MANAGEMENT INFORMATION SYSTEMS

CONCEPTUAL FOUNDATIONS, STRUCTURE, AND DEVELOPMENT

SECOND EDITION

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PREFACE

A major contribution of the first edition of this text was to define the scope or domain of management information systems. The text was very well received by the information systems academic community. It was used across a wide variety of courses ranging from introductory undergraduate courses to graduate seminars. The reason for the diversity of use is the unique contribution of the book. It is a conceptual study of information systems in organizations, and therefore the material can be surveyed at an introductory level or explored in more depth in a graduate seminar. The first edition was identified as a "classic" in the field in a study of information systems books and journals (Scott Hamilton and Blake Ives, "Knowledge Utilization among MIS Researchers," *MIS Quarterly*, 6:4, December 1982, pp. 61-77).

Although there are several terms to describe the content of the book, the term "management information systems" is used because it is well accepted. Alternative terminology such as information systems or organizational information systems would have been acceptable. The conceptual structure implied by the terms is the same—a computer-based information system to support organizational processes. In other words, the information system is a support system for an organization. That part of the information system designed to support organizational operations is an operational support system, the part designed to support decision making is a decision support system (DSS), and the part that supports knowledge work is a knowledge work support system. The information system concept is also broad enough to include information processing support for office work (office automation).

The scope of the text is an organizational information system as broadly defined. It includes standard operational information systems, information systems for management control, information systems for strategic management, decision support systems, office information systems, and knowledge work support systems.

The second edition is a major revision. The features of the revision are the following:

- Reorganization of the chapters. The description of the structure of a management information system is the second chapter.

- Rewriting of the technology chapters and moving them forward as the second section of the book. These are written as an optional section for students without prior exposure or as a review.
- Expansion of the Conceptual Foundations section. A chapter has been added on Concepts of Planning and Control (Chapter 10). The chapter on value of information has been dropped, with some of the material incorporated in the chapter on Concepts of Information.
- Expansion of the material on support systems. Two chapters are devoted to the subject: Chapter 12 on Support Systems for Planning, Control, and Decision Making and Chapter 13 on Support Systems for Management of Knowledge Work.
- Inclusion of a section of four chapters on Information System Requirements. The determination of information requirements and formulation of an information system plan are key problems in information systems. The section has chapters on the information system plan, strategies for information requirements determination, database requirements, and user interface requirements.
- Reorganization and rewriting of the section on Development, Implementation, and Management of Information System Resources.
- Inclusion of short vignettes or incidents in each chapter to illustrate the concepts. These are based on news articles, personal experiences of the authors, or reports from colleagues.
- Addition of short discussion cases at the end of each chapter.

There are selected references at the end of each chapter for further reading. The rapid expansion of literature in the field and the breadth of the topics in the book preclude a complete bibliography of interesting articles or books, and many worthwhile references have not been included. However, the selected references provide a useful starting point for further investigation.

The text does not assume any special background. It can be used by computer science students to introduce them to the concepts of organizational information systems, by business students interested in entering the field of information systems, and by students in a variety of disciplines who are users or potential users of information systems and wish to understand them. The book is suitable as the text in the MBA survey course in information systems. The material is written for the serious student—it is not a "gee whiz" survey. At the same time, the material is written in an understandable style, and students with a wide variety of backgrounds and skills have found the book readable.

There are a number of vignettes and minicases that are excerpted from general newspaper articles, computer newspaper articles, and business journals.

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The book has benefited from the outstanding services of Janice DeGross in typing the manuscript, making corrections, adding codes for the automated printing of the book, and managing the production processes assigned to the authors. A large number of professors have made suggestions on the revision: Aran Srinivasan, Hubert Dunsmore, Paul Cheney, and William King made suggestions prior to the revision; detailed review comments on the manuscript were provided by Gerardine DeSanctis, James Senn, Gad Ariav, Mary Culnan, Jack Baroudi, Blake Ives, and Jane Fedorowicz. Gordon Everest, Sal March, Yannis Vassiliou, and other colleagues at the University of Minnesota and New York University were very helpful when we needed assistance with individual chapters or with specific issues.

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CONTENTS

SECTION ONE

INTRODUCTION TO MANAGEMENT INFORMATION SYSTEMS

The first section of the text is definitional. The two chapters introduce the subject matter of the book and define the boundaries of the topics included in the study of information systems in organizations.

Chapter 1 presents the definition of a management information system. Its relationship to other concepts and the scope of MIS as an academic discipline are explained. The management information system is also described from the perspective of a user. The definition of a management information system introduced in the chapter is a broad one and encompasses various information support systems including decision support systems and office information support systems.

Chapter 2 presents the structure of a management information system and uses three different perspectives to build a synthesis of the conceptual structure.

Frameworks such as those presented in this section aid users and designers to understand their current information system relative to the concept of a comprehensive management information system. The frameworks also highlight issues in the design of a more complete information system.

The section is an introduction to the text; it can also be a summary. After studying the remainder of the book, these two chapters (especially Chapter 2) can provide an integrating summary.

CHAPTER 1

AN OVERVIEW OF MANAGEMENT INFORMATION SYSTEMS

Information processing is a major societal activity. A significant part of an individual's working and personal time is spent recording, searching for, and absorbing information. As much as 80 percent of a typical executive's time is spent in the processing and communication of information. More than 50 percent of the United States work force is employed in jobs that primarily involve some form of information processing. A large proportion of these employees are "knowledge workers"; their duties involve the production and use of information outputs—documents, reports, analyses, plans, etc.

Computers have become an essential part of organizational information processing because of the power of the technology and the volume of data to be processed. The application of computers to information processing began in 1954 when one of the first computers was programmed to process payroll. Today, computerized processing of transaction data is a routine activity of large organizations. Moreover, the capability to automate information processing has permitted an expansion in the scope of formalized organizational information use. The current challenge in information processing is to use the capabilities of computers to support knowledge work, including managerial activities and decision making. The wide variety of computer resources to perform transaction processing, to provide processing for a formal information and reporting system, and to accomplish managerial-decision support are broadly classified as the organization's *management information system* or MIS.

The focus of this text is management information systems rather than routine data processing. MIS is a broad concept rather than a single system. Some MIS activities are highly integrated with routine data processing, while other MIS applications are designed for a particular knowledge work activity or decision-making function. The office use of computer and communication technology to support person-to-person communications and clerical support functions is also included in this text as part of management information systems.

The design and implementation of management information systems in an organization necessitates the identification of information requirements. The requirements for routine transaction processing tend to be stable and relatively easy to identify; information requirements for management and decision making activities are more changeable and more difficult to define. The content of this text is useful both for those who design, implement, and manage information systems and for those who specify information requirements and use the systems. The text can help systems analysts to understand the structure of a management information system and the type of requirements to be included; it can aid information systems executives in planning and

management; it can help users to understand how their information requirements fit into the system and how to analyze and formulate those requirements. It can also aid users who develop their own systems.

HOW LONG CAN AN ORGANIZATION OPERATE WITHOUT COMPUTER INFORMATION PROCESSING?

When asked how long different business functions would be able to operate without the information processing capabilities of computers, 36 companies responded with the following results for all operational applications: On average, the companies estimated that only 28 percent of the operational activities would be functioning within 5.5 days without computer data processing. Finance companies in the sample estimated that only 13 percent of operations would be functioning after 5.5 days without computing. (Figures 1-1).

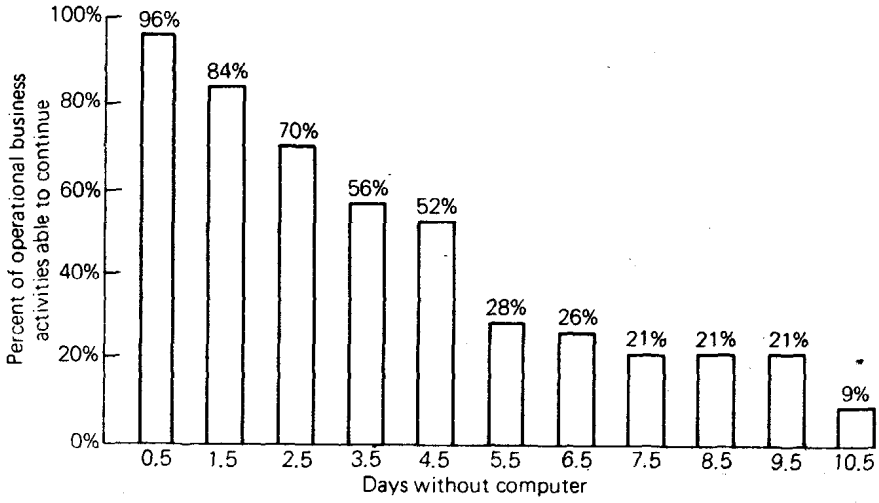

Figure 1-1
Decline in operational business activities following a complete computer data processing failure. (Source: D. O. Aasgaard, P. P. R. Cheung, B. J. Hulbert, and M. C. Simpson, "An Evaluation of Data Processing 'Machine Room' Loss and Selected Recovery Strategies," University of Minnesota, Management Information Systems Research Center WP-79-04, p. 70.)

DEFINITION OF A MANAGEMENT INFORMATION SYSTEM

There is no consensus on the definition of the term "management information system." Some writers prefer alternative terminology such as "information processing system," "information and decision system," "organizational information system," or simply "information system" to refer to the computer-based information processing system which supports the operations, management, and decision-making functions of an organization. This text uses "MIS" because it is descriptive and generally understood; it also frequently uses "information system" instead of "MIS" to refer to an organizational information system.

WHAT'S IN A NAME?

A 1983 survey of 334 large organizations identified the following names used for the information systems function:

Name	Percent
Management information systems	33
Information services	17
Information systems	14
Data processing	12
Information resource management	3
Other	21
	100

"Information Systems Planning to Meet Business Objectives: A Survey of Practice," Cresap, McCormick and Paget, New York, 1983, p. B-7.

A definition of a management information system, as the term is generally understood, is *an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software; manual procedures; models for analysis, planning, control and decision making; and a database.* The fact that it is an integrated system does not mean that it is a single, monolithic structure; rather, it means that the parts fit into an overall design. The elements of the definition are highlighted below.

DEFINITION OF A MANAGEMENT INFORMATION SYSTEM

A management information system is
- An integrated user-machine system
- For providing information
- To support the operations, management, analysis, and decision-making functions
- In an organization

The system utilizes
- Computer hardware and software
- Manual procedures
- Models for analysis, planning, control, and decision making, and
- A database

The management information system has been described as a pyramid structure (Figure 1-2) in which the bottom layer consists of information for transaction processing, status inquiries, etc.; the next level consists of information resources in support of day-to-day operations and control; the third level consists of information system resources to aid in tactical planning and decision making for management control; and the top level consists of information resources to support strategic planning and policy making by higher levels of management. Each level of information processing may make use of data provided for lower levels; but new data may also be introduced. For example, some of the information to support management and decision making is provided by the data obtained for transaction processing, while some may be new data about activities external to the organization.

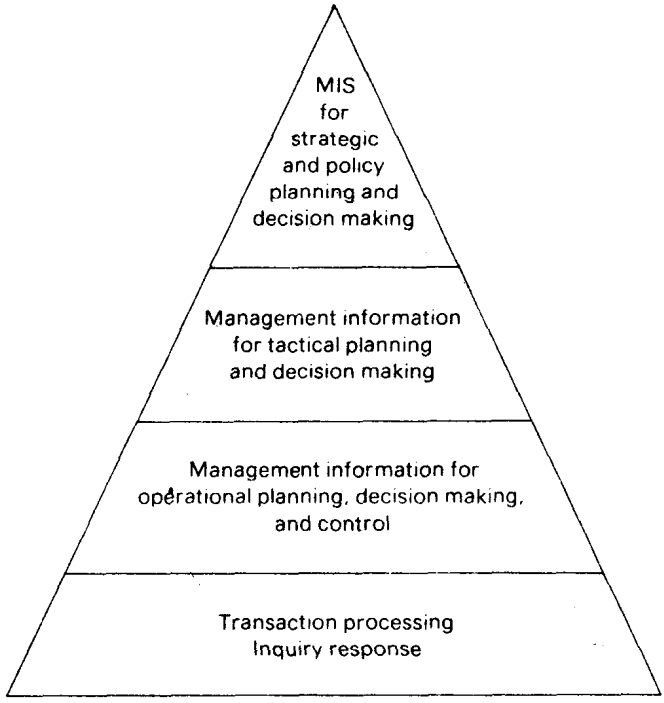

Figure 1-2
Management information system. (Adapted from Robert V. Head, "Management Information Systems: A Critical Appraisal," *Datamation*, May 1967, p. 23.)

In order to further clarify the definition, the following sections elaborate on certain key concepts: the user-machine system, the concept of an integrated system, the need for a database, and the role of planning and decision models. In addition, there is a discussion of the relationship of MIS to other information system structural concepts: information resource management (IRM), decision support systems (DSS), and data processing (DP).

Computer-Based User-Machine System

Conceptually, a management information system can exist without computers, but it is the power of the computer which makes MIS feasible. The question is not whether computers should be used in management information systems, but the extent to which information use should be computerized. The concept of a user-machine system implies that some tasks are best performed by humans, while others are best done by machine. The user of an MIS is any person responsible for entering input data, instructing the system, or utilizing the information output of the system. For many problems, the user and the computer form a combined system with results obtained through a set of interactions between the computer and the user.

User-machine interaction is facilitated by operations in which the user's input-output device (usually a visual display terminal) is connected to the computer. The computer can be a personal computer serving only one user or a large computer that serves a number of users through terminals connected by communication lines. The user input-

output device permits direct input of data and immediate output of results. For instance, a person using the computer interactively in financial planning poses "what if" questions by entering input at the terminal keyboard; the results are displayed on the screen in a few seconds.

The computer-based user-machine characteristics of an MIS affect the knowledge requirements of both system developer and system user. "Computer-based" means that the designer of a management information system must have a knowledge of computers and of their use in information processing. The "user-machine" concept means the system designer should also understand the capabilities of humans as system components (as information processors) and the behavior of humans as users of information.

Information system applications should not require users to be computer experts. However, users need to be able to specify their information requirements; some understanding of computers, the nature of information, and its use in various management functions aids users in this task.

Integrated System

Management information systems typically provide the basis for integration of organizational information processing. Individual applications within information systems are developed for and by diverse sets of users. If there are no integrating processes and mechanisms, the individual applications may be inconsistent and incompatible. Data items may be specified differently and may not be compatible across applications that use the same data. There may be redundant development of separate applications when actually a single application could serve more than one need. A user wanting to perform analysis using data from two different applications may find the task very difficult and sometimes impossible.

The first step in integration of diverse information system applications is an overall information system plan. Even though application systems are implemented one at a time, their design can be guided by the overall plan, which determines how they fit in with other functions. *In essence, the information system is designed as a planned federation of small systems.*

Information system integration is also achieved through standards, guidelines, and procedures set by the MIS function. The enforcement of such standards and procedures permits diverse applications to share data, meet audit and control requirements, and be shared by multiple users. For instance, an application may be developed to run on a particular small computer. Standards for integration may dictate that the equipment selected be compatible with existing computers and that the application be designed for communication with the centralized database.

The trend in information system design is toward separate application processing from the data used to support it. The separate database is the mechanism by which data items are integrated across many applications and made consistently available to a variety of users. The need for a database in MIS is discussed below.

Need for a Database

The terms "information" and "data" are frequently used interchangeably; however, information is generally defined as data that is meaningful or useful to the recipient. Data items are therefore the raw material for producing information.

The underlying concept of a database is that data needs to be managed in order to be available for processing and have appropriate quality. This data management includes both software and organization. The software to create and manage a database is a *database management system*.

When all access to and use of the database is controlled through a database management system, all applications utilizing a particular data item access the same data item which is stored in only one place. A single updating of the data item updates it for all uses. Integration through a database management system requires a central authority for the database. The data can be stored in one central computer or dispersed among several computers; the overriding requirement is that there be an organizational function to exercise control.

Utilization of Models

It is usually insufficient for human recipients to receive only raw data or even summarized data. Data usually needs to be processed and presented in such a way that the result is directed toward the decision to be made. To do this, processing of data items is based on a decision model. For example, an investment decision relative to new capital expenditures might be processed in terms of a capital expenditure decision model.

Decision models can be used to support different stages in the decision-making process. "Intelligence" models can be used to search for problems and/or opportunities. Models can be used to identify and analyze possible solutions. Choice models such as optimization models may be used to find the most desirable solution.

USING INFORMATION IN FINDING PROBLEMS

"Communities across the U.S. are starting to use information as well as fire hoses to combat arson. Boston, New Haven, Knoxville, Phoenix, San Francisco, and Seattle all run programs that collate fire department records with tax, building ownership, and other data....And growing numbers of insurance companies...are using similar surveys to reduce arson fraud by policyholders.'

"The new arson information tracking programs are already paying off.... Last year the Federal Bureau of Investigation reported a 12% drop in arson in the U.S. Although experts say it is too early to link the national drop in arson directly to information management systems, the results from cities that have installed such systems are encouraging. For example, in Phoenix, which installed an arson information program in 1978, arson cases dropped last year to 497, or 35% of all fires, from 739, 49% of the total, in 1978.'

For an arson information system to be effective, cities have found they must strike up a cooperative relationship with insurance companies, which already collect many of the same data. The new arson prevention system encourages the exchange of information instead of duplicating efforts.

Excerpts from "Data Programs Help Stamp Out Arson," *Business Week*, June 13, 1984, pp. 110D–110H.
