the sections on the three major DSS components with information on some recent technology and methodology developments that affect DSS and decision making.

Many developments in DSS components are the result of new developments in hardware and software computer technology, data warehousing, data mining, OLAP, Web technologies, integration of technologies, and DSS application to various and new functional areas. There is also a clear link between hardware and software capabilities and improvements in DSS. Hardware continues to shrink in size while increasing in speed and other capabilities. The sizes of databases and data warehouses have increased dramatically. Data warehouses now provide hundreds of petabytes of sales data for retail organizations and content for major news networks.

We expect to see more seamless integration of DSS components as they adopt Web technologies, especially XML. These Web-based technologies have become the center of activity in developing DSS. Web-based DSS have reduced technological barriers and have made it easier and less costly to make decision-relevant information and model-driven DSS available to managers and staff users in geographically distributed locations, especially through mobile devices.

DSS are becoming more embedded in other systems. Similarly, a major area to expect improvements in DSS is in GSS in supporting collaboration at the enterprise level. This is true even in the educational arena. Almost every new area of information systems involves some level of decision-making support. Thus, DSS, either directly or indirectly, has impacts on CRM, SCM, ERP, KM, PLM, BAM, BPM, and other EIS. As these systems evolve, the active decision-making component that utilizes mathematical, statistical, or even descriptive models increases in size and capability, although it may be buried deep within the system. Finally, different types of DSS components are being integrated more frequently. For example, GIS are readily integrated with other, more traditional, DSS components and tools for improved decision making.

By definition, a DSS must include the three major components—DBMS, MBMS, and user interface. The knowledge-based management subsystem is optional, but it can provide many benefits by providing intelligence in and to the three major components. As in any other MIS, the user may be considered a component of DSS.