INFORMATION SYSTEMS IN MANAGEMENT

JAMES A. SENN

INFORMATION SYSTEMS IN MANAGEMENT

JAMES A. SENN
STATE UNIVERSITY OF NEW YORK, BINGHAMTON

WADSWORTH PUBLISHING COMPANY, INC.
BELMONT, CALIFORNIA

ACKNOWLEDGMENTS

Arthur Andersen & Co.—For excerpts from *Lexicon: General Description Manual,* second edition, 1972. Reprinted by permission of Arthur Andersen & Co.

The Association for Systems Management—for materials in Chapters 3 and 17 based on *Business Systems* textbook, 1975. Reprinted by permission from *Business Systems,* The Association for Systems Management.

Business Horizons—for two tables from "Management Information–Decision Systems" by Gary Dickson in *Business Horizons,* December 1968. Copyright, 1968 by the Foundation for the School of Business at Indiana University. Reprinted by permission.

Computerworld—for "Systems Analysts Face Many Types of Resistance," from *Computerworld,* July 26, 1976. Copyright by *Computerworld,* Newton, Massachusetts 02160.

Farrar, Straus & Giroux, Inc.—for an excerpt from *Cancer Ward* by Alexander Solzhenitsyn, translated by Nicholas Bethell and David Burg, © 1968 by Alexander Solzhenitsyn, English translation © 1968, 1969 by The Bodley Head, Ltd. Reprinted by permission of Farrar, Straus & Giroux, Inc.

R. Buckminster Fuller—for an excerpt from *Operating Manual for Spaceship Earth,* © 1970 by R. Buckminster Fuller. Reprinted by permission of the author.

Informatics Incorporated—for an illustration from Mark IV File Management System, *Student Class Reference Manual.* Reprinted by permission.

International Business Machines Corporation—for "After Talks of Gremlins, They Flooded the CPU" from DP Dialog, 1974, IBM. Reprinted by permission of IBM.

McGraw-Hill Book Company—for an excerpt from *The Successful Computer System* by Joseph Orlicky, © 1969 and reprinted by permission of McGraw–Hill Book Company.

Alan Michaels—for "The Declaration of Human Reduction" by Alan Michaels with his permission.

MRI Systems Corporation—for the COBOL example from *System 2000 General Information Manual.* Reprinted by permission.

G. P. Putnam's Sons—for "The Curse" from *Son of the Great Society* by Art Buchwald. Copyright © 1965, 1966 by Art Buchwald. Reprinted by permission of the publisher and the author.

Random House, Inc.—for an excerpt from *Future Shock* by Alvin Toffler, copyright © 1970. Reprinted by permission of the publisher.

Sperry Univac—for the press release announcing UNIVAC I. Reprinted by permission of Sperry Univac, a Division of the Sperry Rand Corporation.

United Press International—for "MIT Mischief Makers Play Computer Cuties."

Photographs: Ampex Corporation—for Figures 5.26–28. BASF—for Figures 5.31 and 5.38. Control Data Corporation—for Figures 5.1, 5.22, and 5.36. Honeywell Information Systems—for Figures 5.13, 5.15, and 5.37. Houston Instruments—for Figure 5.23. International Business Machines Corporation—for Figures 5.4–6, 5.8, 5.10–12, 5.14–15, 5.18, 5.24, 5.29–30, 5.32, 5.36, 5.39, S5.1, S5.4, and S9.2–5. Smithsonian Institution—for Figures S5.2–3, and S5.5–8. Sperry Univac—for Figure 5.20. Tektronix, Inc.—for Figure 5.17. Teletype Corporation—for Figure 5.16. Wang Laboratories, Inc.—for Figure 5.19.

Library of Congress Cataloging in Publication Data

Senn, James A
Information systems in management.

Bibliography: p.
Includes index.
1. Management information systems. I. Title.
T58.6.S42 651.8'4 77-12421
ISBN 0-534-00563-2

Data Processing Editor: H. Michael Snell
Production Editor: Mary Arbogast
Designers: Design Office/Peter Martin; Victoria Philp
Copy Editor: Carol Dondrea
Illustrator: Ayxa Art
Cover Photo: Nikolay Zurek

Printed in the United States of America

4 5 6 7 8 9 10 – 82 81 80

PREFACE

TO THE STUDENT

Being able to process data and use information effectively is vital to business and government organizations. Without the capability to process data about sales, inventories, income, taxes, and the like, it would be impossible for a business to exist very long. Similarly, if government organizations could not obtain information about citizens and the effect of programs, regulations, and laws on citizens, they would quickly cease to function. Because data and information are so important to organizations, any improvement in the way they are handled is going to improve both the organization and the services it provides.

The most significant improvement associated with data and information in the twentieth century has been the introduction of the electronic computer. Computer-based processing systems were first introduced into business and government organizations in the 1950s. Since then, their use in all types of organizations and commercial enterprises has grown at an astounding rate. As a result, there is hardly an individual in the United States today who is unaffected by computer systems and the data and information they process.

In this book, you will see how data and information are used in organizations and how they are processed by modern computer systems. You probably have many questions about information and data processing. We will be looking at answers to many of them: What is data processing? What is information processing? What is a computer system and how does it work? What can computers do? How can you control computers rather than be controlled by them? What is coming and where are we going in automated data processing? These questions underlie many business activities today. To be competitive in the business community you need to be able to answer them.

The approach taken in writing this book is that you are going to be a user of information systems rather than an engineer who will be designing electrical/mechanical components. Therefore, many examples are presented to give you a good understanding of how information systems are actually used. Many aids are included to help you learn about the field of information systems more quickly. For example, each chapter starts with key questions that will help guide your reading. Each chapter also begins with a short episode describing a situation or idea of interest to people in business and government. Some are amusing and others are of general interest and importance. At the end of each chapter are sets of key words and review questions to help you further pinpoint your reading and learning. Many application problems are included to emphasize real-world situations involving computer-based information systems. By working through them and developing answers or strategies as requested, you will not only be learning the terminology

and concepts of information processing, but you will be making decisions about situations that occur constantly in organizations. You will be acting as a user of information systems and learning how to use information processing tools and techniques. That is, after all, what it's all about.

TO THE INSTRUCTOR

This textbook deals with the relation between data, information, and computer processing as it occurs in a wide variety of organizations. A unifying theme is the application of computer-based processing systems as tools in business and management. There are few chapters devoted to management *per se*. Instead, I have chosen to weave the general theme of management into all of the discussions in each chapter. In other words, concepts and application settings are developed in a way that gives your students a realistic view of how computer-based processing systems are used in organizations.

This text is designed to be used in a semester or quarter course in transaction and information processing. Your students need not have prior knowledge of programming languages to use this book (a summary of programming principles and languages is provided in Chapter 7). If your students do have experience in programming, however, you will be able to develop a more in-depth perspective on the role of information in management and decision making.

I have written this text in a modular fashion, permitting you to emphasize certain aspects of transaction and information processing according to your classroom needs. For example, the computer systems and transaction processing modules could easily be (and have been) studied before the management information module. Chapter supplements provide additional details or emphasis for some topics addressed in the chapter itself. If your students need a better foundation in general management principles you may want them to read the supplement at the end of Chapter 4. But if they have had management courses before, you could omit the management supplement. Similarly, the supplement on number systems may be used or omitted, depending on your preference.

The management information module is devoted to pertinent information, systems, and management topics. The terminology and concepts of information, systems, and control have been carefully developed. This module also draws attention to the role and functions of management in modern enterprises, emphasizing the decision-making responsibility and functions of management.

The computer systems module discusses the key hardware components, operating concepts, and software systems used in data processing. Since this and all other modules emphasize managerial applications, I have not dwelt on elegant architectural topics. Rather, the concern is on what managers need to know about using computers in processing transactions or receiving reports and information to make decisions.

The transaction processing module focuses on how data are captured, stored, and processed in recurring business settings. File storage structures and processing modes are presented with emphasis on when and why they should be used. A supplement introduces management users to ideas on how to improve the quality of the data used in their organizations.

Computers as tools in management control and decision making are dealt with in the management information systems module. After reviewing the impact of computer-based processing systems on organizations, the book explores management

information systems from both a functional and a design perspective. Chapters 12 and 13 deal with databases and database management systems in MIS. Both current features and needed developments are explored.

The analysis and design module investigates the structure of management information systems and transaction processing procedures. Too often, systems are improperly designed and implemented, and in other cases they are not designed at all but thrown together almost haphazardly. These problems are discussed in some detail and ways to deal with them are pointed out. Besides concepts and techniques of analysis and design, this module points out the importance of evaluating information systems, both in an operational sense and in economic cost/benefit terms. The behavioral aspects of implementing information systems are also explored. Finally, Chapter 18 addresses the future of information systems technology, including the impact of the problems of society. The essence of the discussion in this chapter is "Where do we go from here?"

Because it is important to be able to deal with information systems in real settings, I have included four classroom-tested case studies in the book. Each case, based on a real company, can be used as a term project for analysis and design or for class discussions to drive home salient points about transaction and information processing. I have found it useful to begin with one or two of the cases in the first part of the course and then return to the same cases for additional analysis and discussion later on as further insight is developed into the purposes and tools of transaction and information processing systems. It has been most useful to devote a substantial amount of class time to each case, discussing the different points of interest. By having the students decide what the problems are and how they should deal with them, they usually think through the situations much more carefully. Discussing their viewpoints in class gives the students an opportunity to hear other ideas and suggestions, which can also be a learning experience. The cases, as with all of the learning tools in the book, are intended to give the students a practical, applications-oriented view of information systems.

ACKNOWLEDGMENTS

Many people have contributed to the analysis and design of *this* information system. Hugh Juergens (University of Wisconsin, Madison) has been extremely helpful to me in pulling together rough ideas and testing them in his classes. He also read the manuscript several times to assist me in overcoming technical difficulties that crept into the manuscript from time to time. My reviewers were also very helpful in pulling together ideas and opinions. I want to thank the following people for their assistance: Marty Bariff (The Wharton School), Raymond F. Gorman (Providence College), Robert J. Smith (California State University, Long Beach), Robert E. Seiler (University of Houston), John P. Fertakis (Washington State University), James A. Campise (Rice University), Robert B. Stein (Central Connecticut State College), James V. Hansen (Indiana University), George Prater (University of Washington), Marshall N. McFie (California State University at Fullerton), Ted Willoughby (Ball State University), Charles D. Mecimore (University of Cincinnati), William N. Ledbetter (Auburn University), Robert T. Tussing (Illinois State University, Normal), Edward W. Rogers (University of Dayton), and N. D. Bramer (Colorado State University).

The staff at Wadsworth Publishing Company has been invaluable. Mike Snell kept prodding me, offering constant encouragement and many ideas on how to improve the manuscript. Sheryl Fullerton went through the manuscript repeatedly, pointing out areas where further explanations and examples were needed to help drive home particularly difficult concepts. All of the production crew worked hard and have given me constant support and many ideas. I specifically want to thank Jenny Sill, Mary Arbogast, and Ann Wilkinson.

Finally, I want to thank my family—Elaine, Marlene, and Kathy. Without their support and sacrifices of Thousand Islands weekends during the "making a book" it would have remained nothing more than a pile of tattered notes.

CONTENTS

MANAGEMENT INFORMATION MODULE

COMPUTER SYSTEMS MODULE

TRANSACTION PROCESSING MODULE 234

MANAGEMENT INFORMATION SYSTEMS MODULE

CASE STUDY MODULE

1

INTRODUCTION TO INFORMATION PROCESSING

KEY QUESTIONS

What are data?

Why process transaction data?

How does information processing differ from transaction processing?

What role does information processing play in management of organizations?

What is a computer system?

THE 800TH LIFETIME

The Industrial Revolution in the United States dramatically altered the life style and pace of activity of every citizen. The series of changes which began at that time has continued to accelerate at an astounding rate. In demonstrating the rate of change, Alvin Toffler states in Future Shock *that*

if the last 50,000 years of man's existence were divided into lifetimes of approximately sixty-two years each, there would have been 800 such lifetimes. Of these 800, fully 650 were spent in caves.

*Only during the last seventy lifetimes has it been possible to communicate effectively from one lifetime to another—as writing made it possible to do. Only during the last six lifetimes did masses of men ever see a printed word. Only during the last four has it been possible to measure time with any precision. Only in the last two has anyone anywhere used an electronic motor. And the overwhelming majority of all the material goods we use in daily life have been developed within the present, the 800th lifetime.**

The 800th lifetime—the last 62 years—has seen the introduction of most of the machines, equipment, and consumer goods in use right now. These changes have been brought about in just 1/800th *(0.00125) of the last 50,000 years of the history of humanity. Behind this continually accelerating rate of change is the great power plant of technology. Technological innovation has been significant in developing the things we know today. We are now in the midst of a second industrial revolution, a technological revolution that is reaching deeper into the roots of civilization than the revolution in the 1800s. And we feel its impact more and more every day.*

The fuel for this technological revolution is information. Information as an abundant resource entered history after 1500 with the invention of movable type. Production of tremendous volumes of information grew rapidly in the generations that followed. In the 1950s, after the introduction of the electronic digital computer, the production of information skyrocketed and triggered the staggering proliferation of knowledge that we are witnessing today. This was, in part, due to the computer's great speed, flexibility, and unique analytical capabilities. The result was the collection of more information *on* more activities and events *that, when combined with other tools that had been developed, propelled most of the world into a new industrial revolution. Indeed, knowledge and information became the fuel, the power, and the initiator of change and revolution.*

Business and government organizations have been involved in data processing and information processing since the early days of commerce. In the past, the two terms were virtually synonymous and brought to most people's minds the image of a person in a green eyeshade and thick wire-rimmed glasses. The person was tucked away in some dimly lit backroom, working amid stacks of papers and books, with a dusty old adding machine and many worn down pencils. Above was a single bare light bulb suspended from the ceiling by a single strand of electric wire. On the data processor's wrists were plastic sleeve guards, yellow with age. The image of this "data processor,"

*Alvin Toffler, *Future Shock* (New York: Random House, 1970), p. 13.

this necessary evil who recorded accounting data about the business, and the little room in which he or she worked, is how many people still see data and information processing.

As we will see throughout this book, however, data processing and information processing are quite different today. First of all, data processing and information processing, as the terms are used in modern organizations, are quite different from one another. And neither is viewed as a "necessary evil" by the well-educated and experienced manager. Rather, they are recognized as two activities that can improve the performance of an enterprise and make it more successful. In this first chapter, we briefly investigate the meanings of data processing and information processing and place them in perspective in the modern organization.

DATA PROCESSING AND INFORMATION PROCESSING

Data processing and information processing are separate but related activities that are performed in different ways. The foundation of both is **data,** facts that describe persons, places, things, or events. For example, we may base a description of a business's size on the fact that its sales in 1977 were $14 million, or that its sales for 1977 increased 12 percent over 1976. Or we may base it on the fact that the firm employs 13,000 people, 1200 of whom are classed as managers. All of these facts are data that in some way describe the business.

We need data in our personal lives, too. We need to collect facts describing entities that are of interest to us. If, for example, we are planning to drive from New York to Minneapolis, the data we would want to collect would include:

1. Route we will follow
2. Road miles from New York to Minneapolis
3. Miles per gallon of gasoline for the car we will drive
4. Miles driven per day of travel
5. Average cost of a gallon of gasoline
6. Amount of highway and bridge tolls
7. Average cost of a motel/hotel room for one night

All of these data are relevant to the New York–Minneapolis drive. In planning the trip, we would collect or gather only the relevant data. We would not care that it takes a day and a half to drive to Atlanta or five hours to fly from New York to San Francisco, although these facts are also data.

To determine the time and expense associated with driving from New York to Minneapolis, we would process or combine the data about each aspect of the trip. This would provide us with **information** about the journey, that is, we would know more about the time and expense

involved. There would be less guessing or uncertainty. For example, by processing the data below, we could figure the total time of the trip.

a. New York to Minneapolis via interstate highways	1300 miles
b. Miles per gallon for automobile (highway driving)	20 mpg
c. Miles driven per day	650 miles
d. Average cost of gallon of gasoline	$.65
e. Average cost of hotel/motel, per night	$ 27
f. Amount of highway & bridge tolls	$ 11.50

In this case, we would divide the total number of miles, 1300, by the number of miles driven per day, 650, to get two days, one night. To determine the total cost of the trip, we would add the cost of gasoline, tolls, and motel/hotel expenses.

All people process data, or facts, about the world around them. The data might be as simple as the price of a gallon of gas or a shirt, a description of a particular course at a university, or the percentage increase in the rate of crime for last year. Data can also be more complex; they can be the libretto of an opera or the theme of a symphony, the principle of the rotary engine, or hypotheses about causes and cures for cancer. It is hard to think of a single activity that does not involve the processing of data.

Often we collect or use data without realizing that that is what we're doing. For example, if you curl up in your favorite chair to read the current best-selling novel, you are processing data. As you flip through the pages, you're putting bits and pieces of facts away in your memory. The data may be something as specific as the season in which orchids start blooming in Hawaii, or as general as the fear the heroine feels while alone in an empty house on a cold, rainy night—it's pitch black out, the thunder gets louder and louder, and suddenly the lights go out. The dogs begin to howl. Lightning starts to flash. Suddenly there is a creak at the door. She turns around in a jerk, just in time to . . . . It scares you; you are so engrossed in the novel that you can feel your body tightening as you read each line.

You are processing all these data without even realizing it. In fact, you may not be aware that you have "recorded" them in your mind until some time later—when, for example, *you* are alone in an empty house on a rainy night when the lights go out, and you start to have the same fears as the heroine in the novel. You may have the feeling that you've been there before *(déjà vu)*, even though you know you really haven't.

Of course, not all data that you encounter in everyday life are stored away in this manner. Some data you disregard and some are never stored. Other data, like your birthday or the day on which you hope to graduate, you consciously remember. In any case, though, you are processing data continually.

Businesses and organizations do the same thing. Data are the lifeblood of any organization, whether they be the total dollar sales for the month or the fact that the competition has just introduced a new

model that makes all your company's products obsolete. Without data, no business or organization could operate. And they must be processed—and processed properly—or serious problems will result. For example, can you picture an organization like General Motors or the federal government trying to operate without data and data processing? Can you imagine what would happen if the data were not processed correctly?

Organizations process data for two main reasons: (1) to capture the details of transactions and (2) to enable people to make decisions. Virtually all data processing activities can be traced to one or both of these reasons.

TRANSACTION PROCESSING

A **transaction** is an event that involves or affects a business or organization. Selling merchandise and ordering supplies from a manufacturer are common examples of transactions. As transactions occur, certain data about them—those that are relevant or important to the organization—are collected. For example, when selling merchandise, it might be relevant to know the name of the customer; the type, quantity, and price of merchandise sold; and if the customer paid cash for it. When ordering supplies, it would probably be important to record the date of the order, the name of the supplier, and the quantity and type of merchandise ordered. The details of such transactions are stored for later use: totaling the sales each month to a specific customer, determining how many items are sold each month to all customers, and so on.

Processing data about transactions is called **transaction processing.** It is an activity that underlies the orderly operation of any business or organization. The five reasons for transaction processing are classification, sorting, calculation, summarization, and storage of data.

Classification involves grouping data according to some characteristic. For example, the Internal Revenue Service, as a matter of routine procedure, classifies all income tax returns (the "transactions" in this example) by dividing them into three categories: returns on which the person must pay the federal government, returns on which the federal government must refund money, and returns on which no money has to be exchanged. Since each type of return must be processed in the same way, it makes sense to group them into the same categories so they can be handled more quickly.

Another example of classification is a university registration system. Often, upper division (junior and senior) undergraduates, lower division (freshmen and sophomore) undergraduates, and graduate students need different instructions on how to register for courses. Each group must know which courses have to be approved by an advisor, which courses they cannot take for credit, and so on. When instructions are being mailed, it is much easier to categorize the students first so the packet of instructions to be mailed can be assembled quickly and without error.