JOHN G. BURCH, JR. / FELIX R. STRATER / GARY GRUDNITSKI

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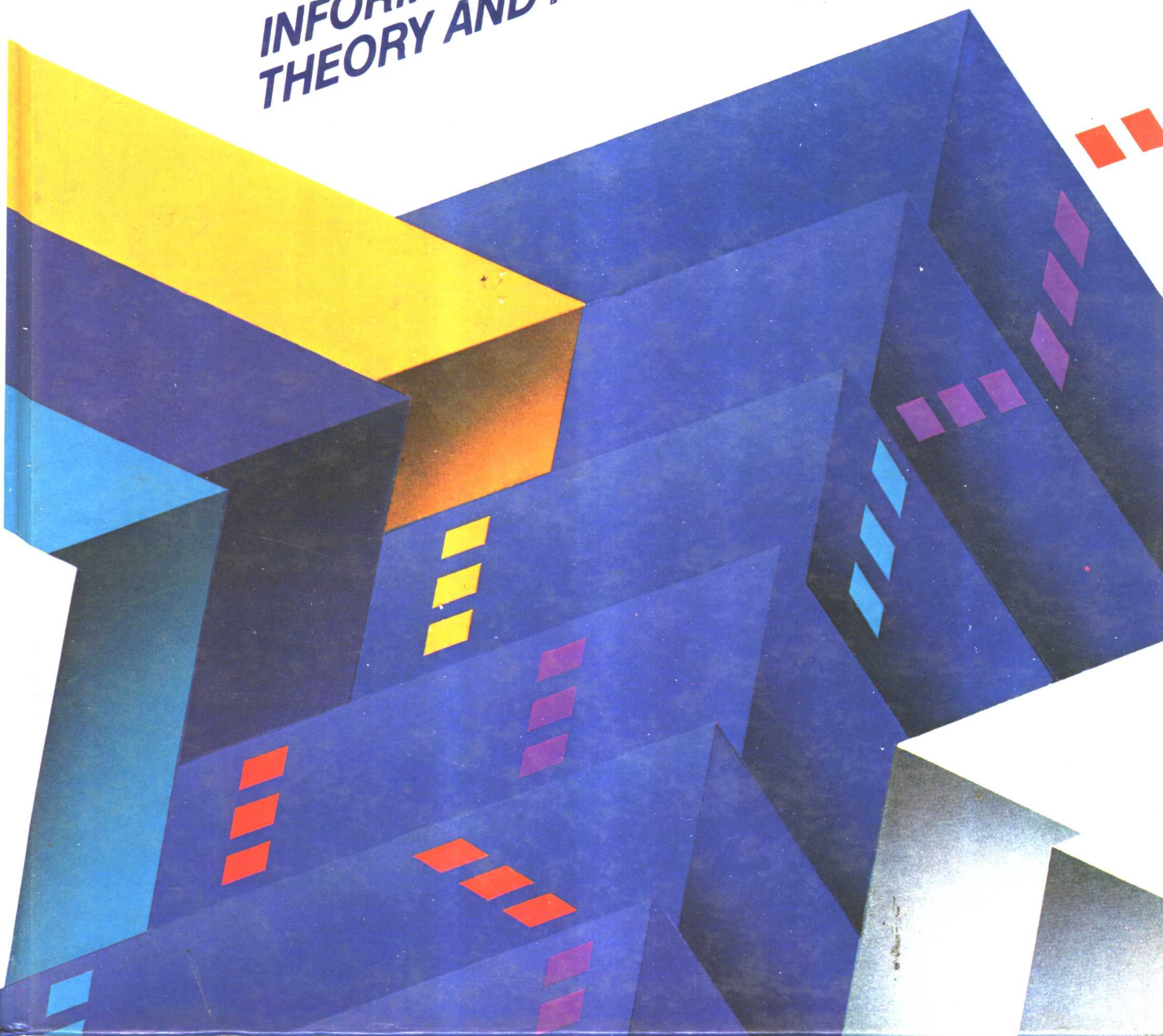

THIRD EDITION

INFORMATION SYSTEMS: THEORY AND PRACTICE

JOHN G. BURCH, JR.
East Texas State University
Texarkana, Texas

FELIX R. STRATER
The Standard Oil Company (Ohio)
Cleveland, Ohio

GARY GRUDNITSKI
The University of Texas at Austin
Austin, Texas

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ABOUT THE AUTHORS

John G. Burch, Jr. is a professor and head of accounting and information systems at East Texas State University in Texarkana. He also has taught at the University of Massachusetts and Louisiana State University. Dr. Burch has instructed graduate and undergraduate courses in accounting, administrative controls, computer auditing and control, computer programming, and information systems in his ten-year career. Prior to his academic career, he worked in general accounting and managerial positions in the construction and oil industries.

A native of Texas and Louisiana, Professor Burch earned his Ph.D. in business from the University of Alabama and his undergraduate degree from Louisiana Tech. He is a member of several professional organizations and also holds membership in Beta Alpha Psi, Beta Gamma Sigma, Phi Beta Phi, and Delta Sigma Pi. He has written many articles that have appeared in professional journals. He has presented a number of papers at several conferences. Dr. Burch has been coauthor of two texts, *Information Systems: A Case Workbook* and *Computer Audit and Control: A Total Systems Approach.*

Many of the concepts of the present textbook are a direct result of consulting and training activities. In addition to continuing education seminars, Dr. Burch has conducted several computer control training sessions for the state of New York. He has also worked with a number of students on a variety of information systems projects in hospital, service, merchandising, and manufacturing organizations.

Felix R. Strater has held a variety of positions in the field of information systems during the past twenty years. He has performed as a programmer, analyst, and systems designer for the steel, plastic, and petroleum industries. He has held a variety of management positions in the areas of systems design, data center operations, software management, and data base development. More recently, Mr. Strater has held a variety of management positions in transportation and distribution functions. He is involved continuously as a guest lecturer in corporate training programs, in industry seminars, and in various university courses. He received his B.S. degree from John Carroll University, and he is a certified data processor (CDP).

Gary Grudnitski is associate professor of accounting at the University of Texas at Austin. He received his B. Comm. and M.B.A. degrees from the University of Saskatchewan, Canada, and his Ph.D. degree from the University of Massachusetts, Amherst. He has worked as a systems analyst for Bell Canada and the Government of Saskatchewan developing applications that ranged from customer billing to driver registration. At the University of Texas, Dr. Grudnitski has instructed information systems courses at the undergraduate, master, and doctoral level. He also taught a graduate consulting course. He belongs to several organizations including the American Accounting Association, American Institute of Decision Sciences, Society for Management Information Systems, and the EDP Auditors Association.

Preface

This third edition of our book follows the format of the previous edition closely. All chapters have been revised to include additional examples, to explain the chapter content better, and to aid students in working the assignments. Some of the assignments have been changed so that students will be better able to come to grips with and derive solutions for them but, because systems work is not cut and dried, room for imagination and analysis still exists. For those who want to stress definition and proficiency in the application of techniques, we continue to include a large number of review questions and exercises that call for specific answers and solutions. Finally, a wealth of discussion questions appear at the end of the chapters.

Whereas the previous edition was divided into four main parts with three appendixes, this edition has three main parts and two appendixes. Parts I and II, of the second edition (the theory material), are now combined in a streamlined Part I in this edition. The building-block concept, a key element of information systems theory, has been refined in this edition to show its role and application more clearly. The theoretical underpinnings of systems are used throughout the book to support the practical side of information systems development. Chapter 5, the final chapter of Part I, brings together the concepts presented in the first four chapters and applies them to a real-world situation.

In the second edition, Part III presented data base concepts and techniques. This fundamental design block is now treated in Part II, which we have restructured, clarifying the definitions and incorporating new ideas from the literature and

practice. Much of the new material is devoted to logical data structures.

Part III, the last main part of the present edition presents the Systems Development Methodology. The primary objective of this part is to describe each of the phases of analysis a systems analyst goes through in the development and design of an information system. Practical facets of systems work are tightly linked to the theory presented in Part I.

Structured analysis, design, and programming receive more detailed treatment in this edition. The section on systems testing has also been rewritten to provide a more complete presentation.

In Part III the Pelican case replaces the TIS case study. The Pelican case stresses how systems analysts go about, on a step-by-step basis, developing information systems. Pedagogically, the main purpose of the case is to show students how the Systems Development Methodology is applied. It deals with an organizational situation all students can understand.

Material from Appendix C of the second edition is incorporated in Part III of this edition. Appendixes A and B have been updated and remain intact. Like the second edition, their purpose is to provide review and reference.

This book is designed so that the material in each chapter can be presented in sequence with the material in the appendixes being referenced throughout the text as necessary. Instructors may want to use various other approaches, however, depending on the background of their students and the objectives of the course. For example, the material in the appendixes can be presented first as a quick review. Or, Appendix A can be given more emphasis and presented with the material in Chapters 2 and 3, while the material in Appendix B can be emphasized during the discussion of Chapter 4. Although a progressive development of ideas and vocabulary from chapter to chapter is made, other alterations in chapter presentation might be appropriate as well.

This book is intended for a one-semester course for students in accounting, business, computer science, engineering, finance, management, and marketing, who have at least an introductory background in computers and business. Students in these and in other disciplines need to understand information systems, their role in organizations, and how they are developed.

We recommend three methods for teaching a course using this book: (1) a conventional classroom approach with heavy emphasis on assignments from each chapter and two or three exams; (2) a seminar/empirical approach with some assignments and an outside systems project, with special attention given to the Pelican case; or (3) a rigorous/theoretical research approach with extensive assignment of problems and topics for library research and a comprehensive qualifying exam. Some instructors use a combination of methods in two 3-hour courses, applying method (3) in the first course and method (2), in the follow-on course.

We gratefully acknowledge the reviews and suggestions offered by Ulric J. Gelinas, Jr., Myron H. Goldberg, Ronald J. Kizior, Sung W. Kim, Jan Pipkin, and Durwin Sharp. Their contributions enhanced several parts of this book. But, as is customary, we are responsible for all errors.

We are fortunate to have Wiley as our publisher and to have had several talented members of its staff working with us on this edition. Special recognition and thanks are due Lucille Sutton, our editor, for her support and encouragement.

We express appreciation to Jill Bedgood, Linda Parker, Sharon Caputo, Bonnie Miller, and Barbara Beeman for their typing and copying work, and for making those mad dashes to the post office for last-minute mailings.

Finally, we express thanks to our many students in regular courses and participants in special seminars. They kept us thinking and searching for ways to improve this book. We hope that we have not disappointed them.

John G. Burch, Jr.
Felix R. Strater
Gary Grudnitski

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PART

I

Introduction to Information Systems

CHAPTER

1

Information Systems Concepts

1.1 ▪ INTRODUCTION

As a nation we are fond of using labels to characterize a significant aspect, event, or emotion for a given time period. Examples of these labels are, "The Dark Ages," "The Stone Age," "The Age of Chivalry," "The Roaring 20's," and "The Depression." A survey of current literature is likely to find references to "The Computer Age," "The Information Age," and "The Systems Age." Whether these labels are fads or of historical importance is not known nor necessarily important to know at this time. However, to more than half of the persons employed in this country today, developing and operating computer-based information systems are what they do for a livelihood.

The long talked about growth of computers and the "information explosion" are today's realities in our social and economic institutions. The purpose of this text is to provide the fundamental knowledge to enable one to participate in the development and use of information systems in modern organizations. Before we discuss the variety of information requirements and the sophisticated ways in which these requirements are satisfied in modern organizations, we first examine the basic concepts underlying information systems. The specific objectives of this chapter are:

1. To develop a descriptive and functional definition of data and information.
2. To analyze systems and their use in developing the information systems concept.
3. To present an overview of the information systems development methodology.

1.2 ▪ DATA AND INFORMATION

Our analysis of information systems begins with functional definitions of data and information and a discussion of their relationship. This initial understanding is enhanced by distinguishing between formal and informal information, discussing the attributes which give value to specific information, and analyzing how information is produced from data.

Basic Definitions

The terms data and information are often used interchangeably, but they refer to two distinct concepts. ***Data*** are language, mathematical, and other symbolic surrogates which are generally agreed upon to represent people, objects, events, and concepts. Simply stated, data are raw facts. ***Information*** is data placed into a meaningful context for its recipient. The following examples illustrate these concepts and their relationship:

> . . . let's consider the implications to various people of a train whistle penetrating the evening dusk. To the saboteur crouching in a culvert, it might signify the failure of his mission because the whistle indicates that the train has already passed over his detonating charge without causing an explosion. To the playboy, it might presage the imminent arrival of the transgressed husband . . . To the lonely wife it means the return of her traveling husband. To the man with his foot caught in the switch down the track, it preshadows doom . . .[1]

It is also likely that others who hear the train whistle associate nothing of value to its sound. Perhaps, some within range of the whistle do not even hear it!

The single most important transaction to any company is the receipt of a customer order. The information value of a specific customer order, however, will vary among the employees of the company. Those individuals most directly responsible for processing customer orders (e.g., credit clerks, inventory pickers, packagers, shipping clerks, etc.) will value the contents of a specific order as necessary information to perform their respective jobs. Individual salespersons will likely be interested in only those orders pertaining to their customers and, perhaps, only the aggregate of all orders received in a given time period (i.e., daily, weekly, monthly). The sales manager may be interested in all customer orders but only values these data when reported or presented in reference to quotas, forecasts, or budgets. Accountants view customer orders as data until such time as they represent or are processed into billable shipments, accounts receivables, monthly revenues, and so forth. Others in the company such as employee relations, research, and engineering personnel routinely are not interested in customer order data.

The sound of a train whistle and a customer order are two examples of data. Whether or not these data are to be valued as information, as the above examples illustrate, depends upon each recipient's specific situation, which includes their particular set of attitudes, emotions, and goals. The amount of data available at any time to each of us, whether it be in our classroom endeavors, recreational pursuits, or job responsibilities is virtually unlimited. Unless we have identified information requirements to satisfy, the sheer volume of available data represents a time and economic burden impossible to overcome. Therefore, if we want to provide information rather than data to individuals, it is necessary to have analyzed their specific situation and determined their specific information requirements.

Formal Versus Informal Information

Formal information systems are based on the supposition that we can identify individuals' information requirements and that we can also determine the methods of producing

[1] Edward D. Dwyer. "Some Observations on Management Information Systems," in *Advances in EDP and Information Systems* (New York: American Management Association, 1961), pp. 16 and 17. Used with permission of the American Management Association.

information from data to satisfy these requirements. The distinction between formal and informal information is a third important concept.

Examples of ***formal information*** include: legal requirements, government legislation, union contracts, accounting procedures, planning requirements, organizational budgets, job demands, communication requirements, control needs, stockholders and creditor demands, problem situations, and general decision-making processes. Paychecks, invoices, purchase orders, and receiving tickets are all examples of structured forms of formal information. Status reports, variances, probabilities, return on investment, reorder points, contribution margins, and traditional accounting statements are highly formalized forms of information. In contrast, ***informal information*** includes opinions, judgments, hunches, intuition, hearsay, personal experiences, "grapevines," "rules of thumb," gossip, assumptions, and so forth.

From the examples presented, the difference between formal and informal information should be clear. Formal information allows us to extract from the recipient the processing or conversion procedures for producing information from data. On the other hand, the value of informal information is arbitrarily assessed by its recipient. The form and content of informal information are both subjective and unstructured, and the process which converts data to information cannot be separated from the recipient.

Both types of information may be essential to the management and operation of an organization, but formal information is the only valid output of a formal information system, and the only valid information discussed in this text. It should be noted, however, that advances in accounting, operations research, finance, and statistics have resulted in formalizing some of what was previously regarded as informal information (e.g., human resource accounting, management forecasts, probability theory).

Information Attributes

Many attributes or qualities associated with the concept of information assist us in identifying and describing specific information requirements. Figure 1.1 illustrates several attributes of information.

As we move from the concept of providing generalized information to providing specific information to an individual, determining the values for the various information attributes illustrated in Figure 1.1 is necessary. This is not an easy task. Some of the attributes are difficult to state and almost impossible to measure objectively. For example, assume you are responsible for scheduling ships in a large shipping company. It is likely that one of your major responsibilities would be to know where each ship is at any given time. It is also likely that you would be routinely asked the location of a given ship by a variety of people. Your response could be any of the following: "At sea," "In the Atlantic," "On her way to Gibraltar," "Three days out of New York," "Latitude 38°N, longitude 51°W."

While each response is accurate and timely, it may or may not satisfy the information requirements of the individual because it fails to satisfy other attributes. The nature of each response presupposes that you have determined each individual's "meaningful context" and that you have determined the relevance of each attribute to that context. To the extent your judgment is correct, you have provided information. To