CHAPTER 1

Decision Support Systems Revisited

Because of increasing complexity, rapid change, and the escalating risks confronting managers and organizations, now is an opportune time to evaluate computerized decision support projects, especially decision support systems (DSS). In the mid-1990s, many software vendors invented new terms associated with decision support. For some vendors, DSS was too general; for others, it was associated with failed projects, unrealistic expectations, and painful memories. However, companies continued to build computerized information systems to support decision makers.

Perhaps we have learned to identify and manage our expectations. Decision support systems differ, and technology can support a wide range of decision-making tasks. There are two fundamental premises associated with computerized decision support. First, computers and information technology can help people make important decisions. Second, computerized DSS assist and support managers and keep them connected to the decision-making loop. The overriding goal is improving decision-making effectiveness and efficiency, not automating decisions.

Many organizations have integrated computerized decision support into day-to-day operating activities, like performance monitoring. Frequently, managers download and analyze sales data, create reports, and analyze and evaluate forecasting results. DSS can help managers perform tasks, such as allocating resources, comparing budget to actual results, drilling down to analyze results, projecting revenues, and evaluating scenarios. Data warehouses can create a single version of the truth for advanced analytics and reporting. More managers are using executive dashboards and scorecards from their personal workstations to track operations and support strategic decision making.

Decision support research has a long history, and the concepts of decision support, decision support systems, and the acronym DSS remain understandable, intuitively descriptive, and even obvious in their meaning. Related terms like analytics, business intelligence (BI), and knowledge management are ambiguous and interpreted in many different ways by vendors and consultants. Sadly, the vocabulary of decision support, including acronyms like BPM, BAM, CPM, and BI, can seem like complex techno-speak. My goal is to make some sense out of the decision support chaos and explain the current jargon.

This chapter discusses the need for decision support, the technology skills of managers, the history of decision support, and a theory of decision support. The last section identifies characteristics of modern decision support applications.

What Is the Need for Decision Support?

Today, decision making is more difficult. The need for decision-making speed has increased, overload of information is common, and there is more distortion of information. On the positive side, there is a greater emphasis on fact-based decision making. A complex decision-making environment creates a need for computerized decision support. Research and case studies provide evidence that a well-designed and appropriate computerized decision support system can encourage fact-based decisions, improve decision quality, and improve the efficiency and effectiveness of decision processes.

Most managers want more analyses and specific decision-relevant reports quickly. Certainly, we have many and increasing information needs. The goal of DSS is to create and use better information. Today, there is a pressing need to use technology to help make important decisions. Decision makers perform better with the right information at the right time. In general, computerized decision support can help transfer and organize knowledge. Effective decision support provides managers more independence to retrieve and analyze data and documents to obtain facts and results, as they need them.

From a different perspective, cognitive decision-making biases exist and create a need for decision support. Information presentation and

information availability influence decision makers both positively and negatively. Reducing bias has been a secondary motivation for building DSS. Most managers accept that some people are biased decision makers but often question if a proposed DSS will reduce bias. For example, decision makers "anchor" on the initial information they receive and that influences how they interpret subsequent information. In addition, decision makers tend to place the greatest attention on more recent information and either ignore or forget historical information.[1]

Changing decision-making environments, managerial requests, and decision-maker limitations creates a need for more and better decision support. We should consider building a computerized decision support system when (a) good information is likely to improve the quality of decisions and (b) potential DSS users recognize a need for and want to use computerized support.

Introducing more and better decision support in an organization does create changes and challenges for managers. Using a smart phone with decision support applications or a Tablet PC with wireless connectivity to the Internet and corporate databases requires new skills and new knowledge.

What Technology Skills Do Managers Need?

Technology skills quickly become obsolete. Concepts and theory have a much longer "shelf life." DSS use reasonably sophisticated information hardware and software technologies, so you need computing and software knowledge to understand such systems. In addition, you need technology skills because you may need to provide input to hardware and software choices. At a minimum in today's business environment, you need to be able to operate the software environment of your personal computing devices (e.g., a workstation, a portable computer, or a smart phone).

Your software environment is rapidly changing (i.e., new versions of Microsoft Office, new Google products, and new intracompany Web-based applications are constantly on the rise). In addition, you need to master software products relevant to your job. In some situations, you may develop small-scale budgeting or cost-estimating applications in Excel or a product like Crystal Reports. There is a growing need for "end

user" development of small-scale DSS and preparation of special decision support studies.

Networks and enterprise-wide global systems are expanding. Because managers and knowledge workers are the primary users of enterprise-wide decision support systems, managers must understand the possibilities and be involved in designing the systems.

For many reasons, all managers need to understand the upside benefits and the downside risks of building a specific decision support capability. Decision support systems can solve problems and create new problems. In addition, as a manager, you need to help make informed decision support design, development, and implementation choices.

DSS, computing, and information technology (IT) knowledge and skill needs are constantly evolving. We all need to learn new concepts and new skills. Some new requirements build on previously learned materials; others force us to change dramatically and to "un" learn what we had learned.

What Is the History of Computerized Decision Support?

Supposedly, if we study some history, we are less likely to make the same mistakes again. Computerized decision support has had failures and successes. This brief review of the evolution of decision support technology touches primarily on DSS pioneers and their successes (see Figure 1.1). My online DSS history articles provide more details.[2]

First-Generation Decision Support

Some researchers trace the origins of computerized decision support systems to 1951 and the Lyons Tea Shops business use of the LEO I (Lyons Electronic Office I) digital computer. LEO handled the company's accounts and logistics. Software factored in the weather forecast to help determine the goods carried by "fresh produce" delivery vans to Lyons's UK shops.[3]

A few years later, work started on the Semi-Automatic Ground Environment (SAGE), a control system for tracking aircraft used by NORAD

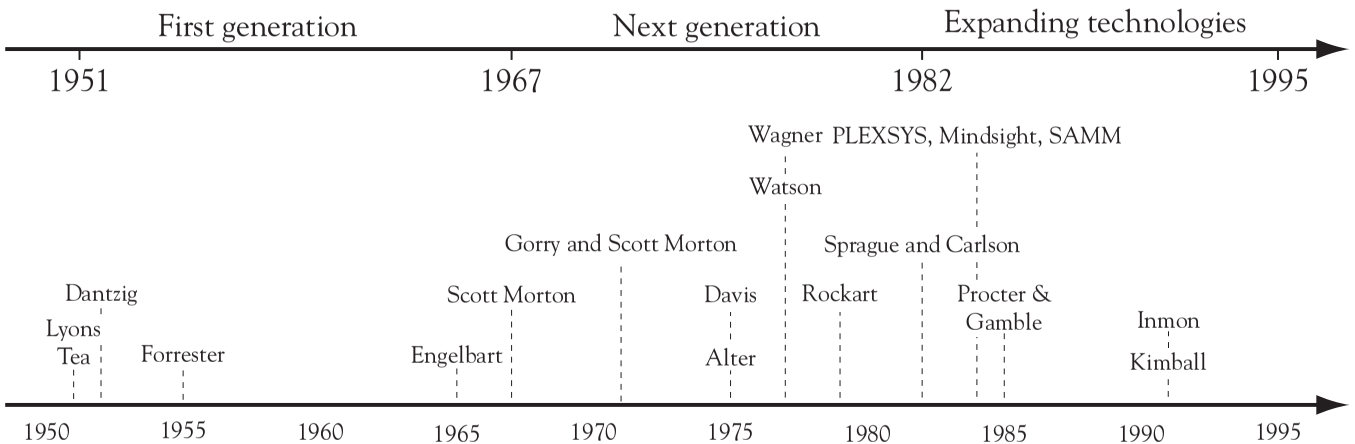

Figure 1.1. Decision Support History Time Line

from the late 1950s to the early 1980s. The name SAGE, a wise mentor, indicated the decision support nature of the system. SAGE was a real-time control system, a real-time communication system, and a real-time management information system.[4]

The pioneering work of George Dantzig, Douglas Engelbart, and Jay Forrester established the feasibility of building computerized decision support systems. In 1952, Dantzig became a research mathematician at the Rand Corporation, where he implemented linear programming on its experimental computers. In the mid-1960s, Engelbart and colleagues developed the first hypermedia groupware system, called NLS (oNLine System). NLS had on-screen video teleconferencing and was a forerunner to group decision support systems. Forrester was involved in building SAGE. In addition, Forrester started the System Dynamics Group at the Massachusetts Institute of Technology Sloan School.

Prior to about 1965, it was very expensive to build large-scale information systems. From 1965 onward, the IBM System 360 and other more powerful mainframe and minicomputer systems made it more practical and cost-effective to develop management information systems (MIS) in large companies. MIS focused on providing managers with structured, periodic reports derived from accounting and transaction systems.[5]

Moving to the Next Generation

In the late 1960s, a new type of information system became practical: model-oriented DSS or management decision systems. In 1971, Michael S. Scott Morton published his Harvard Business School doctoral research involving a computerized management decision system. He had studied how computers and analytical models could help managers make a key decision. Scott Morton conducted an experiment where marketing and production managers used a management decision system to coordinate production planning for laundry equipment. The decision system ran on a 21-inch cathode ray tube monitor with a light pen connected using a 2,400-bits-per-second modem to a pair of Univac 494 computer systems.[6]

In 1971, Gorry and Scott Morton argued that MIS primarily focused on structured decisions and suggested that the information systems for

semistructured and unstructured decisions should be termed decision support systems.[7]

In the late 1970s, researchers were discussing both practice and theory issues related to decision support systems, and companies were implementing a variety of systems. In 1979, John Rockart published an article in the *Harvard Business Review*[8] that led to the development of executive information systems (EIS). In 1980, Steven Alter published a framework for categorizing decision support systems based on studying 58 DSS. He identified both data-oriented and model-oriented DSS.[9]

Ralph Sprague and Eric Carlson's book, *Building Effective Decision Support Systems*,[10] explained in detail the Sprague DSS framework of a database, model base, and dialog generator. In addition, they provided a practical, understandable overview of how organizations could and should build DSS. By 1982, researchers considered decision support systems a new class of information systems.

Financial planning systems became especially popular decision support tools. The idea was to create a "language" that would "allow executives to build models without intermediaries."[11]

Thirty years after Lyons Tea used a computerized system to support operations decision making, managers and researchers recognized that DSS could support decision makers at any level in an organization. DSS could support operations, financial management, management control, and strategic decision making. The scope, purpose, and targeted users for a computerized DSS were expanding.

Expanding Decision Support Technologies

Beginning in approximately 1982, academic researchers developed software to support group decision making.[12] In 1985, Procter & Gamble built a DSS that linked sales information and retail scanner data. BI described a set of concepts and methods to improve business decision making by using fact-based support systems. Some people used BI interchangeably with briefing books, report and query tools, and EIS.[13] Data warehousing and online analytical processing (OLAP) defined a broader category of data-driven DSS.[14]

In the early 1990s, Bill Inmon and Ralph Kimball actively promoted using relational database technologies to build DSS. Kimball was known as "the doctor of DSS," and Inmon became the "father of the data warehouse." Inmon defined a decision support system as "data used in a free form fashion to support managerial decisions."[15] The DSS environment contained only archival, time variant data.

A major technology shift had occurred from mainframe and time-sharing DSS to client or server-based DSS. Vendors introduced desktop OLAP tools during this period. DBMS vendors "recognized that decision support was different from OLTP and started implementing real OLAP capabilities into their databases."[16] By 1995, large-scale data warehousing, a convergence of OLAP, EIS and BI, and the possibilities of the World Wide Web began to stimulate innovation and created a renewed interest in decision support systems.

What Is the Theory of Computerized Decision Support Systems?

Past practice and experience often guide computerized decision support development more than theory and general principles. Some developers say each situation is different so no theory is possible. Others argue that we have conducted insufficient research to develop theories. For these reasons, the theory of decision support and DSS has not been addressed extensively in the literature.

The following set of six propositions from the writings of the late Nobel Laureate Economist Herbert Simon form an initial theory of decision support. From Simon's classic book, *Administrative Behavior*,[17] we draw three propositions.

Proposition 1: If information stored in computers is accessible when needed for making a decision, it can increase human rationality.

Proposition 2: Specialization of decision-making functions is largely dependent upon developing adequate channels of communication to and from decision centers.

Proposition 3: When a particular item of knowledge is needed repeatedly in decision making, an organization can anticipate this need and, by providing the individual with this knowledge prior to decision, can extend his or her area of rationality. Providing this knowledge is particularly important when there are time limits on decisions.

From Simon's article[18] on "Applying Information Technology to Organization Design," we identify three additional propositions:

Proposition 4: In the post-industrial society, the central problem is not how to organize to produce efficiently but how to organize to make decisions—that is, to process information. Improving efficiency will always remain an important consideration.

Proposition 5: From the information processing point of view, division of labor means factoring the total system of decisions that need to be made into relatively independent subsystems, each one of which can be designed with only minimal concern for its interactions with the others.

Proposition 6: The key to the successful design of information systems lies in matching the technology to the limits of the attention of users. In general, an additional component, person, or machine for an information-processing system will improve the system's performance when the following three conditions are true:

1. The component's output is small in comparison with its input so that it conserves attention instead of making additional demands on attention.
2. The component incorporates effective indexes of both passive and active kinds. Active indexes automatically select and filter information.
3. The component incorporates analytic and synthetic models that are capable of solving problems, evaluating solutions, and making decisions.

In summary, computerized decision support is potentially desirable and useful when there is a high likelihood of providing relevant, high-quality information to decision makers when they need it and want it.

What Is Different About Modern Decision Support Systems?

The modern era in decision support systems started in about 1995 with the specification of HTML 2.0, the expansion of the World Wide Web in companies, and the introduction of handheld computing. Today, the Web 2.0 technologies, mobile-integrated communication and computing devices, and improved software development tools have revolutionized DSS user interfaces. Additionally, the decision support data store back-end is now capable of rapidly processing very large data sets.

Modern DSS are more complex and more diverse in functionality than DSS built prior to the widespread use of the World Wide Web. Today, we are seeing more decision automation with business rules and more knowledge-driven decision support systems. Current DSS are changing the mix of decision-making skills needed in organizations. Building better DSS may provide one of the "keys" to competing in a global business environment.

The following attributes are increasingly common in new and updated decision support systems. Some attributes are more closely associated with one category of DSS, but sophisticated DSS often have multiple subsystems. Attributes of contemporary DSS include the following:

1. Multiple, remote users can collaborate in real-time using rich media.
2. Users can access DSS applications anywhere and anytime.
3. Users have fast access to historical data stored in very large data sets.
4. Users can view data and results visually with excellent graphs and charts.
5. Users can receive real-time data when needed.

Summary

Decision support systems differ in purpose, targeted users, and technologies. With current technologies, we can support a wide range of decision-making tasks. Today's complex decision-making environment creates a need for more, and better, computerized decision support.

A brief review of DSS history provides a context for understanding these systems. First-generation DSS were on mainframe computers, but

the SAGE system provided real-time decision support. New decision support technologies in the 1980s broadened the possibilities for computerized decision support.

Nobel Laureate Herbert Simon's ideas provide a theoretical rationale for building computerized decision support systems. Modern decision support systems exploit new technologies and have extensive capabilities. We can build effective decision support systems.