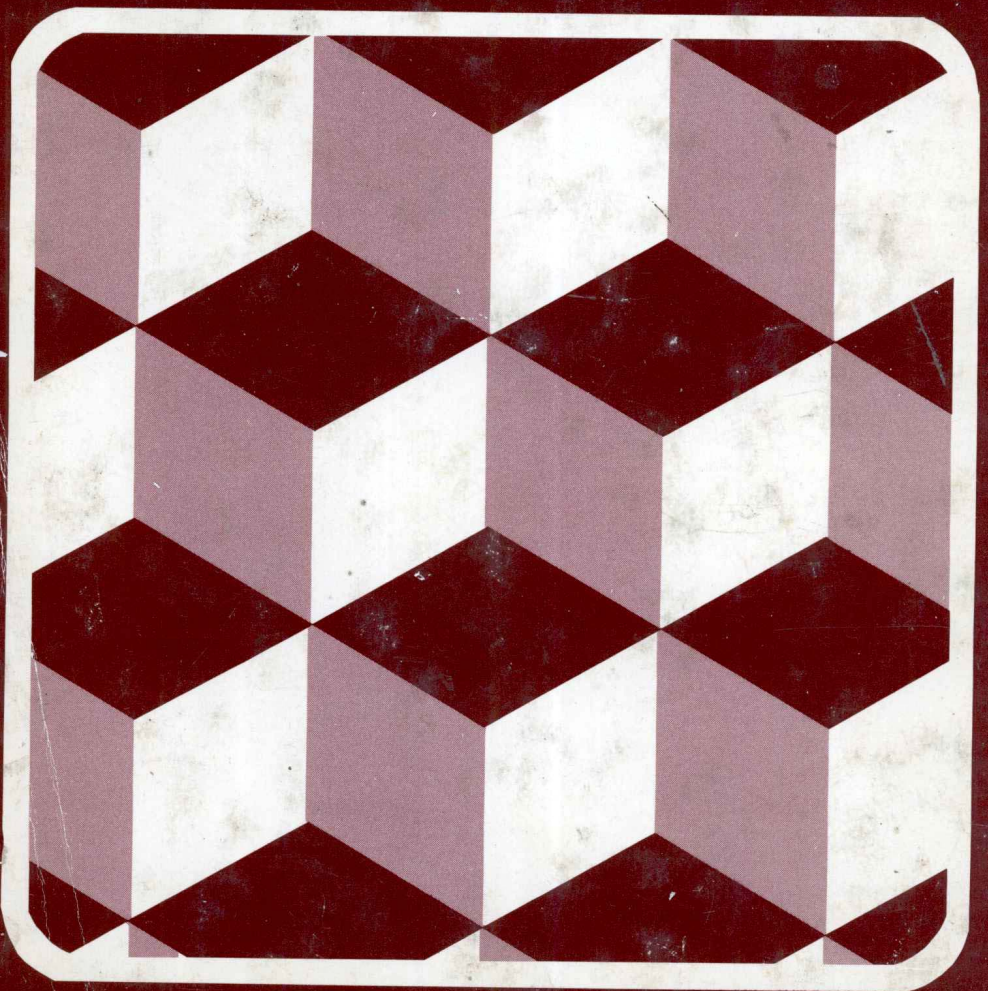


INFORMATION SYSTEMS FOR STRATEGIC DECISIONS

K.J. RADFORD



Information Systems for Strategic Decisions

K. J. Radford

Department of Administrative Studies
Atkinson College, York University
Downsview, Ontario

*Reston Publishing Company, Inc., A Prentice-Hall Company
Reston, Virginia*

Library of Congress Cataloging in Publication Data

Radford, K. J.

Information systems for strategic decisions.

Includes index.

1. Management information systems. 2. Decision-making. I. Title

HF5548.2.R247

658.4'032

78-2660

ISBN 0-87909-389-7

© 1978 by
RESTON PUBLISHING COMPANY, INC.
A Prentice-Hall Company
Reston, Virginia 22090

All rights reserved. No part of this book
may be reproduced in any way, or by any means,
without permission in writing from
the publisher.

10 9 8 7 6 5 4 3 2 1

Printed in the United States of America

Preface

Much of the discussion and published literature on information systems to date has been about systems concerned with the internal administration and operations of an organization. Considerably less attention has been given to the information requirements of the more strategic managerial activities of planning and policy making, in which the future directions and objectives of the organization are decided.

There have been a number of reasons for this concentration on the internal aspects of management in the design and implementation of present day information systems. The greatly increased demands for routine transactional data processing that are inherent in modern society and business have had the effect of directing information systems thinking away from strategic activities. The introduction of the computer in support of this data processing has often given emphasis to the servicing of routine transactions as opposed to the support of less completely-specified and less quantitative aspects of management. In some cases, the very availability of the computer has contributed to the growth of the internally-oriented information system at the expense of developments in other areas.

The introduction of computers into organizations has been accompanied in many instances by very great difficulties. In some cases, the magnitude of the task was underestimated by enthusiastic specialized personnel, with the result that promises of performance were not met. In other circumstances, many human factors in the operations affected were neglected, so that the resulting computer-supported systems did not meet the normal or unanticipated needs of users. In many cases, system development was

pushed ahead with little attention to cost-effectiveness. Sometimes specialists opted for technically sophisticated systems, rather than for a less expensive alternative that met operational requirements with less technical risk.

Hopefully, some, if not all, of these difficulties are now behind us. Overall competence in the use of the computer in support of managerial activities has grown in recent years. Many modern information system implementations have shown evidence of a greater maturity of approach, in which the emphasis of system design is placed on the role of information in the organization rather than on transaction processing alone. The computer is now increasingly regarded as essential supporting equipment for an information system rather than the major factor on which the system design must be based.

With these trends of thought firmly entrenched, it is now widely appreciated that the purpose of an information system is to support managerial activities of all types at all levels of an organization. This makes it imperative that the information needs of the strategic aspects of management be considered along with those of the more familiar activities of internal regulation and control when the design of an organizational information system is undertaken. The purpose of this book is to provide a basis for design of this comprehensive type of information system.

The text starts with a review in Chapter 1 of the development of information systems in recent years, which leads later in the chapter to a discussion of the elements of a modern information system. Two major components are identified: first the familiar internal information system, and second, the strategic information system that serves managerial activities such as planning and policy making. The discussion leads to an initial statement of requirements upon which the design of the overall information system can be based.

One of the most important of these requirements is that the information system must serve and support the activities involved in the direction and management of the organization of which it is an integral part. The second chapter of this text is therefore devoted to a description of these managerial activities. The organization is viewed as a complex system operating within an environment. The various aspects of management are classified under the headings of strategic planning, management control, and operational control. The strategic information system component is primarily concerned with the first of these sets of activities, while the internal system serves the other two.

The prime functions of an information system are the acquisition, transmission, presentation, and retention of information useful in decision making. The types of decisions that arise in management are described briefly in Chapter 3. Since support of the decision-making procedures in

an organization is a vital role of the information system, knowledge of the nature and pattern of decision making is essential in the design and implementation of that system.

The internal information system is described in detail in Chapter 4. This chapter draws material from an earlier book, *Information Systems in Management*.^{*} The discussion builds on this material to provide a comprehensive description of the component of the overall information system that serves the processes of internal regulation and control.

Chapter 5 is concerned with the nature of the information that is used in strategic planning and management. These activities relate primarily to the setting of objectives and future directions for the organization. This chapter provides a complete discussion of the characteristics of strategic information in the context of a modern organization. Reference is made to the extensive literature on military and political intelligence and also to the growing body of evidence that faulty acquisition or use of strategic information is often the cause of disasters in both community and organizational settings.

The subject of Chapter 6 is the design and implementation of the strategic component of the overall information system. This design is brought together with that of the internal system in Chapter 7. Factors that are crucial to the success of an information system are discussed at this point. The chapter ends with a treatment of the costs and benefits of an organizational information system and of the methods by which they can be evaluated.

Acknowledgements

I am indebted to all those authors whose work I have referenced very freely. My special thanks are due to Dr. Malcolm Dando of the University of Sussex for his valuable suggestions on the structure and content of the text and to Professor Nigel Howard for his continued help and collaboration in the area of organizational decision making.

Much of the research upon which Chapters 5 and 6 were based was done most thoroughly by Beverly Fingerhut. She also read and checked the text that was prepared by Laurine Ackert, Leslie Crosby, Doreen Deacon, and Terry Spier. My thanks are extended to all these ladies, without whose efforts this book could not have been produced.

Some of the research upon which some sections of this book is based was supported by research grants to the author from the National Research Council of Canada. This support is most deeply appreciated.

K. J. RADFORD

^{*} K. J. Radford, *Information Systems in Management* (Reston, Va.: Reston Publishing Company, 1973).

Contents

Preface, xi

- 1 An Introduction to Information Systems, 1**
 - The Evolution of Information Systems, 4
 - The Nature of Information, 9
 - The Components of an Information System, 11
 - The Elements of an Information System, 14
 - Initial Specifications for an Organizational Information System, 19
 - The Plan of the Book, 21

- 2 The Direction and Management of the Organization, 27**
 - Introduction, 27
 - Some Basic Systems Concepts, 28
 - The Organization as a System, 30
 - The Organization and Its Environment, 33
 - Managerial Activities, 39
 - Styles of Management, 45
 - The Organizational Structure, 47

- 3 Decision Making in Organizations, 55**
 - Introduction, 55
 - Steps in the Decision Process, 56

- Types of Decision Problems, 58
- Completely-Specified Decision Processes, 60
- Decisions That Cannot Be Completely Specified, 64
- Organizational Procedures for Dealing with Strategic Decision Problems, 68

- 4 The Internal Information System, 81**
 - Introduction, 81
 - The Common Data Base, 84
 - The Management Reporting System, 94
 - The Information Retrieval System, 96
 - The Data Management System, 97
 - Information Flow in an Organization, 98
 - Implementation of an Internal Information System, 105
 - The Impact of the Implementation on the Organization, 112

- 5 Strategic Information, 124**
 - Introduction, 124
 - The Nature of Strategic Information, 125
 - The Search for Information, 131
 - Primary Sources of Strategic Information, 133
 - Sources Used by Managers Gathering Strategic Information, 136
 - Interpretation of Information, 138
 - Effort Allocated in Organizations to Activities Concerned with Strategic Information, 140
 - Examples of Inadequate Use of Strategic Information, 142
 - Causes of Strategic Information Failures, 144
 - Foresight, 148

- 6 Design and Implementation of the Strategic Information System, 162**
 - Acquisition of Strategic Information, 166
 - The Interpretation Function, 177
 - The Storage and Retrieval Function, 183
 - The Presentation Function, 187
 - Implementation of the Strategic Information System, 190
 - The Security of the Strategic Information System, 192

- 7 The Organizational Information System, 201**
 - Introduction, 201
 - Factors Contributing to the Success of the Information System, 203
 - Costs of the Information System, 210

Benefits of an Information System, 213
Evaluation of the Information System, 215

Epilogue, 227

Index, 228

1

An Introduction to Information Systems

Information is an essential commodity in all modern activities. Individuals, organizations, and communities use information in every aspect of their day-to-day affairs. Most organizations have some sort of information system to handle and process the information needed in the various aspects of their work. The system may be elaborate and highly developed or it may be informal and casual in its operation. The system may have been specifically designed and implemented for its task or it may have evolved naturally over a period of time. In recent years, the idea of introducing into an organization an information system that is specially designed to support its managerial and decision-making activities has received increasing acceptance. Some of these systems have met both their design specifications and the expectations of those involved in their creation. Other systems have been less successful. The systems that have not been successful have most commonly been those designed to meet very sophisticated specifications. In many such cases, the specifications called for systems that were more complex than could be attained using the skills and experience available at the time.

The conceptual foundation on which the design of modern information systems is based derives from many sources and disciplines. These sources include not only current organization theory and recent de-

velopments in computer technology and information science, but also the observed pattern of organizational decision making and the recorded behavior of managers in an organizational setting.

The great impact of computers on organizational activities in recent years has caused many authors to take the position that computer technology is the dominant consideration in all information systems. Others, however, take the view that the information requirements of the organization are of primary importance. Those supporting this second view see the computer more as a tool, the application of which should be governed by the perceived needs of the various parts of the organization for information. The treatment in this text will be based on this second approach. The starting point will be the work of Norbert Wiener.

In his original treatise on cybernetics, Wiener compared the acquisition and processing of information in human beings and animals with the similar activity required in the control of machines and other organized activities.¹ Wiener described information-handling in living beings in the same terms used to describe comparable organizational activities. He saw our own information system as a highly developed component of the overall human system. Further, he used the human information system as a general model for the construction of information systems in man-made organizations. He regarded the information system as an essential device, both for enriching the information resources of an organization and for bringing about a greater understanding of the environment in which the being or organization operates.

Some of the statements in Wiener's work reflect the relatively primitive state of computer science at the time that his books were written. However, his basic ideas regarding the role of information in the direction and management of an organization have not lost their force with the passage of time. He regarded communication between the component parts of an organization or community as vital to its activities, stating that "the community extends only so far as there extends an effectual transmission of information."² Wiener saw an information system as the means by which the necessary communication can be established and maintained. His statement that an organization

¹ Wiener, Norbert, *Cybernetics: Control and Communication in the Animal and the Machine*, MIT Press, paperback edition, 1965 (first published 1948).

² *Ibid.*, p. 158.

"is held together . . . by the possession of a means for the acquisition, use, retention, and transmission of information,"⁸ provides a basic outline of the tasks of a modern information system. It is noteworthy that Wiener did not state specifically what constitutes information in his statement. The exact nature of information and the distinction between data and information are points to which we will return shortly.

The parallel between the information system that exists in humans and that which must be created in organizations has many interesting aspects. For example, the human information system can be considered to have developed naturally over a long period of time and to have evolved in a manner dictated by the needs of the human being operating within his environment. By analogy, the characteristics of the organizational information system can be expected to evolve with time and to be influenced by the environment in which the organization operates.

Other aspects of the human information system provide considerable insight into the manner in which an organizational information system should be designed. For example, the human information system is closely integrated with other components of the overall system. These other components include those involved with the internal management of the human body (the regulatory system), those concerned with decision making (parts of both the brain and the nervous system), and those concerned with taking action once a decision has been made (the motor systems). The functions of the human regulatory system can be compared with those of administration and control of the internal operations of an organization. Much of the higher-level activity of the brain is concerned with selecting of objectives and future courses of action for the individual in relation to his or her environment. This activity is analogous to strategic planning in an organization.

The degree of integration in the human system and the manner in which the various systems are interconnected provide examples of efficiency of design that can guide those involved with organizational information systems. However, as with many other such analogies, the comparison between human information systems and organizational information systems loses some applicability and usefulness when pursued to too great a level of detail.

⁸ *Ibid.*, p. 161.

The Evolution of Information Systems

Norbert Wiener's explicit listing of the organizational requirements of information systems in terms of the acquisition, use, retention, and transmission of information is a comparatively recent development. Various systems for processing information were in use by organizations many years before Wiener's analysis. For example, Murdick and Ross have described such a system used in a small country store in the late nineteenth century.⁴ As was typical in those days, the store was owned and operated by one man. The owner was both president and chief executive, undertaking all the functions required to operate the store including sales direction, market research, accounting, inventory control, public relations, and so on. The owner personally gathered all the information necessary to carry out his various functions, either using it as it was gathered or storing the information in his memory for later retrieval. Data that were too numerous or too detailed to be retained in his memory were recorded in a ledger or on pieces of paper that were impaled on a spike. Once a decision was made, the owner usually undertook the necessary action himself.

Within the confines of a small operation, the owner-operated information system was often very efficient. It made use of the highly-integrated information system of the owner himself. Information was expressed and stored in that system in a form that was readily understood by all the components of management. Communication between these components was excellent because all were served by the owner's own integrated information system. The amount of information involved in the relatively simple operation of the one-man store did not usually cause an overload of the communication channels that were being used.

The owner-operated information system could also be expected to be efficient if more than one person worked in the organization, provided that those involved were relatively close in their experience and knowledge. The similarity of purpose and experience of the individuals in such circumstances usually allowed a close communication between them and facilitated the interaction between their respective stores of information.

⁴ Murdick, R. G. and J. E. Ross, *Information Systems for Modern Management*, Prentice-Hall, 1971, pp. 156-157.

In more recent times, an increasing proportion of our affairs have been conducted by larger organizations. Many of the smaller enterprises have been superseded by larger corporations or incorporated into them. Private business and industry have grown as the size and scope of the national economies of the leading industrial nations have expanded. This growth has been accompanied by a corresponding increase in the activities and involvement of government. Industrialization has also resulted in an increase in the size of the urban communities in which many of us live. This increase has been accompanied, in most cases, by a decrease in the size of rural communities.

The development of modern mass economies has had a number of effects on the organizations involved in both the public and private sectors. In the first place, the growth of organizations has made it much more difficult for one man to control and direct the activities of an enterprise in the manner of the owner of the country store. As the staff size of an organization increases, the amount of authority that must be delegated naturally increases also. Responsibility for routine activities and the accompanying decisions is delegated to managers at the middle and lower levels of the organization. Senior management concerns itself with the less routine activities of planning and policy making. These activities are concerned with setting the future objectives and directions of the organization.

A necessary counterpart of delegation of authority is the reporting of the results of the activities that have been assigned. Delegation of authority must, therefore, be accompanied by the establishment of a communication channel through which these results can be reported and discussed. The greater the degree of delegation, the greater is the number of communication channels needed as part of the information system. A greater degree of delegation, however, also increases the chance that some of the necessary channels may become blocked or distorted. Some organizational communication channels may carry formal, structured, and periodic reports. Other channels may exist to facilitate less structured passage of information and to foster informal discussion of the activities of the organization.

A second effect of the growth of an organization is that the breadth of experience and knowledge of individual members of the organization tends to decrease. In the early stages of expansion, the owner, president, or director of a small organization usually does the hiring himself, normally choosing persons with whom he can communicate

easily and readily. As the organization grows, however, the hiring process itself is delegated. The delegation of hiring authority usually results in the hiring of individuals with a wider range of characteristics. It is quite common that individuals with different backgrounds place different interpretations upon information that has been acquired. This diversity of viewpoint often is a source of strength to an organization. It can, however, be a cause of misunderstanding, especially if those involved are engaged in some form of competition or conflict. For this reason, greater attention to communication between individual members is needed as the organization grows in size. This need is particularly acute if the expansion of the organization involves geographic dispersion of units. In a dispersed organization, both the separation of individuals and the absence of frequent personal contact increase the need for clarity and ease of understanding in organizational communications.

Another factor with which modern organizations must contend is the greatly increased complexity of the activities in which they are involved. This complexity is due in most part to the pace and pattern of modern life, and has led to an increased degree of specialization by those who work in organizations.⁵ Increased specialization tends to decrease the amount of knowledge and experience common among members of an organization. In addition, specialization encourages communication between those with similar backgrounds and decreases passage of information between individuals with different interests and specializations.

The complexity of the external environment in which modern organizations operate has greatly increased the amount of information that must be processed within an organization. The nature of the modern environment has also increased the complexity of the necessary information handling. A striking example of this increased complexity is the administration of a company payroll. The owner of the country store usually paid an employee a previously agreed upon amount withdrawn directly from the cash register. The owner then charged the amount to costs. A modern payroll system has the same basic function. However, modern social conditions require that a payroll system also incorporate a large number of other features. In the first place, the gross amount paid to an employee is usually determined by a formal agreement which must be scrupulously observed. Second,

⁵ Toffler, A., *Future Shock*, Random House, 1970, Chapter 8.

modern payroll systems are usually required to make deductions from the gross pay for some or all of the following: income taxes, health care programs, dental care programs, pension schemes, unemployment insurance, charitable donations, taxable allowances and benefits, union dues, parking fees, payroll savings plans, garnishments, disability insurance, and numerous other social and administrative functions. As a result, a modern payroll system is a very large and complicated operation usually requiring computer support to accomplish the necessary data processing tasks.

Organizations have met the demands of the increased complexity of their activities by diverting an increasing proportion of their effort and resources to administrative tasks and information systems.

In the late nineteenth and early twentieth centuries, the information gathering activities were devoted almost entirely to reporting the financial condition of the organization. As managerial skills developed, financial and accounting activities were expanded to include evaluations of the efficiency of subcomponents of the organization in a market-oriented economy. More sophisticated techniques based on concepts developed in economics were introduced under the general heading of management accounting. These techniques included responsibility accounting, in which managers are provided with information identifying any variations from planned performance in the areas for which they have responsibility.⁶ Considerable emphasis was (and still is) given to cost analysis and profitability accounting in the application of these techniques.

The early information systems developed in organizations were oriented almost entirely toward the financial and managerial accounting functions. As unit-record equipment and, later, computers became available, these machines were used to undertake the considerably increased clerical and data processing workload that were associated with the prevalent accounting functions. It is noteworthy that the main initial effect of the introduction of the computer into organizations was an increase in the amount of routine clerical and data-manipulating capacity available to the accounting function. Design and implementation of information systems at this time was often entirely in the hands of accountants and computer specialists. Due to this circumstance, many of the first systems introduced into operation gave highest priority to financial and accounting matters. The concept of

⁶ Higgins, J. A., "Responsibility Accounting," *The Arthur Anderson Chronicle*, April 1952.

an information system designed to serve a wide range of managerial functions was often given little attention. Primary emphasis at the time was given to the work involved in introducing the new computer-supported financial and accounting systems.

In many cases, the introduction of computer-based information systems gave rise to considerable controversy within the organizations concerned. Prior to the general use of computers in organizations, D. R. Daniel had described a crisis in management information.⁷ He called for new organizational approaches and improved information handling to ensure that managerial effectiveness was not hampered by lack of pertinent information. Early attempts to introduce systems to meet these requirements often resulted in disappointment.^{8, 9} To many, the crisis described by Daniel in 1960 was still in effect at a much later time.

Problems still to be overcome in 1973, as described in a survey paper written by J. C. Emery at that time,¹⁰ included (a) alienation, suspicion, and hostility between information system specialists and managers; (b) a tendency for specialists to dictate system characteristics not closely related to the requirements of management; (c) failure by specialists to deliver systems with performances matching specifications; (d) indifference by information systems specialists to costs and inattention to the relation of benefits to cost; (e) inattention to human factors in the design of systems; and (f) failure to provide the flexibility in system design and operation needed to meet the changes that are inevitable in a living organization. Despite these problems, many useful and efficient information systems have been developed in recent years. In particular, information systems that were implemented with the cooperation of both specialists and managerial personnel were shown to provide significant benefits to an organization.¹¹

⁷ Daniel, D. R., "Management Information Crisis," *Harvard Business Review*, September-October 1961, pp. 111-121.

⁸ Dearden, John, "How to Organize Information Systems," *Harvard Business Review*, March-April 1965, pp. 19-27.

⁹ Dearden, John, "MIS Is a Mirage," *Harvard Business Review*, January-February 1972, pp. 90-99.

¹⁰ Emery, J. C., "An Overview of Management Information Systems," in H. L. Morgan, ed., *Proceedings of the Wharton Conference on Research on Computers in Organizations*, published in *Data Base*, vol. 5, nos. 2, 3, and 4, Winter 1973.

¹¹ Hanold, Terrance, "An Executive View of MIS," *Datamation*, November 1972.