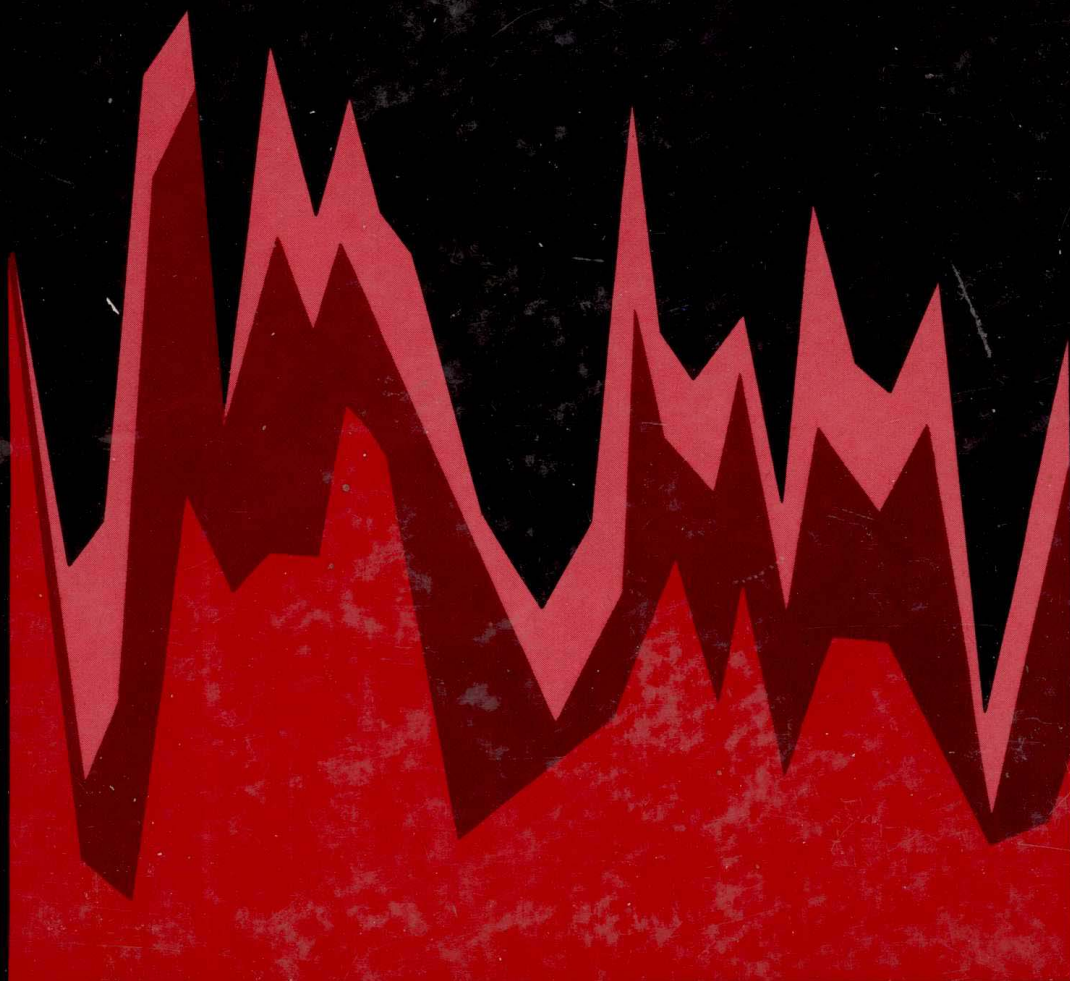# DECISION SUPPORT SYSTEMS FOR EFFECTIVE PLANNING AND CONTROL

A Case Study Approach

Robert J. Thierauf

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Dedicated
to the D.J. O'Conor Family

Preface

The spectacular achievements of computer hardware and software over the past few years now make the latest thrust in information systems, *decision support systems*, a reality. This latest direction in information systems represents an important turning point in how organizations utilize their computerized environment. Instead of looking upon system output as a periodic report or an answer to a recurring question (two-dimensional viewpoint), decision support systems view output from a different perspective. Specifically, they utilize the decision maker's insight, intuition, judgment, and past experience at the various stages of problem solving when interacting with the computer (three-dimensional viewpoint). This interplay means that the information system has the capability to answer ad hoc "what if" questions as they arise in the course of normal business operations. Such an approach provides an *effective* basis to support decision making.

Because of the newness of decision support systems, it would be helpful to define them briefly. Fundamentally, decision support systems are *systems* designed to *support* the *decision* making activities of organization personnel. From this perspective, they can be defined as an approach to effective decision making whereby there is an interface from problem formulation to solution between the individual and the computer for the problem being solved. In effect, decision support systems assist organization personnel in determining effective decisions that contain elements of subjectivity and objectivity that are found in the resolution of most business problems. The capability of combining the individual's judgment about a problem (subjectivity) with the computer's output (objectivity) provides the ability to look inside the problem to see what makes it "tick."

From a management viewpoint, decision support systems aid managers in more effective short- to long-range planning, better organization of a company's resources, improved motivation and communication with company personnel, and better facilitates control of a company's resources according to predetermined objectives and plans. Although decision support systems are principally oriented toward management, there is another way of utilizing them. Because of the emergence of job enrichment and socio-technical (group task approach) programs for some operations personnel, it is possible for these organization personnel to have need of such systems. From this view, decision

support systems permit them to fulfill their assigned tasks in a more effective manner and allow them to make changes to accommodate the present environmental conditions. Thus, decision support systems help managers and operations personnel to improve their effectiveness by allowing their decisions to be supported by computerized information systems. They are being used in a growing number of organizations to improve the effectiveness of the planning and control functions.

The foregoing description of DSS serves as an introduction to the purpose of this text. Fundamentally, it is to broaden one's expertise in the analysis and design of decision support systems. Rather than talk in general terms about an organization's major systems, the text presents a complete decision support system for a progressive manufacturing company, namely, the National Products Corporation. Systems are analyzed, designed, and evaluated for corporate planning, finance, marketing, research and development, engineering, personnel, manufacturing, purchasing, inventory, physical distribution, and accounting. Similarly, quantitative and statistical models are identified and related to each functional area where deemed appropriate. Because the book is not burdened with rigorous mathematics, the systems practitioner or student who has little or no knowledge of higher mathematics will experience no difficulty in comprehending the subject matter. The net result of this "nuts and bolts" approach is a comprehensive look at a complete decision support system unavailable in any other publication to date.

The text is designed for use in the field by the information systems specialist who wishes to broaden his or her perception of this newest thrust in information systems. From this viewpoint, the text is designed to assist systems analysts in understanding how their organizations can move from their present information systems to decision support systems. Additionally, the book is suitable for an undergraduate or graduate business course covering the fundamentals of information systems analysis and design. In either case, the reader is given ample opportunity to design selected parts of a decision support system since end-of-chapter projects have been provided for the text's master case study.

The structure of this book follows a logical sequence for treating comprehensive decision support systems. The major areas covered are as follows:

PART I, INFORMATION SYSTEMS PRIOR TO DECISION SUPPORT SYSTEMS. Chapter 1 briefly surveys the current information systems, namely, MIS (management information systems) and DDP (distributed data processing), and how DSS (decision support systems) complements these two types of information systems. The major subsystems of a complete management information system operating in a distributed data processing environment are presented in Chapter 2 for the National Products Corporation — the text's master case study.

PART II, UNDERLYING CHARACTERISTICS OF DECISION SUPPORT SYS-TEMS. The essential characteristics of decision support systems are set forth in Chapter 3, followed by an analytical framework in Chapter 4 for the decision-making process found in decision support systems.

PART III, FEASIBILITY AND IMPLEMENTATION OF DECISION SUPPORT SYSTEMS. The essentials of systems analysis and design of decision support systems are covered in Chapter 5 together with the key factors for successful DSS. Chapter 6 builds on the preceding chapter by examining equipment selection and implementation of decision support systems. Also, equipment specifications for DSS are explored.

PART IV, EFFECTIVE STRATEGIC PLANNING OF DECISION SUPPORT SYS-TEMS. The essentials of corporate strategic planning as well as the starting point for effective planning are found in Chapter 7. In addition, typical financial planning lan-

guages and statistical packages are presented. In Chapters 8 and 9, respectively, corporate planning and finance subsystems operating in a MIS and a DSS environment for the National Products Corporation are illustrated.

PART V, EFFECTIVE MANAGEMENT AND OPERATIONAL CONTROL OF DECISION SUPPORT SYSTEMS. After setting forth the essential elements of control, control report generators and software machines that have been developed and found useful in a DSS environment are explored in Chapter 10. Within Chapters 11, 12, and 13, respectively, marketing, research and development and engineering, and personnel subsystems of the National Products Corporation are developed initially for a MIS operating mode, followed by a DSS operating mode.

PART VI, REDESIGN OF WORK FOR EFFECTIVE PLANNING AND CONTROL OF DECISION SUPPORT SYSTEMS. Complementary to hardware and software developments for DSS is the need for changes in the work environment, that is, work redesign — the subject matter for Chapter 14. In the remaining chapters of the text — Chapters 15 through 18 — the DSS manufacturing, purchasing and inventory, physical distribution, and accounting subsystems, respectively, are developed for the National Products Corporation in terms of using the previous MIS operating mode as a starting point.

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I

INFORMATION SYSTEMS PRIOR TO DECISION SUPPORT SYSTEMS

1

Relationship of Current Information Systems to Decision Support Systems

Issues Raised and Explored

- *How important is the involvement of the manager (user) in the development of information systems?*
- *What is the relationship of information needs to managerial decision making at all levels in a typical organization?*
- *What significant information systems have been developed over the years in response to new computer developments?*
- *What are the essential characteristics of "classical" management information systems as they are viewed today?*
- *What is the relationship of decision support systems to management information systems operating in a distributed data processing mode?*

Outline

Importance of information
Need for information systems
Involvement of the user in information systems
Information needs for managerial decision making
    Strategic information for top management
    Tactical information for middle management
    Operational information for lower management
    Classification of information for managerial decision making
Development of management information systems
    Information systems prior to real-time MIS
    Real-time management information systems
    Synthesis of "classical" management information systems
    Distributed data processing systems
Decision support systems — latest thrust in information systems
New approach to problem solving
Questions

Timely and accurate business information is a resource, an asset that has been generally undervalued, underestimated, and underused. After the human element, it is a manager's most important resource. A major problem facing today's managers is the volume of information crossing their desks. It is so voluminous as to be almost unmanageable; yet good planning and control over operations via effective decisions must be based on a steady flow of good-quality, up-to-date information. Given these conditions and the accelerating pace of business, there arises a definite need for managers to change their working habits to accommodate a new member of the information management team — the computer. This human/machine dialogue is essential if the manager is to be productive and effective. The computer should not interfere with a manager's thought processes; rather, it should augment the individual's capabilities and become an extension of his or her mind — an essential characteristic of decision support systems (DSS).

As noted throughout the text, the computer has moved out of the data processing center and into the manager's office. Whether it takes the form of a cathode-ray-tube (CRT) terminal or a multifunction management work station is unimportant. What is important is the fact that the computer is the manager's "silent partner" for supporting more effective decision making within a decision support system environment. One of the major factors responsible for bringing computers into the manager's office has been the growth of distributed data processing (DDP) systems. With a distributed data processing system, a manager anywhere in an organization has immediate access to decision-making information. As a result, computer power can be made available for applications, and at locations, that were previously considered uneconomical.

Initially in this chapter, the importance of information and the need for information systems are discussed together with the need for involvement of the users in information systems. After the needs for top, middle, and lower management are explored for effective decision making, information systems prior to and including real-time management information systems are set forth. Not only are their essential characteristics detailed, but also their respective deficiencies are enumerated. In addition, the essentials of distributed data processing systems are set forth. This orderly study places continuing developments of information systems — decision support systems — in their proper perspective. Overall, this background material on information systems gives the reader an overview of past and current developments. Additionally, it sets the stage for the master case study (National Products Corporation) to be presented in the next chapter and succeeding chapters.

IMPORTANCE OF INFORMATION

Information — the logical output of an information system — is of vital importance to the managers of a firm to achieve short-, intermediate-, and

long-range goals. Management needs a fairly accurate measurement of its sales and cost factors for various time periods. It must maximize its income through higher selling prices and/or larger inventory turnover and minimize costs of products and services. In short, management wants a combination of selling prices, turnover, costs, and profit per unit that will provide the highest return on invested capital. Given adequate information on these essential facts, management can rely more on deductive and analytical methods than on guesses and intuitive judgment, which it must employ when many of the relevant facts are missing. Many wrong decisions have been the result of insufficient or inadequately processed information.

There is a growing awareness that accurate and timely information is a vital resource of the firm and that an effective information system is a means of providing the needed information. Many top managers are finding that information is a source of competitive power. It gives them the ability to out-maneuver their rivals at critical times, especially when introducing new products. If the information system does not produce the information necessary for management to handle its operations effectively, an "out-of-control" condition may result and the firm may never recover. An examination of firms that have experienced difficult times over the years will verify this point.

NEED FOR INFORMATION SYSTEMS

The need for an effective information system is of paramount concern to the firm now as well as in the future. Because the firm does not operate in a vacuum, it must coordinate its operations with the business universe. Of prime importance is information about markets in which it operates, current knowledge of its customers and competitors, availability of capital, capabilities of available personnel, and knowledge concerning sources of supply. Increasing prices of purchased materials, rising labor costs, and foreign competition signal the need for an information system that describes the firm's economic environment and coordinates the external environment with the internal factors to provide meaningful management information (Figure 1-1).

The information system, in addition to recognizing trends external to the firm, must treat changes that have occurred and will yet occur in the internal business environment. Advancements in the behavioral sciences, continuing developments in management science, and increasing utilization of paperless computer output terminals must be reflected in the design of the information system. Interdepartmental approaches have transcended the traditional, functional lines of business in complex systems. Still other system technology developments have occurred regarding methods, procedures, computer equipment, and data communications equipment. By no means is this listing of internal factors complete, but it does serve to exemplify what is causing the firm's information system to change.
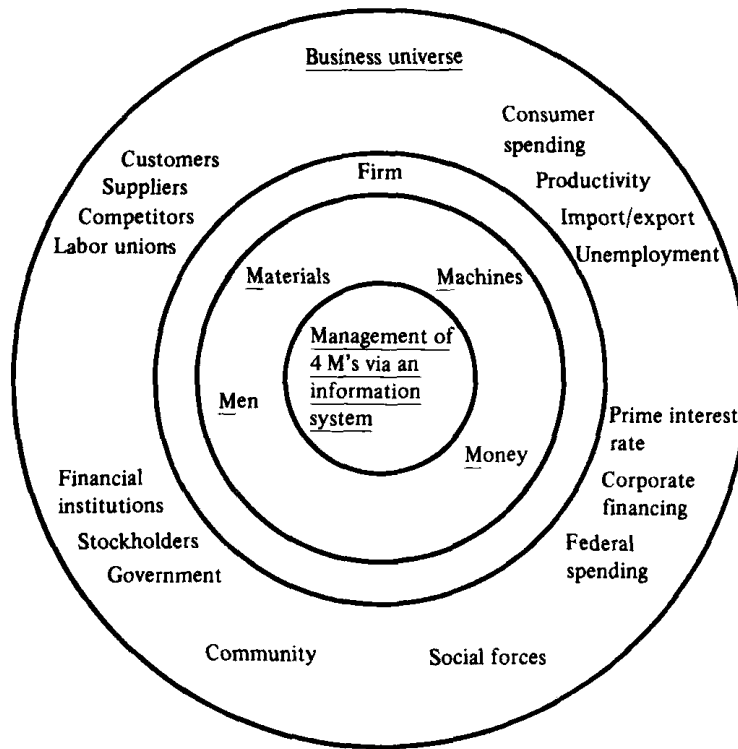
FIGURE 1-1. Relationship of the internal and external factors to the firm's information system.

The changes taking place within and outside the firm generally do not stand alone; each advancement tends to affect and overlap another development. As a result, there is a need for an information system capable of integrating these advances with the needs and capabilities of the firm. Such systems are found within the framework of *decision support systems* — the subject matter of this text.

INVOLVEMENT OF THE USER IN INFORMATION SYSTEMS

Before pursuing background material for decision support systems, it would be helpful at this point to relate the role of the systems analyst to the user when developing new systems. The trend toward decision support systems that serve higher and higher levels of management is forcing us to move away from the notion of data processing toward information processing. Unfortunately, the terms "data" and "information" are used interchangeably. In fact, they are not synonymous. *Data* are the basic representations of an event; as such, they can be considered as the raw materials from which information is processed. Data are transformed into information via some type of

system. *Information* is data that has been culled, analyzed, integrated, and presented on a selective basis and in a format that helps the user gain a better understanding of what is going on. This leads toward better decision making.

For the most part, only managers can define their information needs; the systems analysts cannot. The managers know what it takes to manage their functions effectively. Managers, therefore, must be directly involved in planning and controlling this changing process through personal involvement. When a new information system is designed, what is really being done is changing the "how" of an existing system, changing an existing way, be it manual or already computer-based. What happens is that user management gets a totally new way of doing things. But it is impossible to bring off this change effectively if the user management sits on the sidelines. Through involvement, resistance to change is reduced; system development efforts are less hectic.

The best information system is designed when the user conceives the solution because, in the end, it must be his or her system. And to see this happen requires meaningful involvement through active user participation. Only when the ultimate user of the system makes the relevant decisions will it truly be his or her system. Involvement provides one with an opportunity "to be in on things" that affect one's own function, an opportunity to contribute ideas, a feeling of satisfaction with the courses of action agreed upon, an understanding of the problems of change, and a sense of responsibility for the success of change. By working together, the expected results are not forever in the gray area. There are no surprises for top management, user management, and information systems management. There are no misunderstood objectives or fuzzy specifications. There are no unexpected commitments. There are no gaps between promises and results. The need for interaction of users with systems analysts is paramount in any type of new information system. This is even more true for a decision support system since it is designed to support the user in improved decision making, thereby enhancing operating effectiveness from the lowest level to the highest level in an organization.
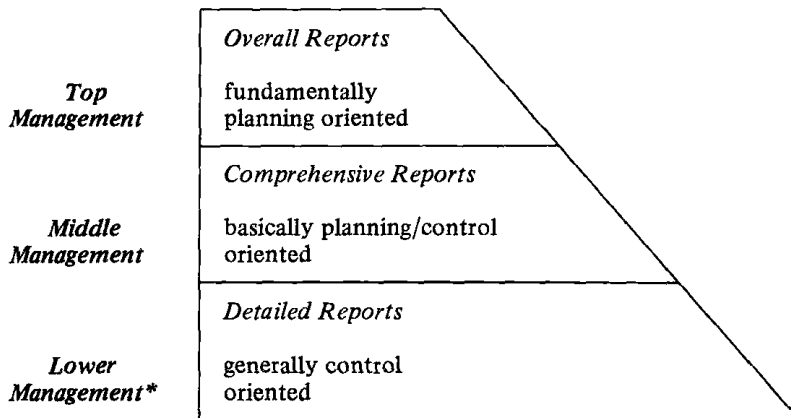
INFORMATION NEEDS FOR MANAGERIAL DECISION MAKING

Because the output of an information system is directed toward assisting management in planning and controlling organization activities, it is beneficial to relate the following types of information:

- Strategic
- Tactical
- Operational

to the managerial levels for decision making. Generally, lower management is concerned with *operational information* for decision making, while *tactical information* and *strategic information* are useful to middle and top management, respectively, for making decisions. The type of information supplied has to do with the activities with which the information is concerned — the internal environment of the organization and the external environment in which the organization operates.

It is a general fact that internal information should be more and more summarized as the level of management for which it is prepared rises in the hierarchical structure, with top management receiving overall reports of operations for future planning. On the other hand, lower echelons of management, being control oriented, receive the most detailed reports. Between top and lower management is middle management, which is planning/control oriented. All three levels of informational needs are illustrated in Figure 1-2.

Top Management	*Overall Reports* fundamentally planning oriented
Middle Management	*Comprehensive Reports* basically planning/control oriented
Lower Management*	*Detailed Reports* generally control oriented

*Includes operating personnel in new work environments.

FIGURE 1-2. Types of informational reports needed by management levels for planning and control of organization activities.

Information concerning the external environment of the organization should be summarized in exactly the opposite manner from that of the internal environment. Because the upper management levels are more planning oriented and because planning necessitates more information about the organization's external environment, this type of information should be most fully supplied to top management. It should be increasingly summarized and selective as the position of the receiver decreases in the managerial hierarchy. Time spent in planning and control for lower, middle, and top management complement one another, as shown in Figure 1-3.
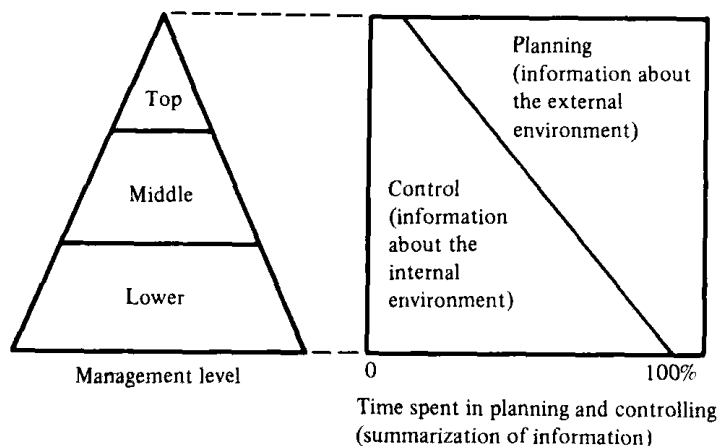
FIGURE 1-3. Relationship of the managerial levels to time spent on planning and control, and to the summarization of information.

Strategic Information for Top Management

Strategic information is used primarily by top management and its staff to cover a long time span, generally one to five years. This type of information is employed for planning purposes and for analysis of problem areas to discover the underlying reasons for specific problems or conditions. Primarily, it involves large amounts of information derived from or relating to areas of knowledge outside the organization. In many cases, strategic information finds answers to the question *why* rather than *what* or *where*, since it concerns itself with determining objectives, initiating priorities, developing strategies, initiating programs, and establishing policies that will govern the acquisition, use, and disposition of the resources needed to achieve objectives. Examples are found in Figure 1-4 for a typical manufacturing organization.

The purpose of generating strategic information is to assist top management in strategic decisions that are characterized by a great deal of uncertainty (since they are future oriented). These decisions establish long-range policies that affect the entire organization. The overall objectives of the organization are stated and a range of strategies are made which may entail, for example, plant expansion, determination of product lines, mergers, diversification into other areas, capital expenditures, or the sale of the organization. Hence, based on strategic information, appropriate strategic decisions are made to further organization objectives.

The main accent of Part IV (Chapters 7 through 9) of the text is to provide examples of strategic information for supporting decision making within a DSS environment for top management. More specifically, the area of corporate planning as well as strategic planning are covered in depth in Chapter 7, followed by specific applications to the corporate planning and finance subsystems of the text's master case study, the National Products Corporation. In addition, the use of software packages (commercially available currently) for corporate modeling is demonstrated to answer "what if"