

HANDBOOK OF DATA PROCESSING FOR LIBRARIES

Second Edition

Handbook of Data Processing for Libraries

Second Edition

SPONSORED BY THE COUNCIL
ON LIBRARY RESOURCES

Robert M. Hayes

University of California, Los Angeles

Joseph Becker

Becker and Hayes, Inc.
Los Angeles, California

A WILEY-BECKER & HAYES SERIES BOOK



MELVILLE PUBLISHING COMPANY

Los Angeles, California



Copyright © 1970, 1973 by John Wiley & Sons, Inc.
Published by Melville Publishing Company,
a Division of John Wiley & Sons, Inc.

All rights reserved. Published simultaneously in Canada.

No part of this book may be reproduced by any means,
nor transmitted, nor translated into a machine language
without the written permission of the publisher.

Library of Congress Cataloging in Publication Data:

Hayes, Robert Mayo, 1926-

Handbook of data processing for libraries.

(Information sciences series)

"A Wiley-Becker & Hayes series book."

Includes bibliographies.

1. Libraries—Automation. 2. Electronic data.

processing—Library science. I. Becker, Joseph,
joint author. II. Title.

Z678.9.H36 1974 025'.02'02854 74-9690

ISBN 0-471-36483-5

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Information Sciences Series

Information is the essential ingredient in decision making. The need for improved information systems in recent years has been made critical by the steady growth in size and complexity of organizations and data.

This series is designed to include books that are concerned with various aspects of communicating, utilizing, and storing digital and graphic information. It will embrace a broad spectrum of topics, such as information system theory and design, man-machine relationships, language data processing, artificial intelligence, mechanization of library processes, non-numerical applications of digital computers, storage and retrieval, automatic publishing, command and control, information display, and so on.

Information science may someday be a profession in its own right. The aim of this series is to bring together the interdisciplinary core of knowledge that is apt to form its foundation. Through this consolidation, it is expected that the series will grow to become the focal point for professional education in this field.

Preface to the Second Edition

The four years since the first edition of this book was published have been a period of exceptional advance in the usage of computers in libraries. Where one or two examples were all that were available at that time to illustrate each kind of application, now there are five to ten; where the cadre of knowledgeable people in libraries at that time was small, now virtually every major library has some kind of systems department; where the efforts at that time were largely experimental and developmental, now they are operational; where the available literature at that time was limited, now there is a wealth. This second edition has therefore been written in a context totally different from that of the first.

But its aims are the same: to ensure that practicing librarians and that students in library schools approach the world of automation with knowledge of its capabilities and limitations and with the techniques of systems analysis by which to analyze and evaluate alternative answers to the library's processing problems. The changes from the first edition therefore represent not a departure from that purpose but simply an updating of its content, to reflect the advances and experience gained, and an opportunity to correct the errors (hopefully minor) that have been found through use of the first edition.

The updating to reflect experience has been based on analysis of the published reports of operational experience and on interviews with people, in various libraries throughout the country, who have been most generous in providing information about their systems.

Reflecting on the progress of library automation over the last several years, we want to pay special tribute to two distinguished librarians, Ralph R. Shaw and Verner W. Clapp, each of whom made incalculably significant contributions to library mechanization and automation, contributions which continue to exert profound influence on every new development in the field.

Shaw brought the scientific method to library practice. To name but a few of his deeds: he invented a library photocopy machine for ordering and circulation work; he published the first Microtext book; he pioneered in cost/benefit analysis of library operations; and he adapted Vannevar Bush's Rapid Selector to photoelectronic storage and retrieval of bibliographic references in the Bibliography of Agriculture.

Clapp did more for the development of library automation in America than any other librarian. He supported numerous micrographic and computer experiments, sponsored the development of the Machine Readable Cataloging system (MARC), established the American Library Association's Library Technology Project, and made Cataloging in Publication a reality. He toiled ceaselessly to move libraries from manual methods to punched cards and then to computers. Most importantly, his enthusiasm was highly infectious.

The many contributions of these two men move us to emphasize the continuing importance of professionalism in the field of library automation. As much as we may respect the feats of technology, we are far more impressed with the individual human ingenuity they demonstrate. The principles and ideas of our late colleagues have influenced virtually everything found between the covers of this book.

ROBERT M. HAYES
Los Angeles, California
February 1974
JOSEPH BECKER

But its aims are the same: to ensure that practicing librarians and that students in library schools approach the world of automation with knowledge of its capabilities and limitations and with the techniques of systems analysis by which to analyze and evaluate alternative answers to the library's processing problems. The changes from the first edition therefore represent not a departure from that purpose but simply an updating of its content, to reflect the advances and experience gained, and an opportunity to correct the errors (hopefully minor) that have been found through use of the first edition.

The updating to reflect experience has been based on analysis of the published reports of operational experience and on interviews with people in various libraries throughout the country, who have been most generous in providing information about their systems.

Reflecting on the progress of library automation over the last several years, we want to pay special tribute to two distinguished librarians, Ralph R. Shaw and Vernon W. Clapp, each of whom made incalculably significant contributions to library mechanization and automation, contributions which continue to exert profound influence on every new development in the field.

Shaw brought the scientific method to library practice. To name but a few of his deeds: he invented a library photocopy machine for ordering and circulation work; he published the first Microtext book; he pioneered in computer analysis of library operations; and he adapted Vannevar Bush's Rapid Selector to photoelectric storage and retrieval of bibliographic references in the Bibliography of Agriculture.

Preface to the First Edition

Data processing has become a subject of vital concern to librarians. Within the past decade, they have begun to realize that advances in technology and improvements in the techniques of information system design are certain to bring about changes in the character of conventional library operations. Scores of libraries are already using computers to reduce clerical burdens and accelerate service to readers. Others, including the Library of Congress, the National Library of Medicine, the National Agricultural Library, and a number of university libraries have started large-scale efforts aimed at establishing national library-based information networks that involve a high degree of mechanization.

Before the digital computer and associated new technology can be put to work constructively in libraries, their power and limitations must be understood by the professional librarian. Data processing clinics and data processing courses, which are beginning to appear in library schools throughout the country, provide excellent opportunities for learning. But they have highlighted a demand for an integrated text appropriate to the needs of both the student and the practicing librarian.

The purpose of this book, therefore, is to assist libraries and librarians in resolving some of the problems faced in utilizing this new technology. The intent is to provide a concrete, factual guide to the principles and methods available for the application of modern data processing to library operations. For the operating librarian, it should be considered a handbook, a tool to guide him in decisions concerning the introduction of data processing techniques into his own library. For the student, it should be a textbook, educating him not only in methodology but also in the interrelationships between data processing and the library. For the system designer, it should be a summary of the state-of-the-art, serving as a bridge between library objectives and the technology. The book, throughout, lays special stress upon the library, and particularly on the significance of library values and policies for determining the choice of system. The book gives emphasis to the computer, but always in the context of applying this technology to the solution of particular operating problems, as a tool of good management and not as an end in itself. At most, therefore, the book aims to educate the profession in the use of

these tools, and in the special problems of applying them to libraries. In this respect, much of the groundwork has already been done—the profession has been educating itself, has carried out analyses of library operations, has experimented with mechanization, and is developing better concepts of cost control. The book merely continues a process which is already underway.

But we would be concerned if this area continues to be a predominant focus of future interest by libraries. Recognition of the professional and social implications of the computer has led university after university to initiate an educational program in information science. These add to library education a responsibility for teaching the newer methods for analyzing and solving operational problems, for instructing in the methods of system analysis, for extending library control to include the newer educational media, for increasing the degree of specialization in library functions, for examining critical social problems in the use of information, and for understanding theoretical foundations. But existing library school curricula are not able, either in content or duration, to accept the added burden which the computer implies. It is clear that a completely new look must be taken. The issues relating to library education are considered to be so critically important that the subject is given special attention in this book.

The book is organized into five major sections, each covering a more or less well-defined segment of the problems in applying automation to libraries. Within a section, each chapter presents a principal topic of interest, and serves as an introduction to an annotated bibliography of primary references and additional recommended reading that follows.

Los Angeles, California

September 1970

R. M. HAYES

J. BECKER

Acknowledgments for the Second Edition

Several people have contributed directly to the preparation of this second edition. It is with deep appreciation that we acknowledge their assistance:

Mr. Lauren Doyle, with the aid of Steve Silver, Marion Rice, and Sherwin A. Kaplan, for his work in updating and correcting the material on the technology.

Mrs. Kathy Block for her work in interviewing people in libraries throughout the country and in revising the descriptions of library clerical applications to reflect their experience.

Mrs. Josephine Pulsifer for her work in establishing the relationship between library operations and machine-readable cataloging.

Mrs. Peggy Cabaniss for her work in analyzing the growing use of machine-readable data bases.

We wish also to acknowledge the assistance of the many people who have helped us to identify and correct errors in the first edition. We hope that others will continue to examine this book as critically and inform us of errors in it as well.

And finally, we continue to be grateful to the Council on Library Resources for providing support from the royalties of the first edition in order to make this second edition possible.

R. M. H.
J. B.

Acknowledgments for the First Edition

First and foremost, we acknowledge the financial and moral support of the Council on Library Resources. Their grant to the Institute of Library Research at UCLA made it possible to involve many more people, both directly and indirectly, in the creation of this *Handbook* than otherwise would have been possible. But it meant even more than that. The support of the Council lent prestige to the Institute and created for it a climate in which far more basic work in developing mechanization in libraries could move forward. The information and results obtained from the great many studies the Institute undertook, at both Los Angeles and Berkeley, gave a firm foundation to the content of the technical chapters of this book.

Second, we especially thank the members of the Advisory Committee, appointed by the Council on Library Resources to overview the development of the *Handbook*. They helped us immeasurably with their reviews and suggestions for improvements in early drafts:

David Weber, Stanford University
Ralph Shoffner, University of California, Berkeley
Ralph Blasingame, Rutgers University
Ted Hines, Columbia University

Third, several people have contributed directly to the preparation of this book. It is with deep appreciation that we acknowledge their assistance:

Mr. Fred Bellomy for his most important technical work, incorporated as the major part of Chapter 5.

Mrs. Ida Riordan, Mrs. Helen Meek, and Mrs. Diana Burkhardt for their technical work incorporated as parts of Chapters 15, 16, and 18.

Mrs. Nancy Brault for her many contributions, but especially for her work on Appendix 2.

Miss Cynthia Stolz, Miss Sue Hattori, and Mr. Stan Weiss for their work in compiling the tables in Chapters 10 to 13.

Sister Marie Ancille Kennedy for her contributions to innumerable chapters.

xiv Acknowledgments for the First Edition

Finally, we are grateful to our secretaries who slaved over the most miserable handwriting and reworked drafts imaginable: Miss Carole Bailey and Mrs. Pat Honley.

R. M. H.
J. B.

First and foremost, we acknowledge the financial and moral support of the Council on Library Resources. Their grant to the Institute of Library Research at UCLA made it possible to involve many more people, both directly and indirectly, in the creation of this Handbook than otherwise would have been possible. But it meant even more than that. The support of the Council lent prestige to the Institute and created for it a climate in which far more basic work in developing mechanization in libraries could move forward. The information and results obtained from the great many studies the Institute undertook, at both Los Angeles and Berkeley, gave a firm foundation to the content of the technical chapters of this book.

Second, we especially thank the members of the Advisory Committee, appointed by the Council on Library Resources to oversee the development of the Handbook. They helped us immeasurably with their reviews and suggestions for improvements in early drafts:

David Weber, Stanford University
Ralph Shofner, University of California, Berkeley
Ralph Blasingame, Rutgers University
Ted Hines, Columbia University

Third, several people have contributed directly to the preparation of this book. It is with deep appreciation that we acknowledge their assistance: Mr. Fred Bellomy for his most important technical work, incorporated as the major part of Chapter 2.

Mrs. Ida Riordan, Mrs. Helen Meek, and Mrs. Diana Burkhardt for their technical work incorporated as parts of Chapters 15, 16, and 18.
Mrs. Nancy Brault for her many contributions, but especially for her work on Appendix 2.

Miss Cynthia Stolz, Miss Sue Hatten, and Mr. Stan Weiss for their work in compiling the tables in Chapters 10 to 13.
Sister Marie Ancille Kennedy for her contributions to innumerable chap-

ters.

Contents

Section One

Introduction to Library Data Processing

Chapter 1	Library Data Processing Systems and Networks	1
Chapter 2	Representative Mechanization Projects in Libraries	3
Chapter 3	Scientific Management of Libraries	28
Chapter 4	Cost Accounting in Libraries	74

Section Two

Management of Library Data Processing		123
Chapter 5	Management Planning	125
Chapter 6	Methods of System Description	145
Chapter 7	System Budgeting and Evaluation	178
Chapter 8	System Implementation	195

Section Three

Data Processing Technology		215
Chapter 9	Machine Language for Data	217
Chapter 10	Processing of Data	237
Chapter 11	Input, Display, and Output	277

Chapter 12	Storage of Data	325
Chapter 13	Communication of Data	367

Section Four

Library Subsystems	381
--------------------	-----

Chapter 14	Administrative Data Processing	383
Chapter 15	Ordering Subsystem	415
Chapter 16	Catalog and Index Production Subsystem	443
Chapter 17	Serials Records Subsystem	502
Chapter 18	Circulation Control Subsystem	529
Chapter 19	Interlibrary Loan	572
Chapter 20	Mechanized Information Services	612
Glossary		645
Index		673

Section One

Introduction to Library Data Processing

Library Data Processing Introduction to

Section One

Chapter One

Library Data Processing Systems and Networks

Data processing technology, including computers and punched cards, has evolved into a multibillion dollar industry and made its impact felt on almost every aspect of our society. Its practical beginning was in the late 1800s when Herman Hollerith of the Bureau of the Census cut a card to the exact dimensions of the American dollar bill, devised a method for representing numbers or letters by holes in the card, and used such cards to analyze statistics collected by the 1890 census.¹

Herman Hollerith's biography in the *Dictionary of American Biography* reveals that the idea was suggested to him by a librarian.² Hollerith thus reports the incident in one of his letters: "One evening at Dr. B's tea table he said to me, 'There ought to be a machine for doing the purely mechanical work of tabulating population and similar statistics.' " The "Dr. B" to whom Hollerith refers was Dr. John Shaw Billings, who was then Librarian of the Army Surgeon General's Library and who became the first Director of the New York Public Library. To this chance remark, Hollerith attributes his inspiration for the development of the punched card. But perhaps the remark was not as "chance" as it appears. The relationship between information technology and libraries in fact has been a long and continuing one. One can visualize (with good reason) conversations between Panizzi and Babbage on the possibility of applying the *analytical engine* to the production of the catalog of the British Museum;³ and Jewett's effort to use *stereotypes* for mechanized publication of catalogs is a part of library history.⁴ The concept of mechanized handling of information was thus, at least subliminally, a part of library tradition.

Over the years since that "chance remark" of Billings, punched cards were gradually applied to diverse areas of business to perform functions associated with accounting. Finally, in 1930 Ralph Parker, then a librarian at the University of Texas, conceived of using punched card equipment for circulation work.⁵ The Director of the University of Texas Library was Donald Coney, and Parker recalls, with good humor, how after many months of persuasion Coney finally gave him a \$300 grant for experimentation—but only after cautioning him to spend the money wisely! Another milestone in the history of library use of punched cards was passed in the following decade when Margery Quigley, Librarian of the Montclair Public Library in New Jersey, acquired special-purpose equipment for controlling book transactions.⁶ This system of circulation control was the first to adopt the method of joining a machine-readable book card and a machine-readable borrower's card as a single master record at borrowing time. This 25-year old pilot punched card installation was the forerunner of the systems used by many libraries today for computerized circulation work.

These more or less experimental activities were of more than local interest, and forward thinking librarians throughout the country discussed in both informal and formal meetings whether these technological developments had utility in the library. Mary Howe, now of the Starved Rock Library System of the State of Illinois, recalls a meeting that she chaired on June 30, 1952. It was held under the auspices of the American Library Association Bibliography Committee and the New York Library Association Mechanical Aids Committee and included some most illustrious names in the development of library uses of technology—Verner Clapp, Ralph Shaw, R. R. Hawken, Ralph Beard, and others. The conversation, as far as the nature of the topics discussed is concerned, could have been recorded today.⁷

From these beginnings, the last 20 years have witnessed a rapidly increasing interest among librarians concerning the possibility of using punched card machines and, more recently, computers to carry out many library functions. The reasons are clear. First, the rate of publishing has climbed steadily, dramatically increasing the number of printed pieces to be acquired, processed, housed, and circulated by libraries. Second, a rapidly expanding and more literate population has generated demands for reader services that have far exceeded a library's ability to respond effectively with traditional methods and techniques. Third, the library as a "labor-intensive" operation, heavily dependent upon manpower, is faced with significant problems in its budget as salaries and wages steadily increase. Fourth, the continuing improvement in the qualitative characteristics and economic efficiency of available technology has finally made mechanized solutions to these problems feasible. Prospects for the future suggest that these factors will become increasingly significant. Hence, profes-