PROCEEDINGS OF THE 1967 CLINIC ON LIBRARY APPLICATIONS OF DATA PROCESSING

Graduate School of Library Science
University of Illinois

UNIVERSITY OF ILLINOIS GRADUATE SCHOOL
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PROCEEDINGS OF THE 1967 CLINIC ON LIBRARY APPLICATIONS OF DATA PROCESSING

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Edited by

DEWEY E. CARROLL

University of Illinois
Graduate School of Library Science
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OTHER VOLUMES IN THIS SERIES

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TABLE OF CONTENTS

FOREWORD

This volume of Proceedings includes the invited papers that were presented and discussed at the fifth annual Clinic on Library Applications of Data Processing which was conducted from April 30 to May 3, 1967, at Urbana by the Division of University Extension and the Graduate School of Library Science of the University of Illinois. As in past years, the Clinic was attended by some ninety registrants (the customary enrollment limit) who received preprints of the papers that are here published formally with only minor revisions.

The purpose of the Clinic has continued substantially the same as in the past—namely, to afford a forum on the intermediate and advanced technical levels for reports and discussions of significant progress and experience in the field. In the principal category of accounts and analyses of actual case experience, papers were presented this year by Charles T. Payne (for the University of Chicago Library), Richard W. Counts (for the Aerospace Research Applications Center of the Indiana University Foundation), Richard E. Chapin (for the Michigan State University Library), Elizabeth B. Hage (for the Prince George's County Memorial Library of Maryland), Ronald A. Zuckerman (for the Los Angeles County Public Library), and Barbara Evans Markuson (for the Library of Congress). In addition, again as is customary, three general papers were also presented—by Don R. Swanson (Education and Library Automation), Sylvian R. Ray (Designing Image Oriented Information Systems), and Eugene B. Jackson (SLA-LTP Survey of Library Automation Activities).

In general, this year's contributions are to be remarked not only for the varied activities which continue to be indicated for different types of libraries, but more importantly for the degree to which systematic investigative efforts are reflected and for the quantity, quality, and predominantly cumulative nature of the practical experience reported.

Because of unforeseen circumstances, the announced paper by Mr. Phil Haines of the Graphic Systems Division, Radio Corporation of America, could not be presented for inclusion in this year's volume. His place at the Clinic was filled by Mr. Thomas Van Dillen, also of RCA's Graphic Systems Division, who spoke informally on the development of the RCA Videocomp system and related problems of computerized composition and electronic character generation. Also omitted from this volume are the informal discussions of the Clinic's problem session and the enumerative bibliography on case applications which has been compiled in years past by Mr. James Krikelas.

It is a pleasure to acknowledge the cooperative work of other members of the planning committee and library staff who contributed directly to the success of the 1967 Clinic: Professor Herbert Goldhor and Professor Frances B. Jenkins of the faculty of the Graduate School of Library Science, Mr. Timothy W. Sineath who serves as liaison representative with the Division of University Extension, and Mr. Robert D. Kozlow, Automation Librarian, University of Illinois Library.

Dewey E. Carroll
Clinic Chairman and Editor

Urbana, Illinois
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EDUCATION AND LIBRARY AUTOMATION

Don R. Swanson

I shall try to develop in this paper a rationale for library education that will, I hope, have a direct bearing on certain major issues that have been of concern to the profession for perhaps half a century. These issues are reflected in questions such as:

How much of the work performed by librarians really requires professional education; are professional librarians used effectively?
Is it practical to expect library education to deal in depth with subject specialities?
If subject depth is acquired at the undergraduate level, let us say in chemistry, can the library profession hope to attract the better students, or is it more likely to attract those who have been unsuccessful in coping with their initially chosen specialty? That is, do not those who do well in chemistry usually become chemists?
What undergraduate specialty does indeed constitute the best preparation for graduate study in librarianship?
Is there a science underlying "library science"?
What does all this have to do with automation and data processing?

A great deal, we may say, in answer to the last, though perhaps somewhat indirectly. Mechanized data processing can be used to improve the efficiency of certain library procedures; and so can other forms of mechanization, including electric typewriters and pencil sharpeners. Whenever, wherever, and however opportunities present themselves to create any set of products or services at lower cost, this should be done—and possibly without making any great fuss about it so far as library education is concerned. Let the fuss begin when it is discovered that the end result has been to do more efficiently that which should never have been done in the first place, and that those whom one would hope to serve are ignoring libraries just as

Don R. Swanson is Dean, Graduate Library School, University of Chicago.

much as ever. This train of thought suggests two reasons why automation might be expected to have an important impact on librarianship:

(1) Questions on purposes and goals are raised that no one before thought of asking.

(2) An opportunity is presented to invent the library of the future as though nothing existed today.

It is this notion of inventing, or planning, future libraries in the light of a critical re-examination of their purposes that may be regarded as having far-reaching implications for library education.

At this point, with some justification, one might begin to suspect a swindle, for the foregoing ideas need not owe either their genesis or their importance to automation. This slight deception admitted, however, the fact remains that the threat of technological progress adds an element of urgency to the need for long-range planning. Furthermore, experience suggests that libraries have come to their present state of affairs through some combination of benign and malevolent accidents of evolution, rather than through long-range planning.

Some Assumptions about Future Libraries

Let us briefly consider some of the possible major changes that planning rather than accidents might bring about. The moving force behind such changes must lie in the inadequacies of present libraries, and so on this basis we prognosticate. To say that what should happen will happen is a dubious proposition at best, but at least with a goal in mind, things are more likely to muddle in the right general direction.

Today's collections, even the biggest, are inadequate for their own users, and so we must eventually take our goal to be the accessibility of all recorded information to all users, just as though all the libraries, and all the indexing and abstracting services of the world, were to function as a single system.

With this revelation, we could say simply that all else follows. However, there is some obligation to explain. To begin with, the case has been overstated. Certainly everything cannot be made available to everyone, and we shall have to settle for some kind of optimal relationship between widespread accessibility to most materials and the cost of providing it. Thus a notion of "optimal allocation of resources" is relevant. The implication is strong that even at very broad levels we might find useful a structured or formal, i.e., a mathematical, approach to problems.

Now, if users of library materials are in general scattered all over the earth, then it follows that we must either make copies of all recorded knowledge available everywhere, or we must provide adequate communication lines so that desired information can be rapidly transmitted to those who have need of it. For example, suppose a few decades from now we were to decide that some 20,000,000 or so books and journals in the Library of Congress constitute the bulk of what a good university library should have. It is not unthinkable that future technology will permit us to create a photographically reduced image of the entire collection (at some enormous cost) and then run off contact prints by the thousands, box up a complete copy of the library into something the size of a large packing crate, and ship one off to every college library in the world at a cost of perhaps only a few hundred thousand dollars per library. (I shall not try to justify my cavalier disregard of copyright law at this point, and of course I am indulging in unrepressed speculation in the matter of cost, but there is a point to it all.) The major alternative to the packing and distributing of libraries is to make a single master library electronically accessible from remote points all over the world. One would then depend primarily on a vast communication network instead of techniques of microreduction as the primary technology for implementation of the future system. It is reasonably clear that the whole matter will really not reflect so simple a dichotomy, but rather, that we shall inevitably end with a mixture of technologies, hopefully glued together by a comprehensive systems plan. It should be clear that whoever is the architect of such a plan must understand fully the implications, with respect to both cost and capability, of microform technology and communications technology, involving, of course, all forms of terminal equipment, concepts of band width and channel capacity, noise, reliability, information capacity of graphic recording versus digital, and so on.

Physical or electronic access to library materials is just one part of the problem, for we have yet to mention the question of intellectual access. Catalogs and indexes in the aggregate must be universal and comprehensive. That is, these tools must guide one to the location of any item of material in the universe of recorded knowledge. The concept seems easily enough stated, but its implications are staggering. We are speaking really of a greatly expanded National Union Catalog combined with some several thousand indexing services. This conglomerate is subject to the same technological dichotomy as are the primary library materials, namely a choice between remote electronic access and wide distribution of printed products. The forerunners of these two techniques are quite visible in today's system. Chemical Abstracts is published and distributed, while the National Union Catalog reposes in a single place which, in a manner of speaking, is electronically accessible to anyone willing to place a telephone call to the Library of Congress.

As users of future systems, we might hope to avoid having to decide which of several thousand sources to consult in order to find the answer to a question, or to find a book. Presumably from a single point of interrogation we should be guided either to Chemical Abstracts, to the National Union Catalog, or to a small catalog of special materials one of which, with further dialogue, would yield the answer. At no point in this fantasy do we suppose that we must arbitrarily forego the clear advantages of small special-purpose collections and small special-purpose indexes and catalogs. The question of frequency of access as a function of the quantity of materials searched is at the core of what mathematicians have begun to call problems of file organization.

The form of storage is also important, economically, and is related to the problems of organization. As has already been suggested, or at least implied, looking something up in a printed index should be regarded as a possible competitor of interrogating machine-stored information. The difference becomes one of economics alone for those types of interrogation in which the capabilities of the two systems are equivalent.

What This Implies for Education

Now let us turn our attention to the question of just who is going to do this systems planning job. Certainly all that has been said so far suggests that it must be done by engineers, physicists, or mathematicians, but this suggestion is misleading. It seems likely that only those who have rummaged around enough in present indexes, catalogs, and other bibliographic tools are likely to have gained a real appreciation of the complex array of problems that will confront the designer of future systems, but this rummaging must be done with a keen sensitivity to alternatives. Most mathematicians who have such sensitivity are not in contact with library problems, and most librarians are not sufficiently sensitized to alternatives by an understanding either of technology or of the mathematics of file storage and organization. Who then shall plan the libraries of the future? This is the dilemma; the question for librarianship is whether to abdicate or respond.

It would seem that graduate library education can only in part respond to this dilemma. It is not possible to teach all we now teach about librarianship, and then add to it enough about computer programming and computer technology, microform technology, and applied mathematics in order to turn out those who one day will lead the profession into its dazzling future. The inference to be drawn from all of this is that we must begin library education with a very basic undergraduate program, but a program which is altogether unlike what is now regarded as librarianship. Undergraduate education must be broad enough and have sufficient intellectual content first to attract the student and also to give him a later freedom of choice, for it cannot be supposed that his career decisions will be made and stabilized during the college years. That is, he needs the skills that are readily "transferable" to many professions. Can these seemingly contradictory demands be reconciled? I think they can, and to support this position I shall suggest some guidelines for an undergraduate program in "pre-librarianship." It is to be hoped, too, that this will turn out to be "pre-" other things as well, and if it does, this should be taken as a reflection of strength rather than weakness.

First, these guidelines should be treated rather loosely, for librarianship, like other professions, needs diversity. Yet such diversity should not be wholly without bounds, and adequate reasons exist to believe that there is a core of fundamental knowledge worth having for librarianship, and for other purposes.

"Intellectual Conditioning"

The planning of future systems would seem to demand a certain kind of intellectual conditioning, the ability to take a problem-oriented approach to a complex situation—i.e., the ability to discover the right problems. It is probably through problem solving that one learns the art of problem discovery, and so it would seem reasonable to include, in any undergraduate curriculum, courses that can be problem-oriented. In this sense, of course, computer science, mathematics, and the physical sciences offer unlimited opportunities. The alternative to problem solving too often is subject matter which places a high premium on the assimilation of facts. One cannot dismiss factual knowledge as unnecessary for the planning of future systems, but it does seem that higher values should be placed on the ability effectively to confront and deal with new situations.

Mathematics. If we begin with the premise that mathematics is not so much a specialty as it is an extension of our powers of communication, it is possible that serious thinking along this line would lead to the development of a good mathematics component for all specialties. It would seem that the humanist and the social scientist must have a certain minimal acquaintance with algebra and in particular with the concept of variables, systems of equations and inequalities, and graphic representation. In particular, they must have the ability to transform a physically meaningful situation into its mathematical representation. The latter point suggests that a certain amount of physics could serve similar ends.

Logic. An introduction to formal logic, and the language of mathematics associated therewith, would serve two ends. First of all, it would develop intellectual discipline, and provide a supremely structured approach to thinking about the world in terms of abstractions. Secondly, it would provide a basis for describing the principles and design of digital computers, and of operations associated with information retrieval. Both the power and the limitations of Boolean algebra, for example, can and should be understood in order to evaluate and appreciate a considerable body of literature on that subject alone.

Statistics. Statistics is in essence the science of dealing with uncertainty in data, and is indispensable to the critical interpretation of most research results. Failure to understand its laws invites the deepest of misconceptions and has led, in library science as elsewhere, to countless dubious conclusions based on ill-conceived experiments. It would seem that some appreciation of statistics should be acquired by any truly educated person, but how much is enough is not easy to decide; a veneer from a course or two probably does not suffice.

Behavioral Science, Social Science, and the Humanities. Since it is, after all, the interaction of a library with its users that is crucial, a good case can be made for the very great importance of the study of human behavior and human institutions as a part of the foundation of library science. Important contributions to studies of the use and users of information have been made by psychologists and social scientists, among others. Theories of indexing and classification have been worked on by mathematicians, scientists, and humanists; their intellectual roots are diverse, but in principle, at least, mathematics, linguistics, and psychology must be among such roots. This area is broad, and it is difficult to generalize excessively as to its applicability to library science; perhaps it is essentially a matter of judging the value of individual courses.

Computer Science and Information Science. The principles of computer organization, design, and programming clearly deserve to be regarded as much more than just a specialty, for they can be taught from a sufficiently fundamental viewpoint to justify their presence in any undergraduate curriculum. Like the study of logic itself, the programming of a computer demands an uncompromisingly rational approach to the formulation and solving of problems, and can be said to represent almost a way of thinking. No other single academic area comes as close to the essential nature of systems planning and analysis at all levels. More specifically, problems of file organization, maintenance, and access can best be approached from a knowledge of computer applications and associated considerations of random and serial access, and memory organization.

The foregoing guidelines to "pre-librarianship" are, admittedly, ambitious, perhaps even excessive, in scope. At least, though, they strongly imply that certain alternatives and commonly held views lack equally strong justification. For example, to suppose that the specific undergraduate curriculum does not much matter seems indefensible. But more than that, I think it is wrong to argue that if one wants to become, for example, a biology librarian, one should major in biology. Biology obviously has its own attractions, and those who find the study of it rewarding should probably not change to librarianship, nor should they decide too early in their careers to specialize so narrowly. Furthermore, such an approach, though it might well work in individual cases, seems to suggest that librarianship has no intellectual substance of its own that would justify planning a library career in the first few years of college. The major thesis here has been that it does have substance and that it does have foundations. This seems especially clear if one accepts the premise that the "planning of future libraries," in contrast to "working in todays' libraries," is an acceptable aim of graduate education in librarianship. It is from the fact that it forces one's attention to the planning function that automation may ultimately have its greatest influence on library education.

PROSPECTS AND PROBLEMS IN DESIGNING IMAGE ORIENTED INFORMATION SYSTEMS†

S. R. Ray

Introduction

There are slowly maturing and growing about us today a number of techniques which are likely to have a very significant effect upon the implementation of information systems in the near future. One of these techniques is pictorial data handling and interpretation, which is a subclass of the general area called pattern recognition. Pictorial data processing first became volumetrically significant in the case of photographic output of synchrotron bubble chambers which now deliver several million photographs per year.[2] More recently, a surge of interest has developed in automatic interpretation of biological, medical, and weather satellite pictorial data. The automatic scanning of microscopic slides for the purpose of identifying certain morphological characters is an example of a rather complex task in the area of biological/medical laboratory automation.

Some new viewpoints have begun to emerge from the experience of grappling with large volume pictorial data handling problems.

First, consideration of these problems has led to innovations in computer organization. Let me expand briefly upon this point. The usual organization of a digital computer is strongly oriented toward arithmetic calculation; hence, a reasonable unit of information is some 6 to 12 decimal digits and this unit (some 20 to 40 bits), a word, is all that can be processed in a single operation. On the other hand, a unit of pictorial information may consist of a million or so bits

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S. R Ray is Associate Professor of Electrical Engineering, Department of Computer Science, University of Illinois, Urbana.

which makes profitable a very large information unit. Furthermore, the arithmetic word contains only one-dimensional positional information (the position weights of digits) whereas the pictorial word contains two-dimensional information (relative geographic position). Thus, pictorial data processing has led to the design of two-dimensional word processors which have data rates much higher than previous computers because of the large words processed in a single operation (e.g., words of 1024 bits).

Second, attacks on the problem of processing pictorial data originating from remote laboratories have focused increased attention on the video transmission and remote terminal facilities required to transmit high-quality, high-data-rate pictures. A concomitant requirement is that of permanent recording of pictorial data and its temporary display, storage, and copying at remote locations.

How can the foregoing developments be profitably applied to the problem of mechanized information retrieval? The remainder of this paper addresses the application of these concepts and techniques to an experimental ISRD (Information Storage, Retrieval, and Dissemination) system wherein economic balance among the storage, indexing and dissemination functions is attempted.

General Description of the System

Before proceeding to the important question of the basic premises of the proposed ISRD system, it is desirable to enumerate the major hardware components and sketch the operation of the system.

Beginning with the hardware system* in Figure 1, the centrally located equipment is clustered conceptually about the central processor. This device can be regarded as a digital computer with special capability for handling non-numerical data and, especially, for switching pictorial images.

A second centrally located device is the parallel processor, a unique device for analyzing and dissecting two-dimensional picture data rapidly. In the present context, the parallel processor is used for character recognition and page format analysis as described in detail subsequently.

The third hardware object is a microimage store which is simply a high-volume, fast-access store of data in image form (as opposed

*The hardware system described here is essentially the ILLIAC III. All major equipment was either in construction, on order from commercial sources, or in the design stage at the Department of Computer Science, University of Illinois, Urbana, in early 1967.

to bit-coded or Hollerith data form). For present purposes, the image store contains the entire document file.

The fourth hardware object is the bit store which is a high capacity, semirandom access magnetic disc or card store. This store contains index information relating to the document data in the microimage store.

The fifth major unit of equipment is a group of consoles with visual display, typewriter, light pen and assorted controls for manipulating data and performing command/control functions for the remaining equipment.

The final group of equipment in the central area consists of program-controlled flying-spot scanners capable of digitizing various sizes of optical film. In particular, one scanner accepts microfiche cards.

Remotely located stations communicate to the central equipment via a video network. A remote station itself contains a display facility as well as a recording mechanism capable of making hard-copy records of the displayed information.

Let us turn next to an outline of the operational system. In its infancy, the system will be operated in a man-controlled, machine-assisted mode which evolves toward greater automaticity as programming matures.

The storage operation begins with printed hard-copy material which is reduced first to primary microfiche, either locally or at some service facility. A small fraction of the primary microfiche images are reformatted onto secondary microfiche, after which all images are reduced to high-density microimage cards for the image store.

After insertion of the daily acquisitions in image store, rudimentary indexing operations are performed. In the immature system, indexing will be strongly controlled by an operator through the local control/display console. The operator will flip through pages in the image store, point with his light pen to (say) title and author data, which are then character-recognized (in the parallel processor) and, eventually, inserted in the index.

As the system matures, an increasing fraction of the indexing-object location task will be relegated to programmed procedures. More thorough indexing may also be performed on an increasingly automatic schedule, relying upon the full text image which remains available.

Finally, retrieval and dissemination proceed from the remote stations where a general user may query the index, obtain summary roadmap diagrams, browse through full text pages, etc. Permanent individual copy may be made locally in the form of microfiche employing the polaroid process.

Premises and Objectives

The fundamental premise of the ISRD system under discussion is that rapid accessibility and dissemination of information are essential features, as well as increasingly vital factors in total information service. The concept of direct user interaction, expounded in the INTREX report[3] and by Licklider,[4] for example, explicitly require on-line accessibility and rapid dissemination as a basic ingredient. In the present instance, we are not so greatly concerned with direct intercommunication between active users as with rapid accessibility and dissemination of data from a central location to users.

"Rapid dissemination and accessibility," as construed here, mean that, ideally, all documents of interest to any user shall be available in electronically accessible and transmittable form. More concisely, the objective is to design a system which, under realistic economic constraints and using present technology, approaches satisfaction of the "all document" accessibility-dissemination criterion.

The first crucial economic problem encountered is the cost of introduction of, perhaps, two to five million pages of original data per year. We propose to enter data into the system in image format only and the arguments for this approach follow:

> The cost of data introduction, per se, in image format is certainly the most economical technique presently feasible, besides being the fastest, especially in view of the fact that the data of interest is usually already in image format.
>
> Furthermore, the cost of a large-volume image store (e.g., 50 to 100 million pages) is less than that of a volumetrically comparable bit store.

Moreover, even a cursory examination of the operational requirements of an information system reveals that there is only one region in the system where information must be in Hollerith (i.e., bit) format. That region is the index and the reason for Hollerith format there is the practical efficiency of searching highly compact bit data as compared to loosely packed, relatively ambiguous image data.

The objective is to derive Hollerith data for the index from the stored image data only when it is needed. Thus, all documents entering the system are indexed crudely, for example, using title word descriptors and author names. As the demonstrable worth of a document grows, it is subjected to deeper indexing requiring conversion of more extensive portions to Hollerith format. In any case, only a relatively tiny fraction of all introduced text need ever be converted to Hollerith data. We estimate, for example, that if every document entering the system is indexed by only 100 characters and 2 percent of the documents are indexed on the basis of 10,000 characters, then only 12 days per year or 3 percent of the recognition system's operation time will be consumed in character recognition (at 1000 characters per second) for a five million pages per year entry rate.

Another major objective of the system is an evolutionary development toward highly automatic indexing capability with concomitant improvement in operational economy. The special problem of the image system is automatic geographical location of text objects for use in the index. An example of automatic location, that of finding figure captions, is given in a subsequent section.

At the present time, relatively little definitive work has been directed toward automatic location of objects in text, per se, although a substantial effort has been applied to related areas[5,6] for the problem is common to all pictorial data analysis. By extrapolation from picture processing experience, it is certain that repetitive, frequently recurring cases of text objects can be automatically located economically, i.e., considering both programming and operating costs. It is equally certain that error-free automatic handling is unachievable because of obscure and bewildering cases which must be treated in the manual back-up mode, i.e., by a console operator. Nevertheless, even very minimal constraints on printing formats would go far toward improving location accuracy and efficiency. Automatic location is performed largely in the parallel processor which, as suggested above, is quite incompletely occupied by character recognition. The same unit is also used for format analysis which is explained further on. Finally, it should be noted that as the level of automatic operation improves and with extensive full text data available, large-scale experiments in automatic indexing algorithms and techniques become more feasible.

The Parallel Processor (Pattern Articulation Unit)

The basic mission of the parallel processor is the rapid dissection and separation—the "articulation"—of image data into recognizable parts. It may be conceived, alternatively, as a programmable property filter which facilitates identification of morphological characteristics in two-dimensional data.

Physically, the PAU consists of a set of planar arrays of memory elements interconnected by extremely flexible, program-controlled logic circuitry. Each plane contains 1156 (= 34 × 34) bits of information which bear a one-to-one relation to the "geographical" coordinates of a picture plane (see Figure 2). However, the magnification factor between the original picture plane and the PAU plane is arbitrary—the area of a PAU plane may correspond, for example, to an entire document page at one extreme, to less than one square millimeter at the other extreme magnification.

Let us address a specific problem, a simple format analysis, to illustrate the application of the PAU. Suppose we wish to identify the geographical area occupied by a simple graphic sketch on a document page (see Figure 3a). Assume that any suitable sketch has less black (ink), on the average, per unit area than normal text.

The analysis which is simplified, to be sure, proceeds as follows:

(1) Insert a document page into the PAU with grayness value corresponding to the average grayness in the area which a memory cell represents.

(2) Mark with "X" all points having average or darker grayness. The marks appear in a separate plane as shown in Figure 3b, and cover (in general) all text areas. This operation is performed in parallel over the entire plane.

(3) Mark with "W" all areas which are not marked X, and which also extend from one edge directly (horizontally or vertically) to the opposite edge.

The operation marks W in all border zones and the vertical center strip (see Figure 3c).

The only remaining unmarked areas are relatively white, non-border areas, which correspond presumably to the desired sketch(es). If so, it is quite simple to

(4) Mark the corner points of the sketch region and read out the coordinates to the general purpose computer. The coordinates of the sketch boundary provide all the requisite information to (a) electronically snip out the sketch and reproduce it elsewhere, or perhaps (b) to introduce into thePAU the area immediately beneath the figure where its caption is probably located. The caption may be used for indexing.

The format analysis procedure indicated above could be accomplished in some 50 to 100 microseconds (exclusive of picture input time) with the present PAU design[7,8] which is by no means optimized for speed.

The other application of the PAU pertinent to the present discussion is that of character recognition. In this case, one character in black/white code is placed in a PAU plane where its morphological properties may be extracted and the object classified. The problems here center mostly on economics, the cost per character, especially over a great dispersion of type fonts, rather than on technical capability.

The Image Store

The critical attributes of an image store are large capacity and very low cost per stored information unit. Furthermore, the access time to any specified image must be as small as possible but certainly not in excess of about five seconds. Access time is inversely related to the maximum permissible number of simultaneous users, which, in turn, affects system economics. In any case, long optical tapes, i.e., serial stores, are hopelessly slow.

A semirandom access image store which satisfies the system design criteria is discussed next.

The basic storage unit is a film card consisting of a 300 mm. strip of 105 mm. sprocketed film. Stored microimages cover an area of about 85 × 250 mm. on the card with each image allotted a 1.5 mm. diameter field. Each image has about 1mm. maximum side length. Each card has a unique address corresponding to the shape of 12 slots along the upper card edge (see Figure 4). In the storage unit, the cards are suspended from semicircular selection rods which pass through the address coding holes of 4096 cards as shown in Figure 5.* The selection rods are analogous to the needle of the familiar needle-sort card addressing technique. Selection of one card is accomplished by simultaneous rotation of each of the 12 rods by 90°, either clockwise or counter-clockwise, which releases exactly one card. The released card falls due to gravity plus the frictional force of downward airflow which also serves to separate the cards. After falling a few centimeters, the selected card is engaged by a linear conveyor which whisks it into the reading station. The card's vertical position is monitored as it enters the read station at a speed of some six meters per second. As the addressed image row approaches the readout station, the card is stopped by a precision vernier "spear" mechanism which aligns the desired image row within ± 25 microns (approximately) of the readout station. The desired image is then illuminated through a fiber-optic pathway which projects the image through a fly's-eye magnification lens onto the face of a vidicon camera tube, where the image is converted to a high resolution television-picture signal.

Card replacement on the selection rods is accomplished by sprocket-driving the card upward from the read station into the replacement mechanism which then pushes the card onto the selection rods and returns to quiescent position. A storage capacity of 38 million images in one storage unit is well within present technical

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*The selection mechanism is similar to that of National Cash Register Company's CRAM (Card Random Access Memory).[9]

feasibility of 1.5 mm. field diameter per image. Capacities up to 80 million images are practically possible.

The cycle time (access + replacement time) for this memory is estimated at 1 to 1.6 seconds for nearest and farthest card, respectively, from the readout station. Access from one image to another in the same row of the same card ("page-turning") is much faster, viz., about 120 milliseconds which is largely determined by the time required for the television camera to sweep a new image.

One Problem—Image Degradation

The manipulation of microimage cards in the image store raises the question of image degradation due to scratch, dust, etc. The meager experience available indicates that obscuration or deletion of small characters (e.g., period, comma) is frequently observed. One solution to this problem is the use of holograms rather than direct images. Every point of the direct image is then dispersed over the microimage area so that a defect only reduces the overall quality of the reconstructed image rather than obscuring any particular point. Holography entails some capricious problems in its own right, particularly with respect to mechanical alignment. For the immediate future, the system will employ a model direct image store while investigation of holographics matures.

The Dissemination Network and a Second Problem—Image Resolution

The design of the dissemination network has far-reaching critical ramifications, potentially, for the overall system design and economics. Inclusion of a wide-band network for dissemination of original image data has been considered only rarely—thus, the specific problems associated therewith have not been frequently discussed.

Image dissemination begins at the image store where a televised replica of a retrieved image is formed and transmitted over the network to a system user. It is assumed that each stored image is transmittable as one picture frame. The channel capacity or channel bandwidth affects the time required to transmit one picture frame with a specified resolution. The constraints are such that not every original document page can be transmitted as a single frame, from which it follows that one original document page may not, in general, be represented as one image in the image store.

Therefore, the questions which arise are (1) "How shall the network parameters be chosen to accommodate document images?" and

(2) "If some document images must be reorganized to 'fit' the network, how shall this be accomplished?"

Several pieces of data are required to answer the first question. Experiments to determine the speed and accuracy of televised character recognition by human subjects have been summarized by Shurtleff.[10] He finds that 98-99 percent correct symbol identification is attained for a vertical resolution of 8-12 lines per symbol height when the character visual size (to the observer) is 12 to 15 minutes of arc, and the horizontal resolution is relatively high. Figure 6 is a picture of text displayed at nine lines vertical resolution* for the tall characters "d," "p," "h," etc., and six lines for the short characters such as "s." In case the figure, as printed here, does not convey the original psychological impression, let me say that subjectively, the original display appears fully acceptable. We propose to allot 15 percent greater resolution than that shown by Figure 6, which results in approximately 10.5 vertical lines for tall lower case letters or 15 lines vertically† for a gross character line, i.e., including one-half the upper and lower line spacing.

The second necessary piece of data is the total resolution required adequately to reproduce text pages. Four cases exhibiting a range of difficulty are shown in Table 1.

On the basis of this data combined with technical state-of-the-art capability, we have chosen a dissemination network with 1536 lines vertical resolution, 1250 lines horizontal resolution transmitted at a bandwidth of 12 megahertz which allows one frame per 80 milliseconds. Crudely, pages of about the complication of a Time magazine page could be reproduced readably, whereas a page of Webster's Collegiate Dictionary at 13 lines per inch would not be reproducible as a single page. Very large original pages, pages with very small type or high resolution photographs would, in general, require segmentation or "reformatting." Before pursuing that problem, however, a few more remarks regarding the dissemination network are relevant.

The network described above is intended for relatively short distance transmission (e.g., up to two miles) where coaxial cable can be economically laid. If wireless transmission is used, it may be economically essential to operate at the standard§ commercial television (video) bandwidth of 4.2 megahertz, corresponding to one picture frame per 0.25 second with the same resolution as before. In any case, the network is not suitable for moving picture transmission without providing for switchable scanning speed at the camera and monitor. Compatibility with a national or international information interchange network is still an open question.

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*Horizontal resolution was calculated at five lines for the width of the letter "s."

†All values are in scan lines and do not include a Kell factor.

§U. S. National Television Standards Committee.

TABLE 1
TELEVISION SYSTEM RESOLUTION REQUIRED FOR DIRECT REPRODUCTION OF EXAMPLE DOCUMENT PAGES

Document (Nominal Page)	Character Line/Inch	TV Linear Resolution/Inch at 15 TV Lines/Character Line†	Total Page Dimension (Inches)		Total TV Linear Resolution Required for Reproduction*		Reproducibility as a Single Frame
			Width	Height	Horizontal	Vertical	
Libraries of the Future-Licklider	5.5	82.5	5	8	410	660	Easy
1401 Programming McCracken	6	96	7.75	11	750	1060	Satisfactory
Time Magazine	7.5	115	8	11	920	1265	Satisfactory
Webster's Collegiate Dictionary 5th Edition	13	195	5.8	8.6	1100	1700	Impossible

*Assuming the aspect ratio (width/height) of picture is identical to the page.
†A resolution adequate for manual or mechanical recognition operations.

Before leaving the topic of television reproduction, we should also note Figure 7 which is a magnified reproduction of Figure 6 showing the approximate quality of characters which would be supplied for recognition processing.

Reformatting

Returning to the question of reformatting, we propose that any required reorganization of a page be performed prior to insertion in image store. Also, the reformatting would be controlled manually in the system's early phases with provisions for evolution toward fully automatic operation. All incoming documents would be accepted as COSATI-standard microfiche. Reformatting is performed, where necessary, and the reorganized images placed on second-level microfiche, after which batches of microfiche cards are reduced onto micro-image cards for the image store.

The reformatting operation in the mature stage is envisioned as follows. Original microfiche is fed through a scanner where each image, sequentially, is coarsely digitized under program control. The resulting numerical representation of the image is transferred to the parallel processor where format analysis proceeds along the lines described earlier. Average or maximum character heights may be determined by electronically "smearing" the image horizontally, which results in gray regions for print lines and white (or whiter) areas between lines. By counting the number of gray smears per inch in all regions of the image, the regions can be characterized according to their suitability for reproduction by the dissemination network.

The geographic data resulting from format analysis is applied to an optical microfiche camera and program-controlled iris which is capable of passing any desired rectangular area of the original microfiche onto secondary microfiche. The microfiche camera, therefore, records selected areas of the original microfiche at controlled magnification so that the secondary microfiche images are each transmittable through the dissemination network. Developed secondary microfiche cards are then transferred by a separate operation onto image store cards (see Figure 8). For all but the most pathological cases, one text page image need not be dissected into more than two images, which is a modest requirement. The reformatting operations are actually less difficult and certainly less time consuming per page, than character recognition. However, success in attaining a high level of automaticity depends upon the general purpose capability of the parallel processor and not simply upon a special purpose optical character reader.

The Remote Station

Cost is the principal ingredient in the design of any remote station. In the present context, the remote stations are optically passive—they originate no image data. Active communication from a remote station to the central facility is accomodated by a small keyset.

Visual data is displayed on a storage-type picture tube which will hold satisfactory resolution for one or two minutes. Hard-copy output will originate from a normal picture tube (non-storage type) slaved to the main display tube.

In order to copy a displayed page, the user will move a pointer to a spot on a surrogate microfiche card. This action moves the film holder of an adapted polaroid camera to a position where a standard microfiche image may be recorded. Then, upon activation of a "COPY" key, the image store address of the presently displayed page is reaccessed and scanned several times to reduce noise. Immediately thereafter, the shutter of the polaroid camera viewing the slaved picture tube is tripped. The microfiche card is then developed by polaroid† process, of course. It should also be noted that image positioning is at the user's discretion.

There are two modest problems concerning the hard-copy system as it is presently designed: (1) there is no microfiche card titling mechanism (other than purely manual), and (2) the resultant card size will not be COSATI-standard* because of limitations on readily available film sizes.

Conclusion

A general observation which our work suggests is that a high-speed dissemination system should not be regarded as a mere appendage to an information storage and retrieval system. The ramifications of the dissemination system characteristics reverberate throughout the system, particularly affecting the storage operation and the number of simultaneous users. These observations hold to some extent in any system employing block-organized data for dissemination.

The image-data oriented system is economically sensitive to dissemination system characteristics. If frame resolution is chosen very large, the transmission frame rate is reduced, adversely affecting the permissible number of simultaneous users. If frame resolution

†Using Polaroid 55 P/N film of 150 lines/mm. resolution.
*60 images per card rather than 72.

is low, the cost of reformatting images may be raised to an uneconomical level. In the present system, it is expected that less than 10 percent of the introduced data will require reformatting.

A means of format analysis, geometric object location and character recognition is essential for fully mechanized operation of an image-data oriented ISRD system. These data processing requirements can be satisfied by a programmable parallel processor (here, the Pattern Articulation Unit) using processing algorithms which are well-known in general but require specialization to text characteristics.

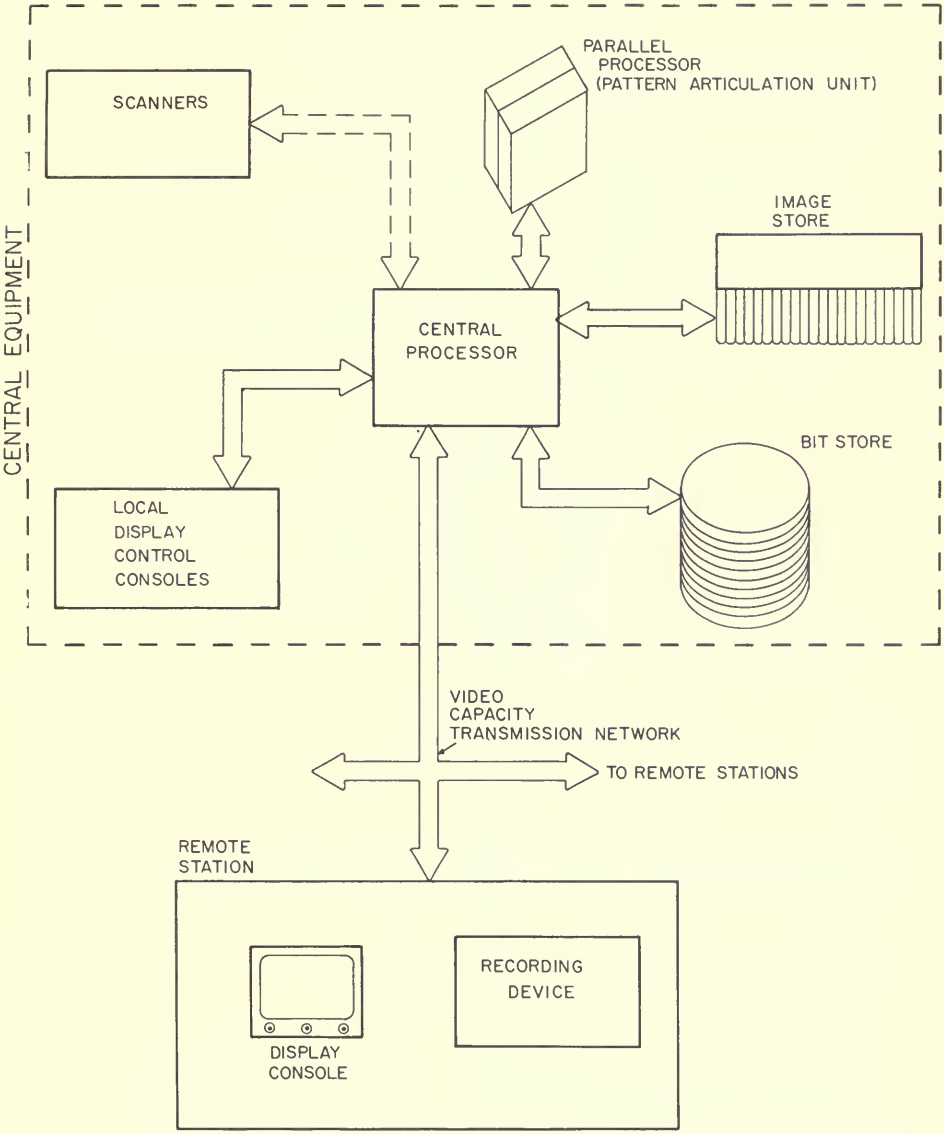


Figure 1
System configuration.

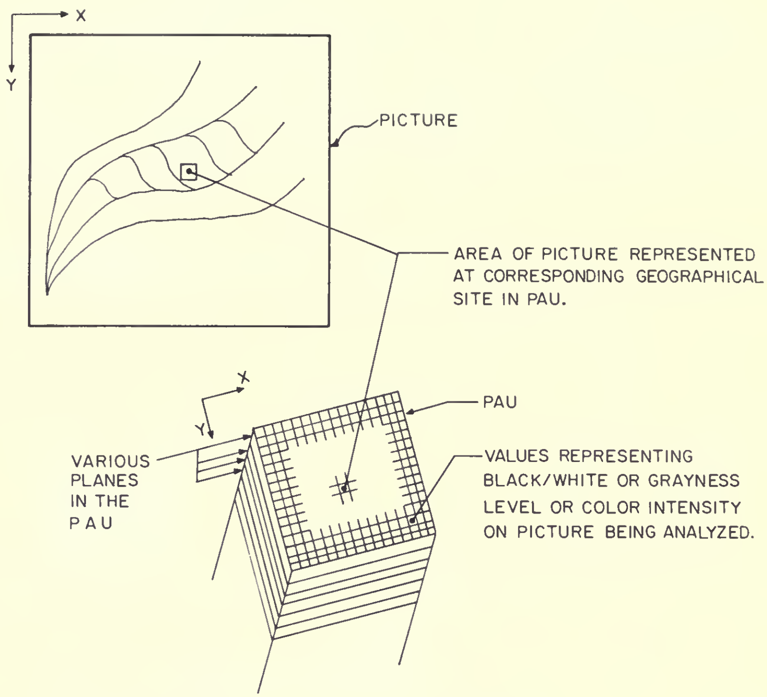
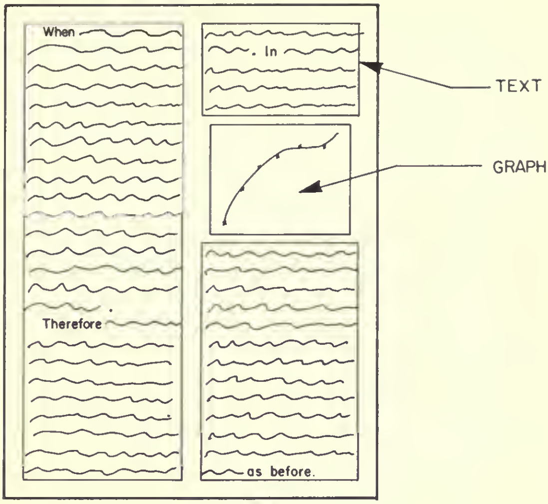


Figure 2
Parallel processor. Illustration of mapping a picture into PAU representation.



EXAMPLE OF A DOCUMENT PAGE CONTAINING A SIMPLE GRAPH SKETCH

FIG. 3a

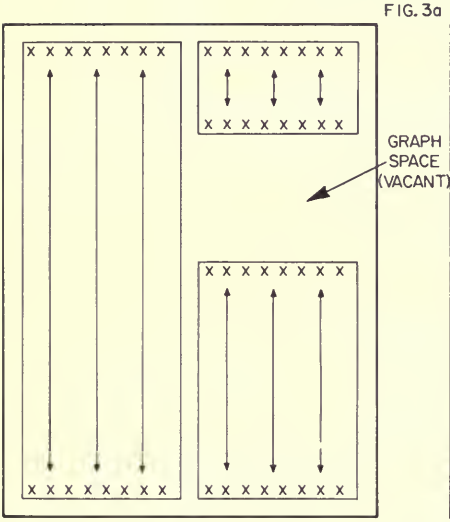


FIG. 3b

TEXT MARKED X

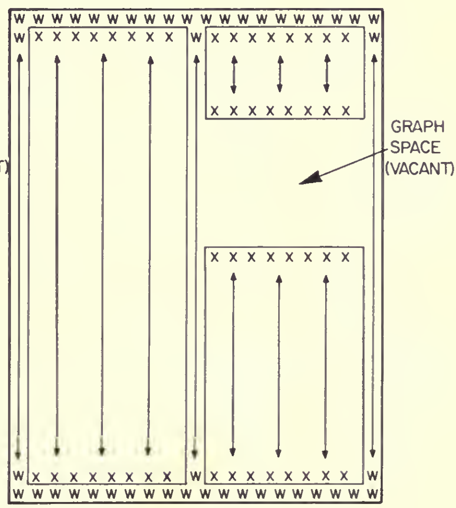


FIG. 3c

TEXT MARKED X

BORDER MARKED W

Figure 3

Format analysis

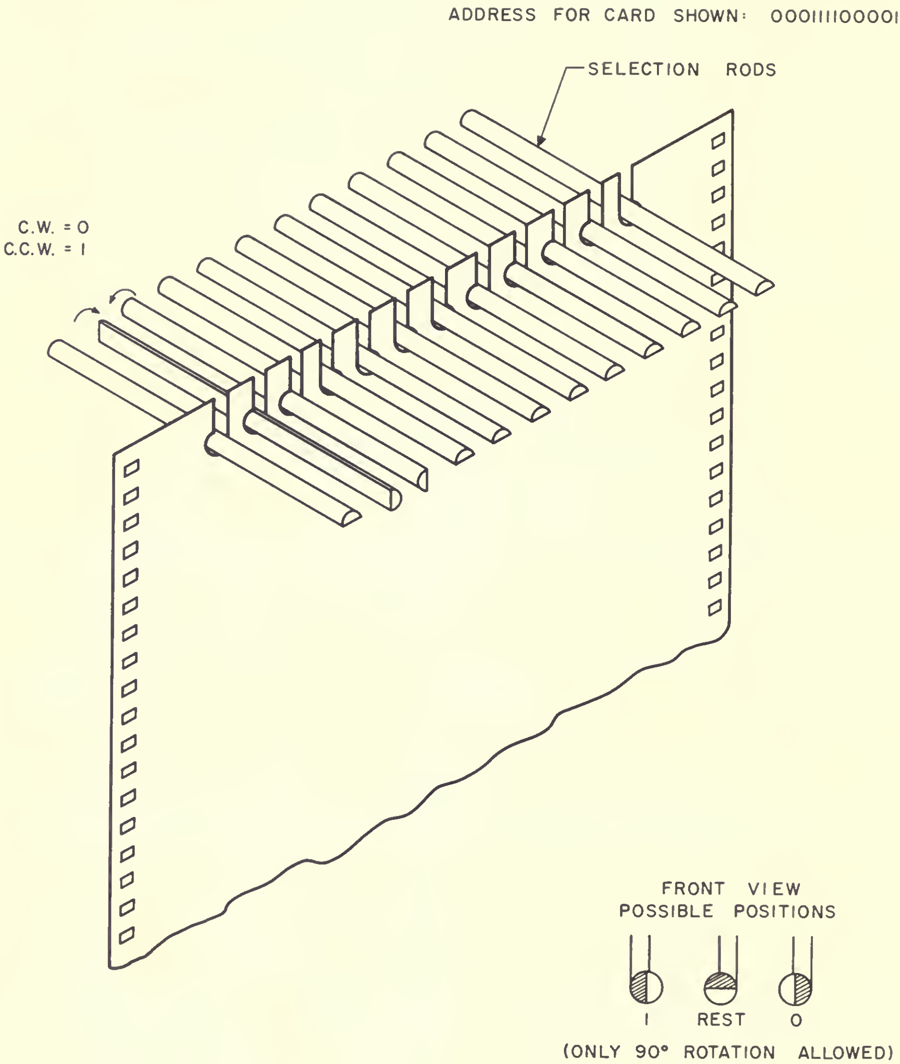


Figure 4
Design B: edge notched card

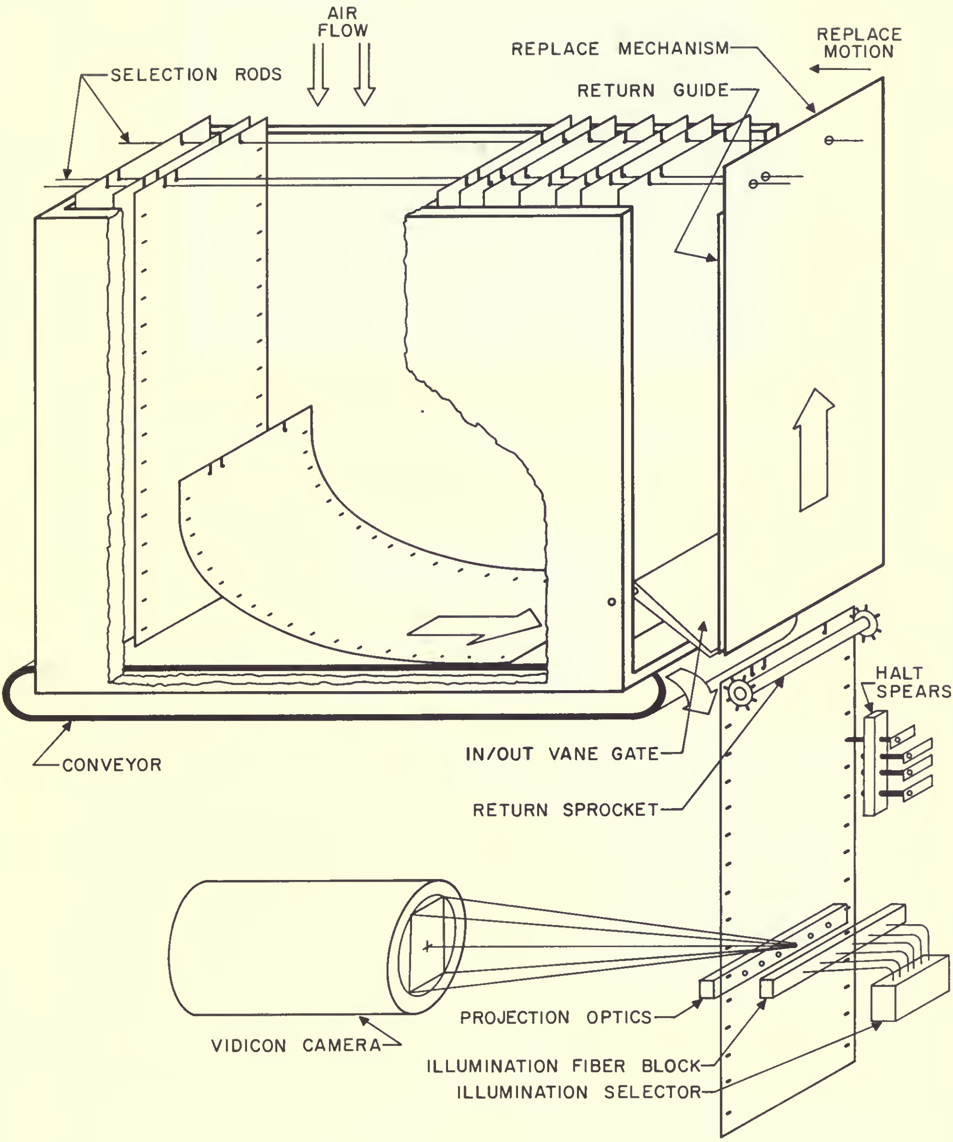


Figure 5
Design B: general mechanism location

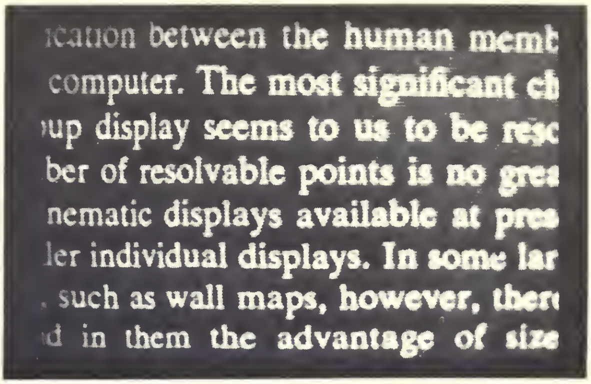


Figure 6
TV monitor display of text: reproduced at 80% of proposed resolution.

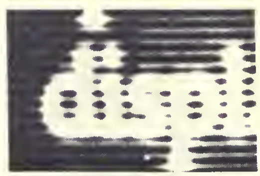


Figure 7
Enlarged view of fig. 6 illustrating character distortion

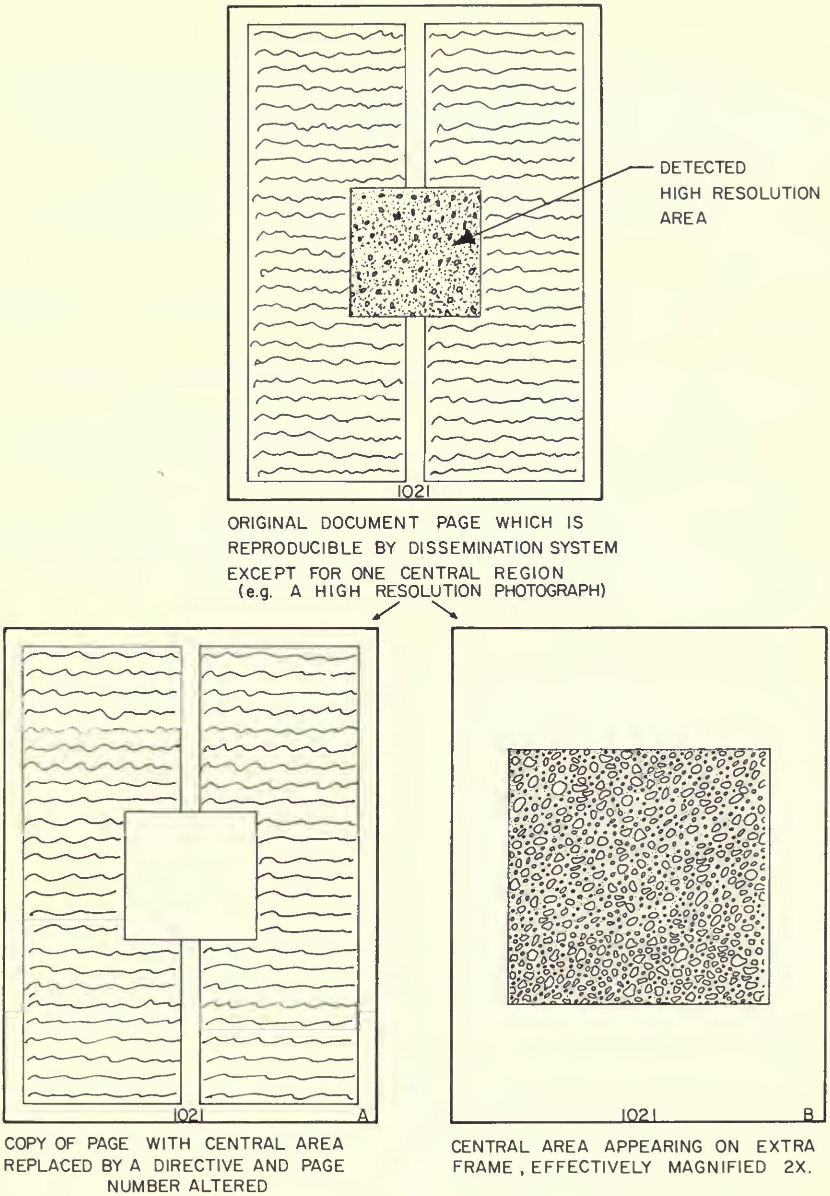


Figure 8
Reformatting example.

REFERENCES

1. McCormick, Bruce H., and Richardson, A. M. Design Concepts for an Information Resource Center with Option of an Attached Automated Laboratory. (Report No. 203, Department of Computer Science, University of Illinois.) Urbana, Ill., May 1, 1966.

2. Gelernter, Herbert. "Data Collection and Reduction for Nuclear Particle Trace Detectors," Advances in Computers, 6:229-296, 1965.

3. Overhage, Carl F. J., and Harman, R. Joyce, eds. INTREX. Cambridge, Mass., M.I.T. Press, 1965.

4. Licklider, J. C. R. Libraries of the Future. Cambridge, Mass., M.I.T. Press, 1965.

5. Ledley, Robert S. Use of Computers in Biology and Medicine. New York, McGraw-Hill, 1965.

6. Narasimhan, Rangaswamy. Syntactic Descriptions of Pictures and Gestalt Phenomena of Visual Perception. (Report No. 142, Digital Computer Laboratory, University of Illinois.) Urbana, Ill., July 25, 1963.

7. McCormick, Bruce H. "The Illinois Pattern Recognition Computer-ILLIAC III," Institute of Electrical & Electronics Engineers Transactions on Electronic Computers, EC-12:791-813, Dec. 1963.

8. Ray, Sylvian R., and Smith, K. C. Design of an Iterative Pattern Recognition Processor. (Report No. 161, Digital Computer Laboratory, University of Illinois.) Urbana, Ill., April 1964.

9. Bloom, Leon, et al., "Card Random Access Memory (CRAM): Functions and Use." In Proceedings of the Eastern Joint Computer Conference, Dec. 12-14, 1961, Washington, D. C. (American Federation of Information Processing Societies, Vol. 20: Computers—Key to Total Systems Control.) New York, Macmillan, pp. 147-157.

10. Shurtleff, Donald A. "Studies in Television Legibility—A Review of the Literature," Information Display, 4:40-45, Jan./Feb. 1967.

AN INTEGRATED COMPUTER-BASED BIBLIOGRAPHIC DATA SYSTEM FOR A LARGE UNIVERSITY LIBRARY: PROBLEMS AND PROGRESS AT THE UNIVERSITY OF CHICAGO

Charles T. Payne

The University of Chicago Library is working on a project for the development of an integrated, computer-based, bibliographical data system for a large university library. This project title is awkward, but it is descriptive, and it stresses some important features of the project: (1) a third generation computer with random-access disk files and remote terminal access capability is being used to implement a real-time library data processing system; (2) the library system design is based on the operational requirements of a large university library and does not attempt to solve the problems of other types of libraries nor those of national systems; (3) the system is highly integrated in that all processing data for the technical processing operations (acquisitions, cataloging, binding, etc.), as well as bibliographic descriptive data, are handled in a single system; and (4) the title emphasizes, we hope, that this work is developmental and experimental.

The long range goals of this project are those of a totally automated library system and thus can now be defined only in general terms. Enormous problems will have to be faced before any sort of total library system can be achieved, including problems such as file conversion, massive file organization and management, and related searching techniques. Even in the early stages of development, where the system design has been defined in detail, much original development work had to be done in implementing and, at times, in nudging forward the state of the art of computer applications. Nothing in our development to date has shown our approach to library automation to be invalid. It will be some time, however, before we have proceeded far enough and have had sufficient operating experience to make meaningful evaluations of costs, benefits, and performance.

A number of factors have helped shape the project design and development. Among the most important is Herman Fussler, the

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Charles T. Payne is Library Systems Analyst, University of Chicago Library.

Director of the University of Chicago Library, who has long been an advocate of the application of machine technologies to solve library problems and who has expended a great deal of effort on the problems of how libraries, both locally and at national levels, can best take advantage of the emerging computer technology. His influence has been important in the development of this project both in long-range planning and in handling of immediate realities. A second factor is the situation at Chicago which demands consideration of both the immediate problems of a badly overcrowded Harper Library and the expectation of vastly different operational conditions in the projected new Joseph Regenstein Library. This situation has affected both the project schedules and the system design. The third major factor influencing the project development was the emergence of a third generation computer with its enormous potential for library systems development. This came during our planning phase, and we made the decision to by-pass punched card and batch processing development and move directly to an on-line operation. The project has cut its teeth on-line, so to speak, and it has been a learning experience. Another and most important factor in the development of this project has been the generous cooperation of the National Science Foundation in providing a substantial portion of the funding. Progress on the project would have been much slower without this aid.

It is good to have long-range plans, even if ill-defined, but in the real world of system design and implementation one must proceed in well-ordered stages and must work within the confines of the possible, or almost possible, and make use of on-the-shelf equipment. The first stage in the project was called the Book Processing System. The remainder of this paper will be a description of the Book Processing System, its implementation, problems, and present state, followed by a discussion of the implications of on-line technology.

In library technical processing operations almost all work can be described in terms of data handling, including those intellectual operations in book selection and in cataloging. The over-all design feature of the Book Processing System is to incorporate all data relating to an item being processed into a single machine record. This includes the bibliographical descriptions, the various processing information such as dealer, fund, bindery, etc., and other operational data such as time in cataloging, cataloger's identification, etc. All production output is generated from the machine records, including orders, claims, cancellation or confirmation notices, fund accounting and invoice processing reports, catalog cards, bindery tickets, book pocket and spine labels, distribution lists, processing file lists, operational statistics, etc.

The potential savings by elimination of repetitious copying, sorting and file maintenance are substantial. In addition, from a given point, the library is creating machine readable records for all materials processed. This seems to solve the problem of machine readable records for future material. If only someone would now solve the problem of the past—the problem of conversion of retrospective records.

In order to handle all of the different data by machine it is necessary to identify and define each element of information that goes into a record. These elements of data are identified by tagging codes. The data elements (with few exceptions) and therefore the item records, are variable in length. Basically, our tagging codes are three-digit numbers which define the various elements of information, e.g., 010 item number, 035 dealer, 520 title, etc. In addition, certain tagging codes initiate actions within the computer system at the time of input. Other codes can change the status of a record within the file. Still others affect or direct output processing and formatting. Every tagging code has a definition that includes input requirements, data content and form, and (if any) resulting processing operations. A numerical code scheme for machine identification of data elements was adopted early in the development of this project. Tagging codes had been used elsewhere for handling bibliographical data and no obviously superior scheme was readily apparent.

Counts of the total number of possible elements in bibliographic and processing data quickly led to use of a 3-digit number. This provided enough code positions so that the various types of entries were assigned individual codes. The output format, therefore, can be defined by the tagging code and no references need to be made elsewhere to determine this. It was possible to build in relationships between the various types of entries.

Over one hundred specific tagging codes were assigned, about two-thirds of which cover bibliographic description. The various elements that make up the complete record can be input at different times. The first input creates the record in the machine file. In operation, the elements of data are input at the time of generation in the library, e.g., at the time of ordering and receiving material, or when it is cataloged. We also have editing routines for correcting or altering previously input data.

The computer used for implementation of this system is an IBM 360 model 30 computer (see Figure 1). This is a small computer and it has a modest core size of 32 K bytes. The computer and peripheral equipment are housed across campus from the Library and its use and costs are shared with other groups. Simultaneous, shared use of the computer has been worked out for applications of both the Library and the Maniac III experimental computer project of the Institute for Computer Research. This is not, however, a large scale, time-shared operation in the true sense.

Connected to the computer are two disk drives with about 14.5 million character on-line storage capacity. The Library has two IBM

1050 terminals. These are connected by telephone line to the computer. Each 1050 unit consists of a typewriter keyboard and printer, paper-tape reader and punch, and an auxiliary printer. The printing elements are the easily interchangeable "golf ball" type, similar to the Selectric typewriter, and offer the potential of providing libraries with a very large character set capability, at a relatively modest cost. It will take some sales potential, however, to persuade the manufacturer to develop the character set potential.

The type of terminal described above is known as a slow speed terminal. The maximum line transmission rate is about fifteen characters per second—much slower than a high speed line printer. We are using the 1050 for printing catalog cards at the present time. The printing speed is slow, but this is not a disaster in terms of computer time when operating in a shared, or multi-programming mode. It takes the computer the same amount of time to format a card for output whether for a high or slow speed printer, and it is free to do other work while printout is going on.

We do not see the 1050 as a permanent solution for the bulk of production printout. We will probably continue to use these or similar terminals for input, for production printout needed in the library on a tight schedule, such as orders, foreign alphabet printout material, for worksheet printout, etc. For the bulk of catalog card printout, a high speed line printer with the universal character set may be used if it becomes available. Various reported developments in non-impact printers sound very interesting and may be a future possibility. In any case, efforts have been made to keep the machine records independent of the means of input or of output. The stored machine records are coded in 360 internal code. The records as such are not formatted for output, but are merely strings of tagged data. The machine record does not look like a catalog card. This data handling system should be versatile enough to allow for any future developments in input-output equipment.

So far discussion of the Book Processing System has concerned data handling—the item record and its elements—and equipment; this was preliminary to talking about programming. In any computer processing, there are two aspects of the programming to consider—the system software, or computer operating system programs, and the applications programs. In the normal course of batch processing, the computer system software can be pretty much ignored. The programmer adapts to the existing operating systems and languages in the development of his programs. Further, most university computation centers have developed large, established sets of system software that will cover almost any need.

It is when the basic operating software for a computer system does not exist that it becomes most noticeable. Our early experience on the 360/30 was with an "undebugged" basic operating system—data file management programs that no one could make work, autotest programs for "debugging" that were themselves "undebugged," and a complete absence of teleprocessing control programs. In effect, although we have called Book Processing implementation our first phase, our actual first phase was to develop an operating computer system.

The situation is vastly improved now. New and improved software packages have been released by the manufacturer. It is not even absolutely necessary to program in assembly language anymore. But the basic lessons are still there: (1) the software must perform the functions required; (2) it must be thoroughly tested; and (3) in any on-line operation it must be resident in core at all times. This latter can become a critical factor in simultaneous shared use of the computer where core size is small.

The applications programs for an on-line operation must be available when called. This means that the applications programs must be resident in core or be available in on-line, random access storage. It quickly became apparent that all of the Book Processing applications programs could not be held in core. In fact, as it worked out, not even the entire set of programs for certain single operations (i.e., catalog card format) could be held at one time and, therefore, program overlays have since been used. The following pages give an outline of the programs and sizes for the data input phase (see Figure 2) and for the catalog card output phase (see Figure 3). The diagrams show the overlay arrangements that have been worked out.

For the input phase the system will:

(a) call in the proper programs on command from the library terminals,

(b) set the conditions to accept data from the library,

(c) check each incoming record against the file to see if it is a new record or update of existing record and call in this indicated data file management program,

(d) scan the input for logical errors,

(e) edit out unwanted blanks, carriage returns, line feeds, tabs, etc.,

(f) convert codes BCD to hexadecimal,

(g) scan for output distribution requests,

(h) create entry in key table for requested output,

(i) enter data into the file, and

(j) perform necessary editing.

These programs are operational and will handle input of all record elements that have been defined so far. We also have operational a major off-line set of programs that construct output stacks working from the input key table. The stack table programs work now for catalog cards only.

From the initial input for distribution, the input phase programs create a key table. The off-line stack program sorts these by type of output (now catalog cards only). From the key table and from the data files, these programs create entries in the stack tables for every card wanted. The new stack entries are merged with previous entries remaining from incomplete output printing. These stacks are sorted by location, by type of array, and by entry (or call number).

The catalog card output phase is a set of programs for on-line production output and is also operational and in use. This is a complex set of programs, but very quickly explained. It does the following:

(a) accepts command from the library terminal and calls in programs,
(b) selects stack tables for requested locations,
(c) selects card for output,
(d) formats call numbers and saves,
(e) formats text (lines and words) and saves,
(f) formats card, and
(g) prints out.

All but the print-out takes but a fraction of a second and then the computer waits to do the next card. In simultaneous operation with Maniac applications, it works for them during this period. This output gives cards for each requested location in filing array. Work is in progress on programs to include charge card, pocket label, and order printing production.

Two additional useful programs are in operation. One prints, on demand, the exact form of the machine record for any item, the only change being translation of machine code to output printing characters. The other program gives counts of the card stacks and is used to schedule output printing. The next major applications programming effort will go into fund bookkeeping, invoice handling, and other acquisitions processing.

The procedures described above are still a long way from a total functioning library system. Much work that had not been tried before has been performed, however, and some things are beginning to be known about this mode of operations. A year ago no one knew about some of the things which now appear obvious. We can see many implications of on-line processing. Some, in conclusion, are discussed below:

(1) System development will become open-ended; the almost unlimited opportunity for change and improvement is irresistible. There is no point where you can say that this is as far as you want to go.

(2) This means that the library systems development staff, the computer systems staff, and the programming staff will become a permanent part of the library and will not be just a temporary bother.

(3) The combination of high core requirements and low computer utilization indicates that future economies will be in the large, university-wide, time-shared computer rather than the computer dedicated to library use alone.

(4) On-line library operations will, of necessity, be simultaneous shared computer operations, even on a dedicated machine. By the time one implements systems for technical processing, with heavy input/output requirements, plus circulation, with immediate response needs, the library will be time-sharing with itself.

(5) In discussions of on-line operation, one frequently hears mentioned the prospect, usually imminent, of putting a terminal on every cataloger's desk or in faculty offices, or scattered around elsewhere. Our experience is that lines are expensive, the terminal equipment is expensive, and the transmission control unit at the computer end is expensive. Rather than spread terminals around we have tried to effect maximum line utilization for the terminals we have. The economics on this should improve, but until they do, it seems likely that most on-line terminals will be stationed in data processing rooms and at specific heavy-load work counters.

(6) The library needs staff members trained both in library operations and in computer science. It has been our experience that computer people will underestimate the library requirements by at least an order of magnitude even when the requirements are documented. The library needs a voice that can talk to the computer policy committee and look after the long-range interests of the library. The library should participate in the planning of computer facilities and see that its future plans and requirements are taken into consideration.

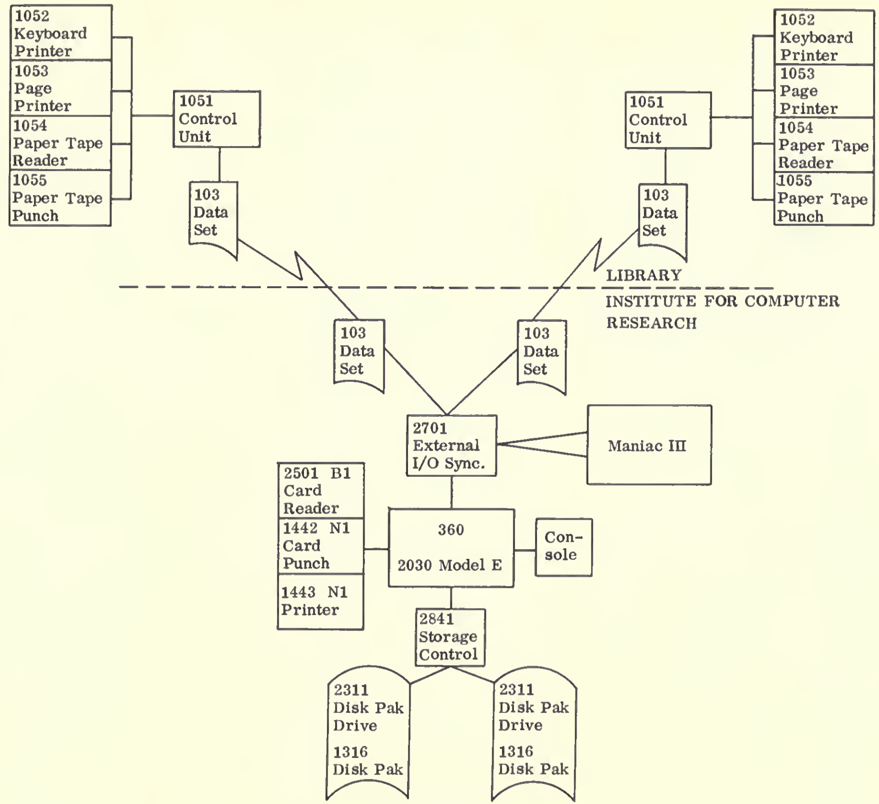

Figure 1.
Computer system and library terminals used during first year development.
On-line disc storage capacity of 14.5 million character.

INPUT PHASE		SIZE (decimal)
1. Supervisor: BOS supervisor 1050 teleprocessing control program Maniac III Input/Output control program		13,024
2. Index Sequential Data File Management	LOAD	2,244
3. Index Sequential Data File Management	ADD/RETRIEVE	3,996
4. Input Scanning Program	CONDNS	3,587
5. Paper Tape Control Module Read paper tape control program Input phase program check Initial edit of input program	 RPT PCHECK REMOVE	4,071
6. Processing Information File Update Module Logical error routine Hex to bcd conversion routing Table search routine Bcd to hex conversion routine Update to Processing Information disk file	 ERROR MAKBCD SEARCH CODEC UPDATE	4,793
7. Output Distribution Request Module Scan and construct indicator pattern from distribution request Create entry in key table for cat. cards, charge cards, and/or orders	 DISTR WTKEY	1,837
8. Historical File Request Module Flag item for historical file	 HISTRY	495
9. 1050 Command Language and Library Supervisor		2,773
		36,820

Figure 2
Input phase

INPUT PHASE (core requirements)

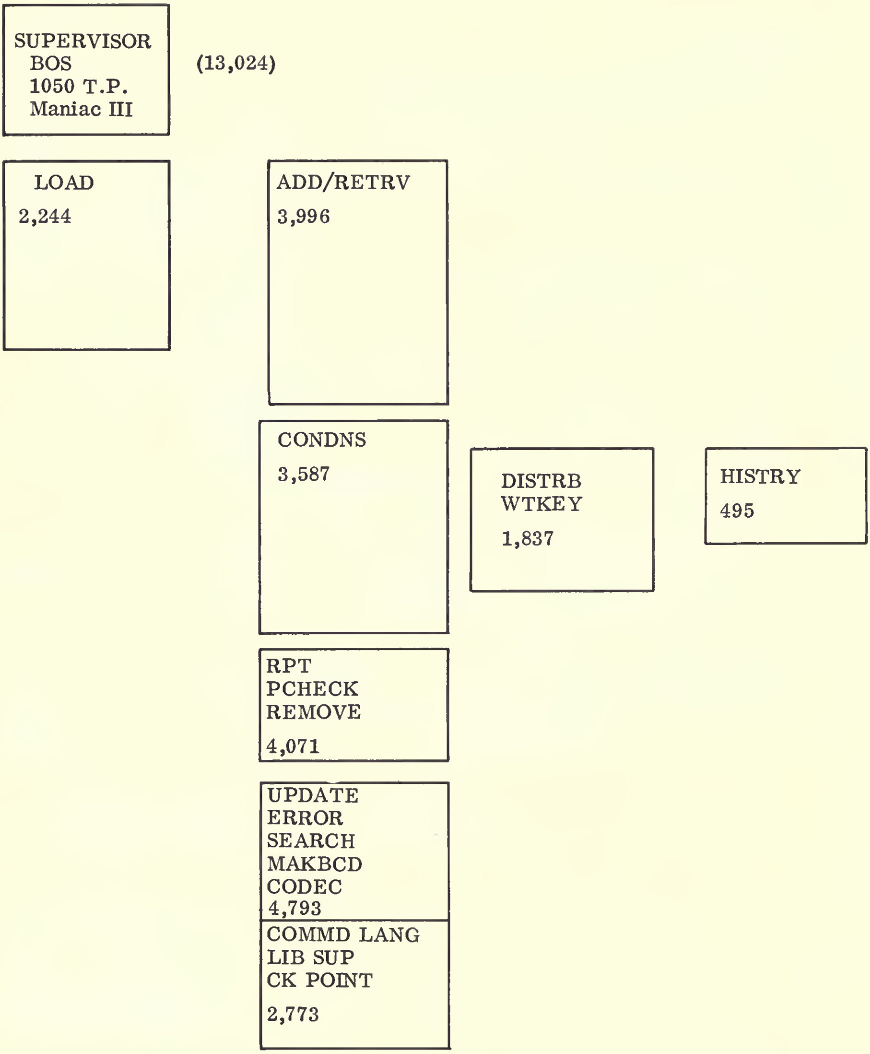

Figure 2 (cont.)

CATALOG CARD OUTPUT PHASE	SIZE (decimal)
1. Supervisor (see input phase)	13,024
2. Major catalog card controlling phase Catalog card teleprocessing supervisor Catalog card data supervisor Build item number routine Index Sequential Data Management read program Interface to I.S.D.M. for reading next tagging code Logical error routine Program check routine for catalog card phase Read stack routine (Catalog Card Descriptor records) Delay routine	13,947
3. Call number formatting routine	1,033
4. Build text of card routine Reformats words and lines	2,855
5. Build catalog card routine Merges call number, main or added entry, and text of card	905
6. Read directory to stack routine	607
7. 1050 Command language and library supervisor	2,773
Total	35,144

Figure 3
Catalog card output phase

OUTPUT PHASE (core requirements)

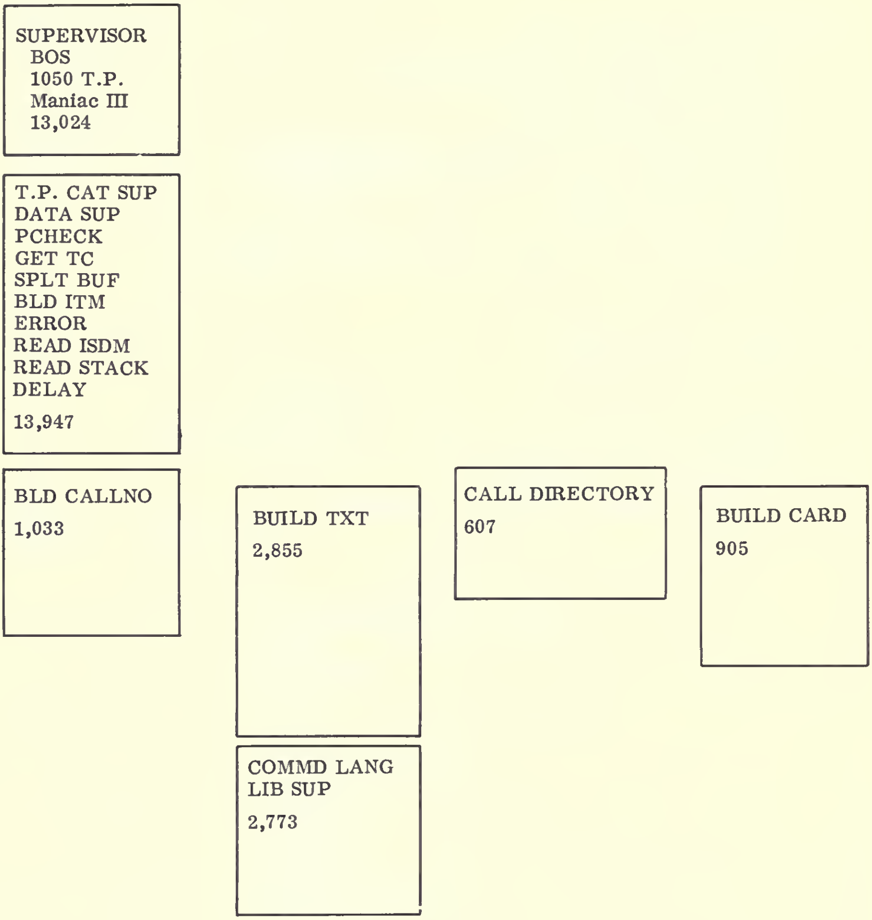

Figure 3 (cont.)

INFORMATION SERVICES AND OPERATIONS OF THE AEROSPACE RESEARCH APPLICATIONS CENTER (ARAC)*

Richard W. Counts

Historical Background of the Aerospace Research Applications Center (ARAC)

In the Space Act of 1958 the Congress required that the National Aeronautics and Space Administration (NASA) should provide for the transfer of the technology generated by government-sponsored space research to benefit the industry of the nation. This requirement gave the nation the opportunity to obtain an additional return from its research and development expenditures. In addition to its responsibilities in the area of space exploration, NASA was thus given the task of pioneering in yet another area, that of technology utilization.

In approaching this problem area of "transfer of technology," the question arises, "What, in fact, constitutes technology?" One obvious representation of the state-of-the-art of NASA technology was the published literature generated from NASA research projects. Much of the information contained in the NASA published literature was certainly of interest from many points of view. The basic problem here, however, was that so much literature was being published as to make it doubtful that anyone would be either able or willing to sort through it all.

As attempts to interact with industry were begun in the early days of the "technology transfer experiment," it became evident that a free information exchange with industry might well be hampered by possible involvement of information considered by individual companies to be highly confidential. It was obvious that before NASA could attempt to help solve a problem in industry, the nature of the

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Richard W. Counts is Manager of Information Systems, Aerospace Research Applications Center, Indiana University, Bloomington, Indiana.

problem would have to be known. Making the nature of the problem known, however, could well involve divulging a company's long-range research plans or some specific competitive advantage which a given organization might be enjoying. NASA was thus faced with the fact that, while many companies were certainly interested in what NASA had to make available, and while NASA was certainly interested in making its technology available, there was little common ground on which to meet. It appeared that no direct dialogue could be effectively established between industry and NASA in areas where confidential information might be involved.

A final and possibly more significant question was that of the worth of NASA information. Granted that space research and the rigorous requirements of blast-off, re-entry and extra-terrestrial travel forced NASA to work at the limit of the state-of-the-art in many areas of technology, this in no way guaranteed that any such efforts would have any applicability whatsoever to the industrial sector of our economy.

Against this background of difficulties, the stage was set for the establishment first of ARAC at Indiana University late in 1962, and later of several other similar centers at other universities throughout the country. The approach employed was to establish university-based centers to act as co-ordinators between NASA's technology base and industrial needs. The universities were also able to function as handlers of companies' highly confidential information. This approach has proved successful in the main, as ARAC and other centers have demonstrated their ability to work closely with industry.

What, Exactly, Can be Done to Transfer Technology?

The attempt to answer this question will provide the opportunity both for an exposition of what ARAC does and also for pointing out the pertinence of its approach to problems which do exist, and probably will become evident in connection with library operations in the near future.

We may focus attention for a moment on the published literature generated by NASA programs. NASA began to organize and index this literature on a large scale in 1962. This effort was and is still carried out by Documentation Incorporated of College Park, Maryland. In the Documentation Incorporated system, all documents are classified under one of the 34 NASA information categories, as is evident in any issue of Scientific and Technical Aerospace Reports. This breakdown by category is obviously rather broad. To make the data base amenable to automated retrieval, each document is further indexed using subject terms from the NASA thesaurus (of some 18,000 terms). A given document is assigned on the average 15 to 20 index terms. The indexing system employed is a form of double posting. Under this system, four or five terms used in indexing each document are very broad in nature and serve to define the content of a given document generally, but yet more explicitly than the 34 previously mentioned information categories. The remaining subject index terms, which are used to characterize the document more completely, are very specific in nature.

Thus, there exists an organized corpus of documents that is reasonably well indexed, from the point of view of machine retrieval. At present, there are roughly 250,000 such documents. The semi-monthly addition rate to this NASA data base tends to be of the order of 2,500 documents and is holding relatively steady. It might be noted also at this point that the NASA data base receives input from many sources. Approximately half of the 2,500 documents are from open literature sources which have pertinence to aerospace research. In addition, Department of Defense as well as Atomic Energy Commission documents pertinent to aerospace research are included. The total, then, represents a major resource which can be applied to the solution of industry's problems, and to the serving of information needs generated by technological development.

The first type of such information needs, historically speaking, is represented by questions on what has been done in the past or what is the present state-of-the-art in a given area of technology. This involves of course, a retrospective search of all information, usually concerning a very specific question, in a given data base. To satisfy such requests, ARAC operates a Retrospective Search Service (RSS) for a data base of a quarter of a million documents.

A second type of information need, which is becoming more important and of greater interest to the technological community than the RSS, is met through the Current Awareness Service (CAS) or Selective Dissemination Service (SDS). The interest in this regard has been brought about by the need of scientists or engineers to keep abreast of their fields in the face of voluminous amounts of new information in any given technology.

The Current Awareness Service

To do justice to the ARAC Current Awareness Service, it is not sufficient to treat only its computer aspects. To appreciate other factors which weigh heavily in determining the success of such a system, it is necessary to examine the total operating system.

Consider, for example, the potential customer. He is typically an engineer. He does not read extensively; he probably does not have time. He is also probably of the opinion that with the volume of information growing so rapidly, the problem of keeping up would be overwhelming, and that by the time he had ferreted out all the information concerning his interest, little time would remain to make use of it. Added to this may be the fact that his company is still showing a good profit from older methods which have been used for years.

With such factors in mind, ARAC set up a staff of some twenty information engineers, who work on a part-time basis, as a link between the user and the computerized data base. These engineers release a user from the frustrations which can occur when one is unaccustomed to the rigors of doing business with a computerized system. In addition, they serve a highly important function in filtering out non-relevant information which may be selected by the computer.

To give a quantitative impression of this problem at ARAC today, only about 42 percent of all the documents identified by the computer are ultimately sent to a user. The remaining 58 percent are evaluated and rejected by an engineer as not relevant to the user's needs and interests. Part of the reason for the rejection of 58 percent of those items selected by the computer stems from the nature of the task which is being attempted. The NASA file, obviously, has a distinct aerospace emphasis. ARAC is attempting, however, to service non-aerospace information needs with an essentially aerospace-oriented file. The 350 users who are currently served by this system are given service of a quality that no other approach, in ARAC's opinion, could provide as effectively at similar cost.

The computerized system of the over-all Current Awareness Service is in actuality composed of three subsystems. These subsystems were by no means defined at the inception of the Current Awareness Service. Their separate existences were brought about by the appearance of distinct problems in the effective handling of the information which is involved in the Current Awareness Service. An analysis of these information-handling problems will serve to introduce these subsystems in detail.

Interest Profile. First to be considered is the Interest Profile, by which I mean the collection of allowed subject index terms and categories which are used as input to the current awareness system. Such a collection of profile elements designates the specific interest of a particular user.

An Interest Profile in the ARAC system can contain up to one hundred subject index terms and eighteen categories. Earlier in ARAC's development a Boolean scheme was used for searching, but this has since been replaced by a weighted term system. In a weighted term system, each subject index term and each category included in the profile are given an importance weight. When a match occurs between a profile index term or category and a document index term or category, the document in question is assigned a weight equal to the weight which was preassigned that term or category in the profile. The document may be identified by the computer as relevant to the profile being processed, provided it accrues a weight greater than a preassigned cutoff value.

The Profile Maintenance Subsystem. As indicated earlier, there are at present approximately 350 computer-served profiles in the system. At any given time, somewhat fewer than 10 percent of these are in the process of modification. In order to keep the file as up to date as possible, it is necessary to have an operating subsystem which handles completely the details of this maintenance.

The Profile Maintenance Subsystem, as this subsystem is called, also handles administrative matters. It maintains control as to which companies are to be served by requiring master identification of a company's ARAC membership before processing any individual profiles to be run. Additions and deletions of single profiles or profiles for entire organizations are similarly handled. With each updating of the master profile file, a complete status report on the file is given. Features of this nature are definitely requisite to any effective control and accounting of an operation of the size of the ARAC SDS system. The cycle of operation for this subsystem is approximately every other day. Operating on this basis the content of the master profile file is current to within forty-eight hours.

The scope of this subsystem is such that the transactions with the file might amount to adding a new member company and its profiles, updating presently existing profiles and deleting existing profiles. The separate operations are indicated to the computer through the medium of punched IBM cards. Upon discovering that a new member company is to be added, the computer system updates its own information concerning the existence of this new member company. It is then able to process information concerning the company, namely current awareness profiles, and add this information to the master file. Had the previous information concerning the existence of a new member company not been available to the computer, the new profile would have been rejected along with reasons for the rejection.

When any information is processed, complete records of all transactions are produced and ultimately reach the hands of the SDS co-ordinator. Should a profile not be accepted (i.e., not added to the master file) complete diagnostics are produced by the computer. With this information concerning a problem in a given profile, the Current Awareness Service co-ordinator can have immediate action taken to resolve any difficulties. Since all information produced by the Profile Maintenance Subsystem must pass through the co-ordinator, this person despatches output from the system to the various internal users. One section will go to accounting, another to master records, and yet another to the ARAC engineer who initiated the transaction.

The point in going into such detail is to make clear the effort made to have as much of the ARAC operations and information flow as possible automatically coordinated in one place and at one time. This type of automated coordination is vitally necessary if an operation of the nature of ARAC is to deliver the kind of service necessary for success.

The Selective Dissemination System. The Profile Maintenance Subsystem provides highly current and accurate information for the subsystem next in sequence, the Selective Dissemination System (SDS). The SDS can assume information which is accurate in content and format. The "Profile File" which is maintained by the Profile Maintenance Subsystem, is one of the inputs to SDS. This is the portion of input which is a representation of the customer's interest.

The other information to be specified is that contained in the documents which are being newly announced. At this point, an analysis of the intended function of the SDS system may be made.

On the one hand, the information contained in the documents should be as accessible to retrieval as possible. This implies that as much information as possible, pertinent to a given document should be included in the document file. Since the presently operating ARAC system is a magnetic tape-oriented system, a large amount of information concerning each document will tend to make the file rather lengthy and expensive to process. To offset this, we made a critical analysis of the data contained in the NASA file, which is supplied to ARAC by Documentation Incorporated. Of the vast amount of information contained in the file, it was decided that, for ARAC's purposes, only subject index terms, accession number, document category, and language of origin information for a given document were necessary. By including only these items in the file, information such as personal author, corporate author, title, etc. is excluded. The decision to exclude this information limits the nature of output which the computer can supply. The method for ultimately delivering information which is useful to human beings will be discussed later.

A residual benefit of establishing this standardized ARAC file format, which requires only a few separate items of information, is that of working with non-NASA data bases. Now, rather than writing a rather complex and expensive computer program to retrieve information from each new data base that one might encounter, all that has to be done is to write a simple and inexpensive program to extract those needed items of information from the new data base and arrange them to conform to the format which the presently existing computer system can understand.

This approach to dealing with additional data bases was the subject of much experimental effort at ARAC about a year ago. The Department of Defense magnetic tape file was reformatted into a file which was compatible with the existing ARAC SDS system, and extensive testing aimed at evaluating the effectiveness of this approach gave positive results. So one might conclude that on this point of system philosophy, namely the standardized file format, there exists additional evidence to support this approach.

The file which is produced is in linear format; that is, on the magnetic tape, information is organized so that an accession number is followed by all the descriptive subject index terms pertinent to that accession number. Another file format is that of the inverted file, which has the information arranged so that a subject index term is followed by all the accession numbers for documents which have been indexed by the term. In many real time, direct access systems the stored information is arranged in both linear and inverted formats to gain the separate advantages which each file offers without suffering the disadvantages. This is possible since one usually finds that a weakness of the linear file is a strength of the inverted file, and vice versa. ARAC has operated under both file formats and can really express no extreme preference for one over the other for the present operation.

The two files, the master profile file and the document information file, are the total input to the SDS subsystem. As mentioned earlier, the nature of the output is limited by this input, in this case to a simple list of accession numbers. However, we may clarify at this point how this list of accession numbers is related to the information sought.

Returning to the information supplied by the Documentation Incorporated file, we may note that the most meaningful elements for identifying a document's content are the title of the document and those indexing terms which have been assigned to it.

Of course, titles are often notoriously poor as indicators of a document's content. The index terms are presumably at least as useful as the title, and to someone versed in the NASA file they are probably more useful. So one might assume that the combination of title plus subject index terms would probably be specific enough for those versed in the information retrieval business. However (and this is the problem) can such information be sent to the average scientist or engineer and receive a sympathetic response? Evidently not. What the user normally wants in order to judge a document's worth is at least an abstract of the document. There is, however, no abstract on the basic NASA file as distributed by Documentation Incorporated. (There are several reasons for the absence of the abstract. The main one is that textual information of this type would tend to make the basic magnetic tape file much too long to be usable.)

At this point, some of the reasoning which indicated the earlier adoption of the restricted information format should become evident. First, the item which was really sought was not to be found on the original magnetic tape file. Secondly, the information which was on the file was not considered adequate, so there was no loss in ignoring it—provided at some later point superior information was obtained.

What is done, and this is the least automated portion of the ARAC SDS operation, is to make a multilith master of each abstract as it appears in Scientific and Technical Aerospace Reports (STAR) or International Aerospace Abstracts (IAA), which is part of the NASA file also, and run off as many copies of each abstract as are needed. The output, namely the accession numbers for each profile, is then used to pull out, by hand, one copy of each abstract required. These abstracts are then forwarded to the ARAC engineer who is coordinating the profile in question. The engineer then further edits these abstracts, based on his personal understanding of the definition of the profile. In this manner, the user is supplied highly relevant material of sufficiently small quantity to receive his proper attention.

This last operation would appear to tie things neatly together; however, one rather important aspect has been ignored. The problem is the effective control, on the part of the ARAC engineer, of the twenty to twenty-five profiles for which he is responsible. Since each profile can contain eighteen categories and up to one hundred descriptor or subject index terms, the possibility of many combinations of terms and categories joining forces to select voluminous amounts of information definitely exists. This problem, in fact, did become so pressing that it became necessary to develop the "Profile Analysis Subsystem" to cope with it.

The Profile Analysis Subsystem. The purpose of this subsystem is to give the engineer, at a glance, an indication of the performance of subject index terms and categories contained in a given profile. This subsystem was also developed to reduce the amount of paper passed through the over-all Current Awareness System.

The analysis of a profile is a fairly straightforward process. In the first place, a profile consists of (1) a set of subject index terms to which have been assigned, *a priori*, importance weights, and (2) a set of analogously weighted categories. It is on the adequacy of these elements that the effectiveness of the profile depends. The problems which can occur with a profile stem either from a poor assignment of importance weights to subject index terms or categories, or from the lack of inclusion of the proper subject index terms or categories in the profile. The profile analysis subsystem is directed toward exposing such defects.

After the engineer has evaluated the output of the SDS system, he submits this information, in the form of lists of relevant and non-relevant document accession numbers, along with the current awareness profile which produced the output under discussion to the profile analysis computer program. The information which is produced by this program is capable of indicating the existence of the previously described profile defects.

This program gives the engineer the subject index terms (with their respective frequencies of occurrence) that were used by the indexer in preparing the documents for computerized retrieval, in both the relevant and non-relevant lists. The program also provides a distribution by categories of the relevant and non-relevant documents. Finally, and most importantly, the engineer is informed of the frequency of occurrence of each term in his profile in both the relevant and non-relevant sets of documents. With this collection of information, the engineer can adjust the importance weights which he has assigned to the categories and index terms. He can also add or delete index terms or categories as indicated.

Many of the problems encountered in developing the separate subsystems have suggested new directions for research. This is especially true in the area of profile analysis.

With the amount of information provided and the numerical specificity of the information, the engineer's task in making an already analyzed profile effective is almost routine. He either includes or deletes subject index terms or categories depending on the frequencies of occurrence supplied to him. He adjusts the importance weights assigned to these elements according to the relative frequencies or occurrence of the given index term or category in the relevant and non-relevant lists. It should be possible to achieve some set of decision rules or algorithms which could automatically perform the above-mentioned tasks at the time the profile is analyzed. This in turn might make it possible for a great portion of the current awareness service to function with only a minimum of human intervention.

With such a goal in mind, ARAC, under a separate contract to NASA, is carrying on a research program along these lines. Four different decision rules are to be tested. Presently existing profiles, which will be chosen as representative of the thirty-four categories into which NASA divides scientific information, will be used as the test vehicle. The effectiveness of the pre-selected sets of decision rules will be compared on a continuing basis for some extensive period of time against the effectiveness of an ARAC engineer in maintaining a given profile.

Perhaps we may digress for a moment on the importance of including, in this experiment, profiles from all the existing NASA information categories. In a study* which was done several years ago using the NASA data base in conjunction with ARAC, it was found that all areas of information did not behave identically when subjected to attempts to improve the relevance of current awareness profiles. The problem may be explained by the following example.

First, assume that there exists a corpus of documents about which a person is completely knowledgeable. That is, the exact number of documents related to physics, chemistry, metallurgy, etc. is known. Given this, it is possible to know whether or not a profile which has been written to select information from any one given area is selecting all the available information. The ratio of the number of documents in a given area selected by the computer to the total number of documents in a given information area which exist in the corpus of documents is called the "Recall." If the profile under discussion selected all the pertinent or relevant documents in the file, we would say that the "Recall" was 100 percent. The "Relevancy Ratio" of a profile is the ratio of the number of relevant documents selected to the total number of documents selected by the profile. If all the documents selected by a given profile were truly relevant, the "Relevancy" would be 100 percent.

Keeping these definitions in mind, let us imagine there exist two profiles; one in neutronics (or neutron related technology) and one in physiology. Suppose next that some technique such as profile analysis is applied to each of these profiles. The effect found in such instances indicates that while it may be possible to improve the relevancy of the neutronics profile without altering its recall, it might well not be possible to improve the relevancy of the physiology profile by even 10 percent without destroying its recall completely. This is what is meant by "non-identical behavior of information areas."

Given the possibility of this type of difficulty, care will have to be exercised in the research program previously described. It may well be that no single rule will be dependable; some highly elaborate set of decision rules may provide the only workable solution.

Yet another area of endeavor is the creation of a current awareness profile from a written description of a user's interest. Whereas the information and tools for an experiment in automated profile maintenance are immediately available, those required for original profile creation are not. One item which would be needed is a master file relating scientific and technical vocabulary of the English language to all synonymous or even remotely synonymous terms in the closed thesaurus which is being used to index the data set. It would also be

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*Sprague, Ralph H., Jr. A Comparison of Systems for Selectively Disseminating Information (Indiana Business Report No. 38). [Bloomington, Ind.], Indiana University, Bureau of Business Research, 1965.

necessary to specify the degree of synonymity of terms. Upon the completion of the present research project, this may well be the next area of inquiry.

The Retrospective Search System

When an organization is contemplating entering into a new product area, it wants to know as much as is available about the technology of a given product. Likewise, when a project has come to a stumbling block in the path of development, an organization needs to know as much as possible about what has been done in relation to the given problems. As previously indicated, problems of this nature are handled at ARAC by the Retrospective Search Service (RSS).

Typically, a user from a member company may either write or telephone in an RSS request. There is an RSS coordinator whose function is to analyze the question being asked and to assign the specific search to an ARAC engineer professionally qualified in the technological area in which the search seems to belong. Upon being assigned the search, the ARAC engineer contacts the person who submitted the request and discusses the search until the problem is clearly defined. Once the problem is clearly defined, the ARAC engineer devises a suitable search strategy. In certain cases in which the problem area has proven troublesome on previous occasions, the engineer may simultaneously attempt several search strategies.

The present computerized system which serves the Retrospective Search Service is distinguished only by the fact that it does seem to function effectively. The weighted term approach which was described in conjunction with the ARAC Current Awareness Service is also used in the RSS.

However, an experiment which was conducted by the Bunker-Ramo Corporation under contract to NASA, and in which ARAC participated, should be of interest in the area of library operations. The experiment consisted of testing a real-time, remote access retrieval system. The computer handling the retrieval task was located in New York City. It was a very modest piece of equipment, a Univac 1050. Remotely coupled to this computer, by means of microwave transmission towers, were several other small, special-purpose, process control computers. Connected to the latter computers were two communication stations through which information could be passed to the special-purpose computer and from there to the computer in New York. The results of the search were displayed on a cathode ray tube.

As mentioned earlier, both linear and inverted file formats may be used in such systems. For purposes of actual searching, an inverted file format was employed, with entries provided by subject index term, by author, by corporate source, and by contract number for each document in the NASA data base. Inverted files, when used in conjunction with Boolean search logics, can provide quite rapid search systems. However, to provide certain other types of output, such as a list of the descriptors used to index a given document, it is usually necessary to have a linear file format if real-time response is to be given. During this experiment, response time was of the order of 30 seconds to one minute. The results which were being supplied so rapidly also agreed accurately with the searches that had been run under the ARAC system.

In the description of this system, we noted that the computer which accomplished this task was very modest. Most university libraries could probably afford such equipment. Consider for a moment the type of operation which could be established if this type of system concept were established. Stored on mass storage devices at the central library would be indices by author, by Library of Congress number, and the like. Situated in convenient locations throughout the campus would be remote communication consoles. A user could easily query the computer at the central library concerning the status of a book or periodical. The computer could respond with the availability data. If the book or periodical were not checked out, the computer could instruct the librarian to reserve the book for the user. Were the book or periodical checked out, the computer could inform the user as to when the book was due back or who presently was in possession. Should the book be already overdue, the computer could alert the librarian to request the return of the item and reserve it in the name of the user. Such a system is certainly within the realm of present retrieval methods and computer hardware. The previously described real-time experiment would seem to indicate the existence of all the necessary know-how.

What is NASA Technology Worth to Industry?

Much attention has here been devoted to the subject of identifying technology and devising means for transferring it. However, the outstanding question among the people involved in the technology transfer business is whether or not the type of advanced technology which NASA has developed will find adequate application in industry. Without this, it would certainly be impractical to expend vast sums of tax dollars on the effort to disseminate this technology. NASA has therefore devised an approach to the problem which should answer this question clearly.

The possibility always existed that as long as some government agency was carrying the cost of disseminating information, industry would continue to express an interest in the information, although it might be used for little more than browsing. The attitude on the part of industry might well be that since the information was essentially free, there was no reason not to take part in the dissemination efforts. A true test, then, would be whether or not industry would be willing to pay for these services. Of course, such a test would be a harsh method of gauging interest and need, but it is also true that industry will not support an idea unless it pays off in net profits at some point. The information dissemination idea was by no means tested when ARAC was established. ARAC was, indeed, established to test this idea. It was obvious that in the early stages of ARAC's operation, some NASA subsidy would have to be supplied to permit ARAC to establish its information services and iron out their operations. With this in mind ARAC was given five years to become self-supporting.

Stated quite simply, the above approach represented NASA's point of view. Let us look at things from ARAC's point of view. First of all, any businessman knows that the best products or the best services in the world are not going to be a financial success if the business responsible for them incurs costs in producing the product or service which exceed its revenues. So, in addition to devising and supplying meaningful information services, ARAC must do so for a price that will convince national industry that it is getting a bargain and still cover costs.

This aspect of the ARAC operation should prove of interest to the library community also. What, exactly, are the costs of information services? How does one actually find these costs and keep control of them? Toward this goal, ARAC was forced to establish an elaborate cost accounting system. (To keep control of the costs, once they had been identified, it was necessary to automate this cost accounting system.) A new fee schedule based on this system appears to offer ARAC the opportunity to cover costs and yet make its price for services to industry attractive.

This is the fifth and final year of NASA subsidy for ARAC dissemination efforts. In this year the new fee schedule just mentioned is being presented to ARAC member companies. Future survival and success of ARAC could depend very heavily on two factors. First, are ARAC services worth what they are going to cost? Second, is the cost accounting system devised representative of ARAC costs? Time will provide the answer to these questions.

How does this Affect Libraries?

I have emphasized the cost aspect of the ARAC operation because considerations of this nature could profitably be applied to library operations.

Libraries presently offer a group of services. These services will undoubtedly be expanded in view of new ideas. The problem is that there probably cannot be any significant expansion of funds available for the operation of these services. In effect, then, a group of services will be competing for funds. Which services will be most profitably—in a very broad sense—emphasized and to what extent? In the past it has been possible to make fairly accurate judgements based on intuition and operational information available to a single individual or group of individuals. In the future, intuition can at best be only a vague indicator, and operational information will have to be more clearly identified and refined for any individual or group of individuals to make successful decisions.

The Situation in Review

In an effort to execute a responsibility assigned to NASA by the Space Act of 1958, a number of organizations were established to attempt a transfer of NASA technology. ARAC was the first of such organizations.

In order to accomplish this transfer of technology, it was first necessary to identify the relevant technology and then figure out ways to transfer it. To aid in this transfer, ARAC established a group of services, two of which have been described in detail in this exposition of ARAC services.

A final note may serve concerning several other ARAC services which have not been discussed because they have little direct bearing on libraries. They include the Computer Information Service, which distributes computer program and computer related information, the Industrial Applications Service, and the Marketing Information Service. Such services are primarily aimed at industry, although with the rapid proliferation of computers, libraries in the future may indeed deal in computer programs as well as books.

In any event, ARAC is attempting to test the existence of a market for such information services as have been described. All indications are that a market for such information services as have been described does exist. However, the only true test will be the continued operation of ARAC-like services in coming years.

ADMINISTRATIVE AND ECONOMIC CONSIDERATIONS FOR LIBRARY AUTOMATION

Richard E. Chapin

This paper might well be entitled Profile of Decision, for it is concerned with the decisions relating to the introduction of automation in a library. Indeed, several hard decisions are necessary before a library becomes involved with automation. A recent article in Library Journal pointed out that one of our Australian colleagues feels that we talk more about automation than make decisions to initiate programs.[1] Perhaps he is right: the decisions do not come easily.

The easiest decision for an administrator to make is not to automate; after all, the traditional methods have worked for years. We are all aware that some of our most able library administrators have carefully avoided automation. Whether their decisions are right or wrong is immaterial, but it is the easy decision and it is a single decision. The decision to automate comes only after a long series of other decisions in regard to specific problems.

The decision not to automate often will have the support of a large number of library users. It is obvious to them that automation of even the routines of library operations is the first step toward destroying the book. This view, of course, is unknowingly supported by some of the most vigorous advocates of automation. In a publication of the Educational Facilities Laboratory, Sol Cornberg, consultant on the programs for Grand Valley College (Michigan), indicated that reading and libraries are inefficient.[2] He goes so far as to state that reading and writing will become obsolete skills. With such quotations available in the literature, it is easy to decide that automation is not the answer for our libraries.

The uncertainty of the cost of automation, even more than tradition, is another reason to resist the machine age. As purveyors of the human record, we have failed to record the cost of automation. If dollar figures are included in the reports and articles, they are all too vague as to their meaning. The only terms that seem to have credence

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Richard E. Chapin is Director of Libraries, Michigan State University, East Lansing.

to the administration are "too much," "more than you spend today," "unreasonable," or other such figures of speech that are too often true.

Even if operational costs can be determined and funded, the administrator still has another easy out because of the problems relating to the conversion of records. Until such time as scanners are available that will read varied type-fonts, and even non-Western alphabets, the process of converting records seems impossible. And then there is the matter of what record to convert. If we were to wait on standardization of format and study of the conversion record, nothing would be done with the present generation of computers. As long as the doubts exist, however, they furnish still another reason to make the easy decision and forestall automation.

If costs of operation and conversion are unknown, other information needed to make a decision is equally lacking in details. We have all faced the salesman from company A-B-C or D-E-F who has all the answers to all the problems of our library. His equipment, and only his, will store, index, and copy everything needed. He is eager to show you a documented program of a "library" (and I use the quotation marks advisedly) of 10,000 reports that is growing at the rate of 888 reports per year. This is just the sort of information that the administrator of a large library needs: that is about how many serials he is receiving daily.

Confusion regarding automation is spelled out in College & Research Libraries on the case of circulation at Hawaii. You will recall that in the original article Cammack made the following statement:

> It [computer based circulation system] was designed to operate at approximately the same cost as the unsatisfactory manual system which preceded it. . . . Machine costs turned out to be considerably lower than expected as a result of unpredictable advantages gained through cooperative use of certain items.[3]

It is obvious that Cammack felt that the new system would be more economical than its predecessor. In a later issue of the journal Ralph Shaw stated that "the net cost of computer charging was found to be substantially more than double that of the old manual charging system, which was no model of efficiency."[4] So for the administrator who is looking for some reason to resist automation, all further arguments in favor of machines will fall on deaf ears.

The arguments against automation are plentiful and forceful. If one is inclined to wait a few years, he is not only in good company, but he might even have logic in his favor. Such will continue to be the case until we compile a core of useful data regarding mechanized programs, or until we develop adequate criteria to measure automated efforts.

In spite of the tendency to make the one easy decision, there are continued pressures on the administrator to find better techniques or procedures to meet the challenges of today's libraries. Not the least of these pressures is the university administrator or the engineer who is conscious that automation has cut costs and produced better information in other paper-oriented industries.

Computers are being used and being used successfully. In the late 1940's it was predicted that fewer than a dozen electronic computers would be able to satisfy the entire computational requirements of this country. At the end of 1966, 39,983 computers were in operation and an additional 23,443 were on order. And some of these are exclusively for library use.

Another source of pressure to use automation in libraries comes from many of our users. Not only are they familiar with automated techniques, many using them in their own research programs, but their information needs have increased at such a fantastic rate that they see automation as the only hope. As an example from my own campus, one of our highly respected professors in the biological sciences informed me that he no longer had time to read anything except Current Contents and one section of the Chemical Abstracts. His question to me was: "What are you going to do about it?" Obviously there is nothing I can do about it using the traditional techniques of librarianship. Yet on a national basis, beginning with the Weinberg Report,[5] but certainly not ending with it, are demands that librarians provide better access to an ever-increasing amount of information. Certainly the technicians will do this job if librarians do not take the initiative to do it themselves.

There are pressures on the administrator to automate placed there by his own library operation. The traditional methods are less and less able to satisfy the increasing demands being placed on the research libraries of today. First among these is the continuing need for more space for both staff and readers. The cost of the space, assuming land is available, continues to increase. If there is any way to save space by using the new techniques, then we are obligated to give them full consideration. Furthermore, the continued increase in the use of printed record is known to all. One might expect some leveling off of circulation statistics, but none seems to occur. The inventory problems facing librarians are truly difficult.

Besides the problem of keeping track of what we already have, there is the other problem of the ever-increasing amount of literature available. A recent report from Purdue University School of Engineering indicated that the number of books published in the United States doubled in the period between 1960 and 1964; that 900,500 documents were generated in the nation's technical report literature in 1965, and this is expected to increase to 1,143,000 by 1970; and that the acquisition rate of science information amounts to 250,000,000 pages annually. If we are having problems today, we can look forward to no let-up in the flood of information that we will have to handle in the next few years.

Compounding the above-mentioned problems is the fact that we do not have enough personnel. Even those libraries that have positions available are having difficulties recruiting. More obvious, however, is the fact that most of our libraries are greatly understaffed in terms of the demand put upon them by the reader and by the user. We must find better ways of using the personnel we have to accomplish our goals.

In our colleges and universities the libraries are demanding an ever-increasing proportion of the total institutional budgets for their operations. If we are to continue to use traditional methods, then we must expect a continued increase in this percentage. We should be thankful that librarians are often equated with God, mother, and country, because if they were not, the faculty and administrators would begin to ask why other programs must be curtailed because of continually increasing budgets for the libraries.

One factor, perhaps greater than all of the others, that is forcing the library administrator to reconsider his position on automation is that of the constant search for better ways to fulfill his obligations to his constituency. No administrator can supply all of the materials that his users will at some time need; but he can utilize more of the information he has in his collections better to satisfy the needs of his clientele.

If there is one thing that led me to consider automation, it was the "frustration factor" involved in the use of our collections. (The frustration factor is the relationship between the items or information supplied by the library as opposed to the unfilled requests.) There is some point in our operations where the students and faculty will not tolerate a higher frustration factor. Hopefully, automation will prevent us from reaching this point.

If one needs further motivation to automate his resources, all he has to do is re-read his Library of Congress report on automation. The committee's letter of transmittal in this report, addressed to the Honorable L. Quincy Mumford and dated December 1, 1963, begins: "We are pleased to be able to submit to you a report in which the automation of major operations within the Library of Congress is shown to be both desirable and feasible."[6] With these words the library profession was presented with a new challenge. Our previous excuses not to automate would no longer be heeded.

If it were as simple as mustering the arguments pro and con, most libraries would still be debating the point. Unfortunately, problems do not wait for us to solve philosophical differences. It was a current problem, or problems, that put us on the side of the machines.

To return to the profile of our decision at Michigan State University, it is necessary to give some history of our circulation system. In the 1959-60 school year, circulation of materials both for home use and assigned reading was decentralized in five divisional libraries. A student might well proceed to one, two, or even five different areas to charge out books for home use. After two weeks he was asked to return the books to the rooms from which they were borrowed. In extreme cases, there could be five books from five locations, five charge slips, five identification showings, five returns, five overdue slips, five fine notices (and the mail notices were not all sent at the same time), and five thousand unhappy students. In an early attempt to develop a program budget, we determined that our costs for circulation, exclusive of the students' own time, were 29 cents per transaction.

The initial solution to our problem was to centralize circulation at one point. The student would still go to five rooms to retrieve his books, but all transactions and returns were centralized in one location. Not only did this change make for a more efficient system, but our costs were reduced to 20 cents per transaction.

Centralization solved some problems but created others. As enrollments grew, and as per-student use increased, the traffic at the circulation desk grew beyond the point of diminishing return. There was limited room for staff on one side of the desk, but there seemed to be unlimited room for students on the other side. As each semester progressed, the circulation crisis increased. At peak times, especially the two weeks prior to finals, we were flooded with returned books while out-going materials still remained at their high level. Books returned two weeks prior to finals were still in demand for term papers, but they might well still be unshelved during registration for next term. The semester-end clean-up would barely be completed before the next onslaught began.

We did not need a consultant to tell us we had a problem. There were many suggested solutions, and most were tried. In our conventional wisdom, to borrow a term and a meaning from Galbraith's Affluent Society, all of the familiar and established ideas were considered. Most obvious, of course, was to hire more students to slip the books. Unfortunately, the files were in full use for renewals, charge-outs, fines, and more filing. There seemed to be no appropriate time to discharge materials. A late shift and an early Sunday morning shift were our only salvation, after a fashion.

Not so much from conventional wisdom, but more from the wisdom of our colleagues in public libraries, we even tried the use of transaction numbers. The purpose of this move was designed to cut down on filing time and discharging time. The disadvantages were that we could not report to students and faculty when a book would be returned, nor could we reserve specific titles. The advantages, we soon discovered, were tempered by the fact that fully one half of the books were not returned within two weeks. Since our transaction file was to be limited to two weeks, with the remaining slips to be placed in the files in shelf list order, our savings in filing time did not offset the stated disadvantages of the system.

At this point we knew that the traditional methods would most likely not provide us with the type of control we felt was needed. A possible solution seemed to be with data processing techniques. One might even conclude that we did not seek out automation, but rather that we turned to it as the last resort. At any rate a decision was made—not a decision to automate, but rather a decision to consider this as yet another possible solution.

A special point should be made at this time that our primary interest was in control of the collections. No consideration had been given to cost or to a total system approach. We had an inventory record problem with circulation and we were seeking a solution. With a cost of circulation of less than 20 cents per transaction, we did not see that we could find a more economical solution.

The next decision to be made was who would do the automation. Dake Gull in a speech at Purdue pointed to four approaches: (1) the librarian himself, as personified by Ralph Parker at Missouri; (2) librarians with assistance from data processing personnel and equipment manufacturers, as at Purdue and University of California at San Diego; (3) a local team of librarians and clientele, as at the National Agricultural Library; or (4) by contract to a consulting firm as was done by the National Library of Medicine. We opted for the second choice of using our staff along with the analysts and programmers from our Data Processing Center. Even if this were not the best choice for M.S.U., others would have been rejected because I am not a Ralph Parker, the N.A.L. scheme is still more talk than program, and we did not have the funds to call in a consulting firm as was done at N.L.M.

Members of our staff were encouraged to read up on automation and to become familiar with its potential. This admonition was given generally to the staff, not just to those concerned with circulation. It seemed rather obvious that problems similar to circulation's were developing in other areas, but that they had not yet reached the critical stage.

At Michigan State we were in the happy position of having a staff in Data Processing who were sufficiently intrigued with our problem to want to assist us in finding a solution. Other libraries may not be so fortunate. If not, the funding for the exploratory study will be more difficult. If you cannot convince your administration to support your study, or if you cannot find some outside funds, then you must rely on equipment salesmen. Although some of my best friends are salesmen (or representatives), their motivation is somewhat different than ours. Still, we are fortunate that the representatives in automated data processing equipment are as talented as they are. At a minimum they can give you the basic cost figures you need; and more often than not, they can and will help in the design of a system. Acceptance of their recommendations must be tempered only by recognition of their motivation.

The final design of our system at Michigan State University is of little importance at this time. Suffice to say that we have used a form of the usual mechanized system with which you are all familiar. Our major adaptation was to use the Friden Collectadata-30 system, which we thought would give us more flexibility for input.

In the process of designing our system, one of the important decisions was the extent of our program. A recurring theme of our discussions with the Data Processing personnel was, "Where does the design of this system end and others begin?" It seemed that when we made a decision that would affect favorably our problem in circulation, we would hinder future automation of acquisitions or cataloging. Many times we even went so far as to discard the system and start over with a total systems approach. As time went on, and as books continued to pile up in the Circulation Department, it became apparent that we had to make a decision related to the problem at hand. Hopefully we have been wise enough to design the system so that later automation of acquisitions, cataloging, and serials can be accomplished within the design. Likewise, the system has the capacity to be adapted for on-line use of computers.

Related to the extent of the system within the library are the problems of a total university-wide data processing system. The university is concerned with all aspects of data processing on campus. Although individual departments are free to design their own systems, the Data Processing personnel attempt to keep all programs compatible. A case in point is our use of the registrar's tape for student addresses. Further analysis of library use will rely on other tapes available in the Center. Likewise, all library tapes (master book tape, use tape, etc.) will be available for other legitimate uses on campus.

Other decisions were needed that related to conversion. Would we convert only those books that had expected circulation? Would we need more information than just the call number, as at Southern Illinois? If we were to convert something other than call number, what information would be needed? All of these questions, and many more, had to be answered.

In our final design we decided to convert the call number, at least a portion of the author's name and title, and the date of publication. Also, we determined that the entire shelf list record should be converted, even if we did not put book cards in all volumes. By having the above information in machine-readable form, we could create a master book tape that would have uses beyond our circulation program. Primarily, however, we though that all this information would be necessary to maintain our circulation control.

Once the system was designed, the university's Data Processing department gave us an analysis of the cost. Although it could cost the operation, it was of little assistance in defining the extent of conversion. At this point we applied to the Council on Library Resources for a grant to test three different methods of converting records. We were concerned with verifying the statements of the various salesmen regarding their own equipment. Verner Clapp agreed to finance our study, so that we could get cost information on converting records to machine-readable tape via key-punching, paper-tape typewriter, and by scanning on a service bureau basis. More will be said on the cost of this operation later. Any analysis of the cost at Michigan State University for computer time and programmers would not necessarily hold true for other libraries. It soon becomes apparent that each university has a different manner of charging for data processing services.

The next decision related to the selection of equipment for use in the testing program. As stated above, we have gone to paper-tape for collecting our data. All other equipment was that in use by our Data Processing Center. A problem arose in that the Center did not have a paper-tape to magnetic-tape converter. Since our decision was to use paper-tape rather than cards, however, an additional converter to handle tape-to-tape has been acquired. After having equipment installed, we were able to have a trial run in parallel with our manual system. Much to everyone's surprise, the system worked.

Once the system was designed, it was necessary to evaluate it and make the major decisions regarding automation. How could we evaluate the projected system, with the projected cost, in terms of the problem we had at Michigan State University? A search of the literature soon revealed that no criteria had been established against which to measure the possible success of an automated program.

With some advantage of experience, it now seems possible to define six criteria, most of which should be met before a system is accepted. At times only some of the criteria might be met for the program to be successful; in other cases it will be desirable for all six criteria to be satisfied. If the criteria can be applied to both an automated and a manual system, in relation to a problem, the decision-making will be easier.

The first criterion, and they are listed in no particular order of importance, is that of cost. Will the system be more economical than the manual system it is replacing? Will the system save space which can be translated into dollars? Will the system save time for the user? Although these latter dollars are not budgeted by the library, they should be considered.

In applying this criterion, one should consider future costs as well as the cost of today's operation. Most automated systems have a high ratio of fixed costs to variable costs. The cost of a circulation system with 1,000 transactions per day might be only slightly less than one with 10,000 transactions. If this is so, and if the projected number of transactions will increase, the savings all might be in the 1970's rather than the 1960's. The decision, then, is one of timing in relation to present costs. Consideration should also be given to the fact that a system may be more expensive in its first few years of operation than it is later. Experience with data processing tends to decrease costs.

In applying the criteria to a proposed program, little consideration should be given to the cost of conversion. This is a decision which will have to be made later, but the system should be considered only on the cost of installation and operation. Conversion can be prorated over a period of time; or it can be considered and budgeted as a one-time cost. It seems that changing to machine-readable record is not very different from changing from Dewey to LC classification. It is a cost brought about by the changing nature of our libraries and the information they contain.

Another criterion against which a new program should be measured is its capacity to handle an increased load. This criterion is closely related to the cost criterion, but it is sufficiently different to be considered separately. If there is one thing we know about libraries, it is that they continue to grow: more books are acquired, the birth rate of new serial titles is exceedingly high and is reflected in the growing list of serials, circulation refuses to reach the point of no return, and there is a seeming insatiable demand for new services. The record of growth of research libraries reveals that any new system must have provisions for growth; and we should probably consider geometric growth rather than arithmetic growth.

The third criterion relates to the better utilization of resources, specifically the use of library materials. Will the system permit us to utilize more fully the resources available? In the case of the M.S.U. circulation department, the automated program makes it possible for us to have books back on the shelves in a fraction of the time that was possible under the manual system. Since the books in circulation tend to be the same ones that other students need, we will receive much fuller utilization of our resources than under the manual system.

Other automation programs, and future automation programs at M.S.U., offer more startling examples of the utilization of resources. Depth of indexing, permutation programs, and retrieval systems are outstanding examples. Printed catalogs, and even the potential of printing sections of the shelf list from our master book tape, will make collections more readily available to the library user.

The fourth criterion is that of more complete and/or additional reports. In most cases of automation, libraries have ended up with more reports about more aspects of their operation than they had ever thought possible. We may find out too much, of course, but we are better off with too much than with too little information.

Operations research workers are closely associated with automation. Information from automated programs, in their hands, yields most interesting results. They have done much of their research without our automation, but the more information we give them, the more they can do. For example, by applying queuing theory to circulation, they have found that if a book circulates for two weeks, to eight different people in one year, then two of the eight users will be seeking the book when it is off the shelves. What does this say to us in terms of duplication? Can we program our computers to tell us when a title has X number of circulations in a period of months, so as to decrease the frustration factor? How useful is such information in relation to cost of the program? We might be wise to accept a system that costs $20,000 a year more than the manual system if it provides us with enough additional information. Since we are unaccustomed to having such information, we find it difficult to equate it with dollar value.

Better reporting for day-to-day operations is one of the noticeable aspects of automation: books in process, outstanding orders, acquisition lists, books in circulation, overdues, and many other aspects are the subjects of standard reports in automated systems. Decision-making and operations are made easier by having this information. A system designed with too many reports can be adapted more easily than one with inadequate reports.

Acceptance of a system by the user, and even by the staff, is another criterion to be considered. We are all aware of SCUM (Student Committee to Undermine Machines), and I even consider joining when I see some systems—especially those that generate demands for payment. The influence of SCUM can be ignored, but not what it signifies. The best-laid plans of any automated system can be hampered by the users. They do not have to love the computer, but they should accept it. In order to meet this criterion, a system should be designed so as to provide the user with more information or better service. If possible, the user should be informed as to why automation is being installed and how it will work. With our circulation system we had almost instant acceptance because the user no longer had to fill out call slips with call number, author, title, name, address, and student number (a process which consumed over 4,000 student man hours last year). Secondly, as important as acceptance by user is acceptance by staff. If the system does not meet their expectation, or if they do not understand the routines for operating the system, then a wise administrator should proceed with caution.

The last criterion to apply to a system is that of accuracy and currency. Will we be provided with more accurate and more up-to-date records? A system with accurate records that are not current cannot meet this criterion. A printed catalog, for instance, that cannot be up-dated as often as required would not meet this criterion. The Hawaii circulation system as described by Shaw, taking an average of 3.3 days to get a record into the computer file and in some cases up to two weeks, would not meet the criterion.[4]

If this criterion were applied to our manual systems, and if we examined the current serial records of large libraries, it is likely that few if any of them would meet a proper standard of accuracy and currency. The lack of accuracy in our manual systems was brought before millions of readers recently in *Life* magazine's story about the lost notebooks of Leonardo da Vinci, which stated: "It had been known for years that the notebooks had belonged to the library, but they were miscataloged a century ago and numerous searches failed to turn them up."[7] Such a statement makes us wonder how many "lost" items are in our own catalogs.

In applying these criteria to new automated systems, it is impossible to devise a formula or to give scores rating each of the criteria in order to arrive at an objective evaluation. Each situation, each problem, and each system must be judged subjectively. At the same time, however, it is necessary to apply the criteria to the present manual system. It is best to weigh both systems against each criterion before reaching a decision.

It is obvious that knowledge of past history and projections for the future are necessary to make a judgment. What are the current costs for circulation, acquisitions, or cataloging? What is the projected scope of the operations? Can costs be projected on a direct ratio, or is there a point beyond which present systems cannot be expanded? These are questions you must ask and must answer before becoming too involved with automation.

Once the proposed automated system has been measured against the criteria, the decision to proceed or not must be made. All decisions to this time have been preliminary. If this paper were being flow-charted, we would now have the decision box with a plus and a minus. If we opt for the latter, we can stop; if for the former, there will be more decision boxes.

The first decision that has to be reached after one decides to continue with automation concerns conversion of the records. In our case we had to decide whether we would convert only the call number, a partial bibliographical record, or a complete bibliographical record. Southern Illinois had completed its conversion for circulation by using a mark-sensed form on which call numbers were indicated. These forms were then sent to a service bureau to be transcribed and to have book cards produced. This seemed to be a very inexpensive and effective way of doing the project. The disadvantage of the system is that the only information given in machine-readable form is the call number. Overdue notices and other communications with the user are strictly with numbers. It was our decision that we needed more information than the S.I.U. procedure would allow. Not only would we want to communicate with our students by title and author, but we could see further uses of information in a total library system.

At the other extreme from Southern Illinois is the project that is now under way at the Library of Congress. The MARC project will provide complete bibliographical information. At the time of our decision, no national program had been developed, nor was information available as to what would be put in machine readable form for the L.C. project.

At Michigan State University, we allowed 35 spaces on a card for call number and copy, four spaces for publication date, and 40 for the author. In most cases we can get the complete name, but in cases of corporate author we ended up with only the first 40 characters. A second card was keypunched, or the tape was extended, with a repeat of the call number and the first 44 characters of the title. We felt that this information was not only necessary for circulation, but that it had some other uses. Specifically, we had the capability to print out portions of the shelf list as demanded by users. We could even print out some sort of an author list, or all of our holdings, if we so desired.

The next decision made by us was whether we should key-punch, use paper-tape typewriters, or find another method of converting the records. Each of the salesmen had convinced us that his method was absolutely the most economical. As mentioned above, we received a grant from the Council on Library Resources to test three methods. It is with some hesitation that I give you a report on our findings. Since the final results will not be known until later in the year, the following must be accepted for what they are: preliminary.

At this point in time, it appears safe to say there is no appreciable difference between keypunching, using paper-tape typewriter or having the shelf list scanned by a commercial service bureau. The costs of each of these are as follows: keypunching, .0392 cents; paper-tape, .0464 cents; and service bureau, .0575 cents. In the case of keypunching, costs are on the basis of producing two cards; paper-tape includes cost of producing tape and converting it to cards (the tape-to-tape converter has just recently been acquired); and the service bureau figures are for typing, scanning, and production of magnetic tape. All records are placed on the master book tape and a book card (35 spaces for call number, 12 characters of author, 26 characters of title and 4 spaces for publishing date) is produced by the computer.

The cost figures reflect an average cost for a number of operators. There is a notable difference between production of individuals.

One of our key operators, originally trained as a key puncher rather than typist, meets the average cost (.0392) for keypunching but produces paper-tape entries at a cost of only .0375 cents.

We are likely to recommend that anyone who is converting a large number of records should use a service bureau. It is true that there is the disadvantage of the shelf list being off campus for a length of time. The ease with which the project can be completed by a large number of typists employed just for this job more than offsets the two week inconvenience of some records being temporarily unavailable. On a continuing basis, our study will likely show that paper-tape typewriter is the most convenient, even if not most economical, way to up-date your files.

We have often been asked about the economic value of our circulation system as compared to the manual one. This was of primary concern to our budget officers as our records were being converted, because we would need several thousand more dollars to operate the automated system. Since book cards would not be available immediately for all books, the two systems were to run in parallel for a time. Our entire data processing costs were to be new dollars in our circulation budget.

From the beginning, we knew that it would cost us more per book circulated with the automated system. At the same time, we knew that at certain periods of the year we lost complete control of our inventory record. We were more concerned that we have an efficiently operating system than that we have a more economical system which did not work when we needed it most.

All of the criteria listed previously, with the exception of present savings, could be met by the system. And although present savings could not be shown, potential savings could. On a chart of projected costs, with the y-axis being time and the x-axis being cost per item circulated, present costs of manual system start low but rise rapidly as amount of circulation increases; automated costs start higher but then will decrease per item as more books are circulated in future years. Although we will spend more in 1966-67, we expect the lines to cross in 1970. The losses for three years of operation will be accounted for in the future.

At present, about one-third of our circulation is on the automated system. Even this amount has saved us from the quarterly crisis. As we are just now entering the week of final exams, the circulation desk is operating and books are being returned to the shelves. The many decisions have given us a workable system.

It is difficult to segregate programming, conversion, and operational costs of the manual and automated systems. At the present time, however, it is our tentative estimate that the automated program will cost 20 percent more than our manual system. We continue to evaluate the program, to make adaptations, and to change flow charts. As we gain more experience with data processing techniques, we are encouraged to move into serials, acquisitions, and other library operations.

A high portion of the cost of automation is equipment. Even though we work through the university's central Data Processing department, several dollars are being expended for equipment rental for the library. For efficiency, all equipment should be utilized as fully as possible. We are considering a number of different programs to take advantage of the available equipment. A specific example of equipment utilization is our student payroll. We have one Friden machine available as standby equipment. In the total Collectadata-30 system is a clock. Time cards were made for all 350 of our student employees. The Collectadata acts as our time-clock for each student. Total hours worked are recorded daily on the tape for each student. The paper tape is sent to Data Processing and records are forwarded directly to the payroll office. Not only do we have a more accurate record of the time students work, but it has been accomplished with a 15 percent saving in the time of our payroll clerk.

There will be other decisions regarding automation as we gain experience. It is even possible that the most difficult one of all will have to be made—the decision that automation does not work after all! I hope that if that time comes we have the wisdom and the courage to admit it. In the meantime, we are pleased with the few small steps we have taken.

REFERENCES

1. Bryan, Harrison. "American Automation in Action," Library Journal, 92:189-196, Jan. 15, 1967.

2. Educational Facilities Laboratories, Inc. Bricks and Mortarboards. A Report on College Planning and Building. New York, Educational Facilities Laboratory, [1964], p. 93.

3. Cammack, Floyd M. "Remote-Control Circulation," College & Research Libraries, 26:217, May 1965.

4. Shaw, Ralph. "Machine Application at the University of Hawaii," College & Research Libraries, 26:382, Sept. 1965.

5. President's Science Advisory Committee. U. S. Science, Government and Information: the Responsibilities of the Technical Community and the Government in the Transfer of Information; a Report. Washington, D. C., U.S.G.P.O., 1963.

6. King, Gilbert W., et al. Automation and the Library of Congress. Washington, D. C., Library of Congress, U.S.G.P.O., 1963, p. v.

7. "Leonardo's Lost Notebooks," Life, 62:25, Mar. 3, 1967.

COMPUTERIZED BOOK CATALOGS AND THEIR EFFECTS ON INTEGRATED LIBRARY DATA PROCESSING: RESEARCH AND PROGRESS AT THE LOS ANGELES COUNTY PUBLIC LIBRARY

Ronald A. Zuckerman

Fashions in library catalogs change with current academic-administrative climate, technological advances, and the socio-economic well-being of a society. Book catalogs were supreme in the rarefied quill pen era. The typewriter, coupled with emerging professionalism, brought card catalogs to full flower. Equipment breakthroughs, the ever-increasing "information explosion," and expanding mass interest in libraries have brought about a revival in catalog experimentation. As systems become more complex, the need for long-range planning grows dramatically. If automatic data processing (ADP) is to be used successfully and selectively, library administrators must increasingly approach individual applications within a framework of integrated data processing.

For the past three years, the Los Angeles County Public Library has been conducting a systemwide study dealing with potential areas of library mechanization. A task group representing various specialties within the library has been operative during this time. William S. Geller, County Librarian, and members of his Executive Division have utilized group findings in formulating their approach to integrated data processing.

Since 1952, the County Library has been producing book catalogs, first via unit record (or punched card) equipment and currently through sequential camera processing. During this time, catalog content and format have undergone developmental modifications to improve overall quality. The library is now preparing for conversion to a computerized catalog system, since the sequential camera method, while providing excellent copy, is fraught with production difficulties.

Ronald A. Zuckerman, formerly Research Assistant, Los Angeles County Public Library, is Associate Systems Analyst, Chancellor's Office, California State Colleges.

Research at the County Library has centered about advances in data collection, sophisticated computer output devices, library bibliographical techniques, and to a lesser extent computer processing where an advanced state-of-the-art exists. In July, 1966, the Council on Library Resources, Inc., granted the County $38,000 to conduct a research-demonstration project. One of the major project goals involves demonstrating optical character recognition in bibliographical control, patron registration, and circulation applications. At present, this CLR-sponsored study is still in progress.

Book Catalog Production Methods

There are essentially five book catalog production methods:

(1) Manual, in which previously prepared catalog cards are arranged to form pages. An image of the arranged cards is converted into a repro-plate, stencil, etc. Catalog pages are then reduced and bound. With the manual method, it is also possible to type or typeset complete catalog pages, rather than shingle or arrange cards.

(2) Unit record, in which catalog data is keypunched into tab cards. Decks of cards are manually or machine sequenced (coding is required for machine sequencing), and listings are printed out on a tabulator. Listings may be printed out on multilith mats or ordinary paper with or without carbons. Listing pages are then bound or reproduced and bound.

(3) Sequential camera, in which data is typed or typeset in single or multiple lines, on tab or other cards. Decks of cards are then manually or machine sequenced (coding is required for machine sequencing). Cards are then processed by sequential camera, that is, they are individually photographed on a continuous roll of film. After film is developed, cut into column lengths and pasted up to form pages, reproduction and binding processes commence.

(4) Computer, in which catalog data is converted to machine processable form. Data is sequenced by manual or machine methods and then listed on a line printer or converted to a form which may be listed off-line on a line printer, typesetter, or other device.

(5) Combinations of the above. An example of such a combination is provided by the Alanar book catalogs of Bro-Dart, Inc. In these catalogs, random catalog cards are arranged to form pages, then referenced by page number and location, and processed to produce "registers." This procedure is equivalent to the manual method previously described. Indexes to the registers are produced by keypunching short catalog information and register page and entry location into tab cards. Index information is then processed, reproduced and bound as in the unit record or computer method.

There are advantages and disadvantages associated with all book catalog methods, when one considers the requirements of a particular library. Within the framework of integrated data processing, a library might select any one of the methods presented or their variants, selecting a combination on the basis of catalog quality desired, technical restrictions, and cost factors.[1]

Computerized Catalogs—Hardware

Hardware ranging from small-scale card computers to large-scale processors with many peripherals may be used advantageously in book catalog production. Minimal control processing unit (CPU) and equipment configuration technical capabilities are dictated primarily by data file size, individual record length, the extent of data manipulation required, the complexity of or necessity for machine sorting, and the input medium used in preparing data. New general and special purpose computers with catalog production capability are continually being developed by an increasing number of manufacturers. A descriptive list of selected newer machines is presented in Figure 1.

Five basic types of equipment are currently available for generation or input of catalog data: keypunches, paper-tape punches, magnetic tape writers, on-line terminals, and optical character readers. Magnetic ink character readers, pattern recognition equipment (mark sense, bar code, etc.), incremental measurement devices, and sound recording techniques are presently unsuitable for such use.

Keypunching, paper-tape punching, and magnetic-tape writing all employ keystroking to encode machine-processable information. After the keystroking process, data is verified by performing either a second keystroking operation, manual scanning of interpreted data, or proofreading of a machine printout. When errors are encountered, data are corrected.

On-line terminals are used for keying information directly into a computer or peripheral processing system. Data usually is simultaneously typed out or displayed on a cathode ray tube (CRT) with on-line verification and correction procedures. More detailed information concerning data conversion via terminals is available in studies completed by IBM for the Library of Congress.[2]

Optical character-page readers are capable of reading characters typewritten on stylized forms with great accuracy, when quality is controlled. This is the only method in which man and the machine are able to "read" the same symbols. With character recognition, it is possible to type a catalog entry on a page, manually proof the page, make corrections, additions, and deletions to the page—and then optically read fully proofed data. In 1966, the first book to deal exclusively with optical character-page reader (OCR) equipment, techniques, and selected applications was published.[3]

Figure 2 lists selected equipment of the five basic types previously described.

To date, direct-access storage has not been a popular medium for retaining large files of catalog data. This is probably due to the relatively high cost of direct-access storage devices such as disc pacs, when compared to magnetic tape and other sequential storage media. Newer mass memory devices such as magnetic strip files have not yet countered this trend.

While there are a number of on-line and off-line computer output devices, except for several notable examples, book catalogs have been listed on standard computer printers. When a lower case alphabet and extensive special symbols are added to a line printer character set, speed of the printer and system throughout are substantially reduced. Input-output (I/O) typewriters are too slow for serious consideration in listing book catalogs. The availability of newer hardware, such as a computer interfaced Calcomp 835 plotter, has not countered the preference for off-line alternatives to the computer printer.

Devices used for off-line preparation of catalog pages are primarily magnetic tape or punched paper tape activated. Such machines and systems range from relatively simple automatic typewriters and print stations to complex photo-composers and high speed microfilm recorders of cathode ray tube (CRT) displayed symbols. When off-line processing requires a conversion from magnetic tape to punched paper tape, it is possible that conversion time may exceed processing time, since paper tape cannot be punched as fast as it may be read. Libraries and Automation,[4] though lacking details on the latest equipment, contains excellent information about automated graphics. A selected list of currently available hardware is included in Figure 3.

Computerized Catalogs—Systems and Software

Mechanized book catalog procedures all employ some manual procedures. The balance between manual and machine operations fluctuates widely with different systems. A computer may be used in a limited capacity much like a 407 tabulator, that is, as a printer for listing decks of punched cards which are manually sequenced. In a highly computerized book catalog system, a complete bibliographical record might be prepared once, in a machine-processable form. Subsequent computer processing might include extracting data from master records for catalog entries; formatting entry data; machine sequencing or alphabetizing of entries in a dictionary catalog or individual sections of a divided catalog; deletion of repetitious heading information; maintenance of master and other files; and creation of multi-columned catalog pages which include fixed-spaced or proportionally-spaced characters and justified or unjustified right hand margins in columns.

The minimal hardware capabilities and software requirements for computerized book catalog production increase with the number and/or type of operations to be performed on the computer. It is a most difficult matter to estimate (accurately) system design and programming costs for a catalog system of this complexity. Figure 4 charts the range of operations and equipment which may be potentially incorporated into computerized book catalog systems.

To machine-catalog data in accordance with ALA or similar filing rules presents formidable problems. Computers sort fixed length fields of data strictly character by character. A typical collating sequence or ascending character order for computer filing is space, A-Z, and 0-9. A period (.) might file after the space and before the character A. Non-standard treatment of characters or data to be sorted must be programmed into the computer. For example, if "U.S." is to be filed as United States, a special subroutine must be written to handle such cases. To develop a workable machine-filing system requires compromise. Data will require rearrangement in the input-preparation stage. Special symbols with programmed filing uses will have to be added to records. Filing rules will need to be modified on occasion for the benefit of the computer and quite possibly the catalog user. The mysteries of machine filing are explored in some depth in a recent work issued by the Bro-Dart Foundation.[5]

A single source record concept is difficult to develop for bibliographical data. Within catalog records there are units of data such as author, title, notes, etc., which may be designated as fields. Fields may be referenced by tags. For example, the class number field might be identified by the tag 1, the author field by the tag 2, etc. Unfortunately, fields may contain extremely variable length data. Any given catalog record may contain data for only a selected number of fields. There is even lack of agreement in the library world as to how fine a division of data should be made when separating bibliographical data into fields. The Library of Congress in its Project MARC has completed a considerable amount of work dealing with the organization of input data.[6]

Other factors which affect computer catalog systems are frequency of issuing master and supplement catalogs; dictionary arrangement or divided nature of a catalog; readability and format requirements for printed copy; and entry density on the printed page. These and other factors are discussed in studies conducted for the

State of New York,[7] the New York Public Library,[8] and the California State Library.[9]

Book Catalogs and Integrated Library Data Processing

Proponents of integrated data processing usually reason that data for catalog and book record production may be captured during acquisition input preparation. Acquisition data actually decreases in value as a source of catalog information as depth and quality of cataloging increase. If one is planning a highly mechanized book catalog which will contain entries comparable to Library of Congress cataloging in detail, together with a fair number of added entries, and which will have good typographical quality, it is highly improbable that acquisitions data can be successfully adapted for catalog input use.

Catalog production is the one public library application in which there is a strong interest in extended character sets and high speed graphic quality output. Applications such as ordering, registration, circulation and serials may effectively use upper case alphabetic information, numerals and a limited array of punctuation and special symbols, as available on standard unit record and line-printing equipment.

Los Angeles County Computerized Catalog Planning

The evolution of the Los Angeles County Public Library unit record book catalogs[10] and sequential camera catalogs[11] has greatly influenced the design of this library's future computer-compiled catalogs. Major aims, goals, and solutions presently incorporated into the over-all system currently under development include:

(1) Retaining the informational content and sectional division of present catalogs. Samples of entry content are presented in Figure 5. Separate catalogs are produced for Adult and Juvenile collections. Adult catalogs are divided into Author, Title, Subject, Fiction and Foreign sections. Juvenile catalogs contain Author, Title and Subject sections.

(2) Retaining the present concept of master catalogs with periodical cumulative supplements. The planned production schedule includes six printings of catalogs each year, a master catalog with five bi-monthly cumulative supplements. These catalogs will be printed and bound in a quantity of three hundred copies.

(3) The conversion of the entire present catalog data base to a machine-processable form in an extended character set, by library personnel in a relatively short time. A single master record approach will be used. Library authority files are presently undergoing modification to conform to the new Operations Manual which has been issued. Actual input data will be typed on IBM Selectric typewriters equipped with carbon ribbons and pin-feed platens. This data will be "machine-read" through otpical character recognition techniques. See Figures 6 and 7 for input description and samples.

(4) Initially contracting with a vendor or vendors for complete programming, computer processing, printing and binding of book catalogs. At this writing a request for proposal (RFP) to vendors is being finalized. This RFP includes specifications for at least upper and lower case alphameric catalog printouts with a minimum of eighteen special symbols. Double-columned pages, suppression of duplicate author and subject headings, and computer filing of data are specified. Figure 8 documents the system under development.

Implementation and Future Plans

The computerized catalog system should become operative in the latter part of 1967. Initially the system will be used to produce cumulative bi-monthly supplements and to convert master catalog data to magnetic tape. A complete set of master catalogs is scheduled for production in late 1969. It is estimated that these master catalogs will contain approximately 2,000,000 lines of computer printout or more than 20,000 pages which will then be printed and bound in quantity.

It is difficult to determine what future systems improvements will be incorporated into Los Angeles County Public Library book catalogs. There is much interest in using newer high speed type composing equipment such as the RCA Videocomp. Magnetic tapes to be produced may be modified at a later date for use with type composing equipment.

Another technique which may be explored is the graphic reproduction of OCR input forms typed at the Library. These printed input forms could be supplied to other libraries for use in similar catalog production systems. A user library could add and/or delete information as needed directly on input forms prior to machine processing.

There is a tendency, in developing a computer-based book catalog system, to overstate the importance of data processing operations. While great care and ingenuity must go into engineering such a mechanized system, it must always be realized that the system is dependent on non-mechanized functions, such as cataloging, proofreading and maintenance of information files. The success or failure of a computer-based catalog will depend heavily on these manual procedures long after technical problems have been overcome.

COMPANY & MODEL	BITS PER WORD	CORE SIZE (K)	CARDS		PAPER TAPE		MAG. TAPE (Kcps)	PRINTER LPM	DISC	DRUM
			IN	OUT	IN	OUT				
Burroughs										
B300	6	4.8-19.2	200-1400	300	1000	100	18-72	475-1040	x	-
B5500	48	4-32	200-1400	300	1000	100	24-66	475-1040	x	x
Control Data										
3300	24	8-262	1200	250	100	120	120	150-1000	x	x
6400	60	32-131	1200	250	100	120	30-240	150-1000	x	x
General Electric										
115	8	2-8	600	300	400	100	21-42	600	x	-
435	24	32	900	300	500	150	160	900	x	x
Honeywell										
200/120	Varies	2-32	800	100-400	600	120	13-90	450-1260	x	x
200/4200	Varies	32-524	800	100-400	600	120	13-90	650-950	x	x
IBM										
360/20	8	4-16	1000	300	-	-	15	200-1100	-	-
360/65	8	131-524	1000	300	-	-	30-340	200-1100	x	x
NCR										
590	48	.2-.4	100	100	650	120	-	125	x	x
315RMC	12	20-80	2000	250	1000	120	24-120	1000	x	-
RCA spectra										
70/15	8	4-8	550-1435	100-300	200	100	30-120	600-1250	-	-
70/55	8	65-524	550-1435	100-300	200	100	30-120	600-1250	x	x
Univac										
9200	8	1-4	1000	75-200	-	-	-	250	-	-
1108	36	32-131	900	300	400	110	25-120	700-922	x	x

Figure 1.
Selected Newer Computer Systems

INPUT EQUIPMENT.

KEYPUNCHES & VERIFIERS			TAPE PUNCHING		MAGNETIC TAPE WRITING	
COMPANY	MODEL	INTERPRET	COMPANY	MODEL	COMPANY	MODEL
IBM	024 026 029 056	no yes yes -	Dura Business Machines	Mach 10	Mohawk Data Sciences	1101 keyed Data Recorder
Univac	80 column keypunch 80 column verifier	no -	Friden	Flexowriter Justowriter		
			Invac	TMP-200		
			SCM	Typetronic		
			Fairchild	Line perforator (non-typing)		

OPTICAL PAGE READERS

COMPANY	MODEL	CHARACTER SET	FONT (S)	PAGE SIZE (INCHES)	CPS*	FEED & TRANSPORT	SCANNER & LOGIC
Burroughs	Typed Page Reader	Alphameric Punctuation	Upper. Case Elite	L:11 W:8.5	75	Vacuum, Drum	Flying spot, Matrix match
Rabinow (CDC)	915/Page Reader	Alphameric Punctuation Symbols	A.S.A. & other Upper Case	L:2.5-14 W:4-12	370	Vacuum, Conveyor belt	Parallel photocell, Matrix match
Farrington	1P Page Reader	Alphameric Punctuation Symbols	Selfchek, A.S.A. & IBM 1428	L:5.5-13.5	280	Vacuum, Drive roller	Mechanical disc, Stroke analysis
	Selected Data Page Scanner	Alphameric Punctuation Symbols	Selfchek	L:5.5-13.5 W:4.5-8.5	200	Vacuum, Drive roller	Mechanical disc, Stroke analysis
Philco	General Purpose Print Reader	Alphameric Punctuation Symbols	Multiple fonts	L:3-11 W:5-8.5	2000	Vacuum, Conveyor belt	Flying spot, Matrix match
Recognition Equipment	Electronic Retina Rapid Index Page Reader	Alphameric Punctuation Symbols	Multiple fonts	L:3.25-14 W:4.88-14	2400	Vacuum, Drum & conveyor belt	Parallel photocell, Matrix match

*Reading speed in terms of CPS (characters per second) should not be used for comparison purposes. Selective reading requirements, document handling speed, page layout, machine reject rates, etc., all affect actual production speed of OCR (optical character-page reader) devices.

Figure 2
Selected Data Collection Equipment.

DISPLAY SYSTEMS*

MANUFACTURER	CONSOLE (ALPHAMERIC)	# CHARACTERS DISPLAYED	PRINTER MODEL
Control Data	211	1000	Model 218 Hard copy printer
General Electric	760	736	Model 33 or 35 Teletype
Honeywell	303	768	
IBM	2260	960	1053 Terminal
Rsytheon	DIDS-400	1040	Model 33 Teletype
Sanders	720	1024	Model 33 Teletype
Stromberg Carlson	SC1100	500	Model 33 Teletype
Teleregister	203	768	Model 33 Teletype

*Displsy systems require controllers or other devices to interface with a central processing unit. Tbe number of display stations which msy be placed on-line varies with different systems. Additionsl information about display systems is available in System Development Corporation report TM-2571, Study of Small Scale Tabular Display Systems, 1965.

TERMINAL SYSTEMS*

MANUFACTURER	SYSTEM	KEYING DEVICE
IBM	1440/1460 Administrative Terminal System	1052/2 Printer-Keybosrd Terminals or Modified Selectric I/O Typewriter terminals

*A description of ATS (administrative terminal system) is contained in IBM Application Program report number H20-0129-0.

Figure 2 (cont.)
Selected Data Collection Equipment.

TYPE OF DEVICE	SPEED RANGE	PROPOR-TIONAL SPACING	LOWER CASE	BOLD FACE	PRINT QUALITY	EXAMPLES
Typewriter on-line	5-15 cps	Yes	Yes	No	Good	
Automatic typewriter	5-15 cps	Yes	Yes	No	Good	Flexowriter
Computer line-printer	150-1200 lpm	No	Yes*	Yes*	Fair	IBM 1403
Off-line printers	150-1200 lpm	No	Yes*	Yes*	Fair	Data Products 4000 series Potter Instru-ments Chain Printer
Hot Metal Typesetters	3-8 cps	Yes	Yes	Yes	Excellent	Mergenthaler Linotype
Photocomposers Paper tape activated	5-30 lpm	Yes	Yes	Yes	Excellent	Mergenthaler Linofilm Photon 713
Magnetic tape activated	25-150 lpm	Yes	Yes	Yes	Excellent	Photon Zip
Videocomposers	100-180 lpm	Yes	Yes	Yes	Excellent	RCA Videocomp
High speed plotters & microfilm recorders	50,000-100,000 lpm	No	Yes	No	Fair-Good	Stromberg Carlson 4000 series equip. Calcomp 835

*Speed is substantially reduced with the addition of characters.

Figure 3
Printout Devices

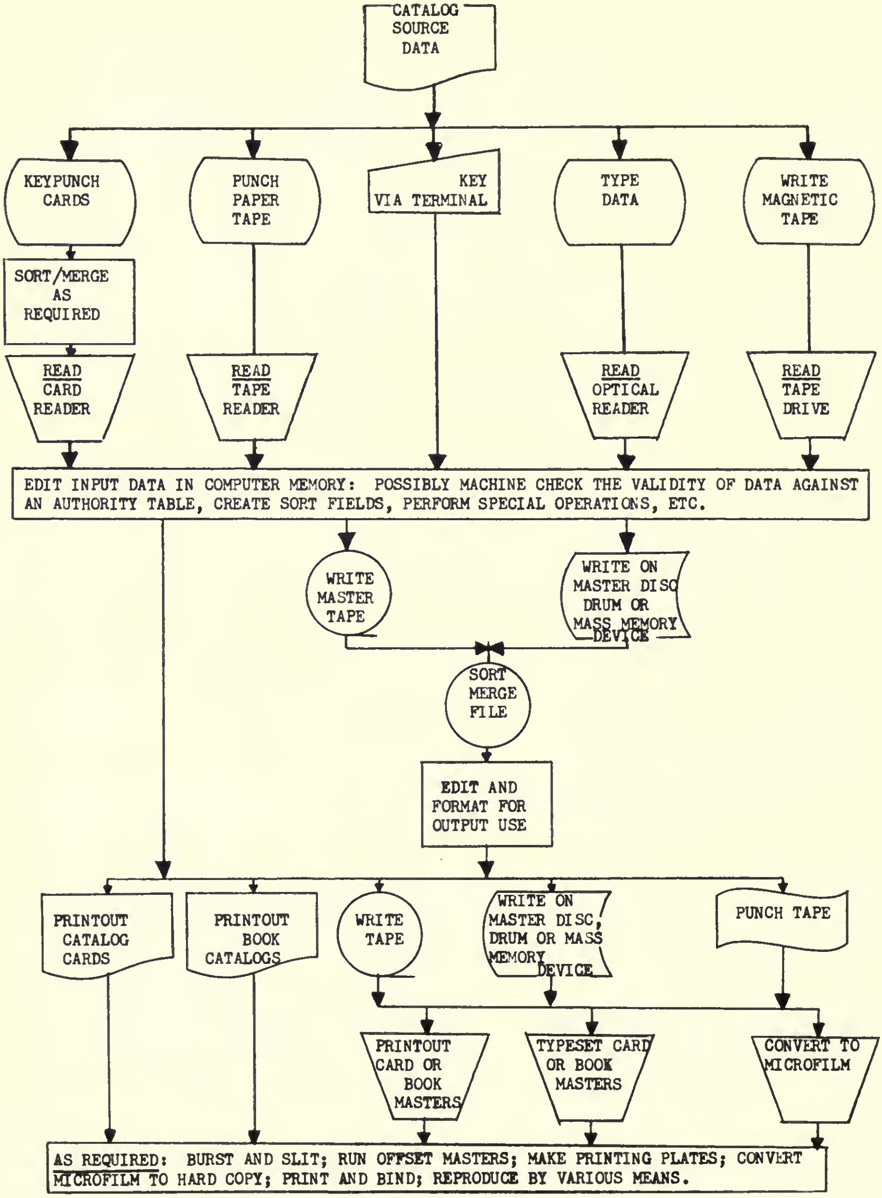

Figure 4
Operations and Equipment for Computerized Book Catalog Systems.

KENNEDY, JOHN FITZGERALD, PRES. U. S.

#816 Adler, Bill. John F. Kennedy and the young people of America. McKay, 1965. 146 p. Illus.
Collection of letters sent by children and young people to John F Kennedy and his wife.

975.5 Andrews, Peter. In honored glory; the story of Arlington. Putnam, 1966. 191 p. Illus., ports.
Arlington National Cemetray from the Civil War to the Kennedy Memorial, and the lives of twenty-five notable persons buried there.

92 K354 Bergquist, Laura. Very special President. Photos. by S. Tretick. Designed by L. Jossel. McGraw, 1965. 203 p. Illus., ports.
A portrait based upon interviews with John F. Kennedy by Look newswoman.

SUBJECT

– U –

R317.3 U39P8 U. S. census of population: 1960. Detailed characteristics. California, by U. S. Bureau of the Census.
U. S. Government serials & periodicals *SEE*
015 Andriot, John L. Guide to U. S. Government serials & periodicals.
947.08 U. S. S. R. and the future, by L. B. Schapiro.
92 N962 U Nu of Burma, by R. A. Butwell.
641.56 Ulcer diet cook book, by H. Rubin.

TITLE

WRIGHT, LOUIS BOOKER
822 S52 Shakespeare for everyman. Washington Square Pr., 1965. 221 p. Illus., ports., facsims. Bibliography: p. 193-209.
972.99 Voyage to Virginia in 1609; two narratives: Strachey's "True reportory" and Jourdain's Discovery of the Bermudas. Published for the Association for the Preservation of Virginia Antiquities, by Univ. Pr. of Va., 1964. 116 p.

CHURCH WORK
\# Curtsinger, Josephine. Seldom without love; a mock mock epic. Macmillan, 1965.
Newly acquired hearing aid sparks a Texas wife's determination to raise money for her church.

CIRCUSES AND CIRCUS LIFE
Finney, Charles Grandison, 1905- Circus of Dr. Lao; with drawings by B. Artzybasheff. Viking, 1964, 1962.
Impact of a traveling circus upon the citizenry of small American town.
Stewart, Mary. Airs above the ground. Mill, 1965.
What promised to be no more than a personal mission for a married woman and her young charge in Vienna, eventually involves security forces of three countries and the white stallions of Vienna.

CIVIL RIGHTS
Kennedy, Jay Richard. Favor the runner. World Pub. Co., 1965.
New York attorney, champion of many past causes, and a Negro entertainer ente into partnership to aid the Civil Rights movement

FICTION

BERLITZ SCHOOLS OF LANGUAGES OF AMERICA, INC.
J438.6 Berlitz German for children: Cinderella and Sleeping beauty. Ed. by the staff of the Berlitz Schools of Languages under the direction of R. Strumpen-Darrie and C. F. Berlitz. Illus. by D. Wilson.
Grosset, 1962.
English and German in text.

BERNA, PAUL
J Flood warning. Tr. from the French by J. Buchanan-Brown. Illus. by C. Keeping.
Patheon, 1962.
Translation of "La grande alerte".

Figure 5
Samples of Entry Content of present Los Angeles County Public Library Book Catalog.

WRIGHT, LOUISE LEONARD
SEE
327 Wright, Quincy. Study of war. Abridged ed. 1964.

WRIGHT, QUINCY
327 Study of war. Abridged ed. Abridged by L. L. Wright. Univ. of Chicago Pr., 1964. 451 p.

AUTHOR

—A—

J A promise is a promise, by M. Cone.
J633 About grasses, grains, and canes, by M. J. Uhl.
J386 About canals, by S. P. Newman.
J634 About nuts, by S. P. Russell.
J Across five Aprils, by I. Hunt.
J150 Adventure book of the human mind, by J. G. Miller.

JUVENILE TITLE

JUVENILE AUTHOR

WESTWARD MOVEMENT - STORIES
J Bond, Gladys Baker. Head on her shoulders. Illus. by R. Kennedy. Abelard, 1963.
An accident forces thirteen-year-old Brita to assume the responsibility of moving three younger children and family possessions in a boxcar traveling west with a pioneer train. Grades 5-6.
J Yates, Elizabeth. Carolina's courage. Illus. by N. S. Unwin. Dutton, 1964.
A young girl has a difficult sacrifice to make during the long journey westward with her family in pioneer days. Grades 3-4.

JUVENILE SUBJECT

Figure 5 (cont.)
Samples of Entry Content of present Los Angeles County Public Library Book Catalog.

903

LOS ANGELES COUNTY PUBLIC LIBRARY
BIBLIOGRAPHICAL DATA

Figure 6
Sample Bibliographic Input Form

TAG	FIELD	DESCRIPTION
0	Class number	Dewey number or special symbol(s)
1	Author	The entire main author under which a work is listed in the Author Catalog
2	Title (main title)	The entire title of a work or portion thereof which is listed in the Title Catalog
3	Sub Title and/or additional information	Any information which follows the main title of a work and precedes the imprint
4	Imprint	The publisher and publication date
5	Collation	Information concerning pagination, illustrations, bibliographical coverage, etc., which follows the imprint and precedes the notes
6	Notes (Liners and Contents)	Any notes to which the library has added the liner indication
7	Annotation	A descriptive statement developed by the library for inclusion in one of the various types of subject catalogs
8	Subject(s)	The subject heading which will appear in the non-fiction Subject Catalog (also foreign language)
9	Fiction subject(s)	The subject heading which will appear in the Fiction Subject Catalog
A		Author reference to an author
B		Author reference to a work
C		Author-title reference to a work
D		Title reference to a work
E		Title-author reference to a work
F		Non-fiction subject reference
G		Fiction subject reference
H-Z		Reserved for future uses and information for ordering or book records production usage if required

Figure 7
Sample Input Data Tags and Fields

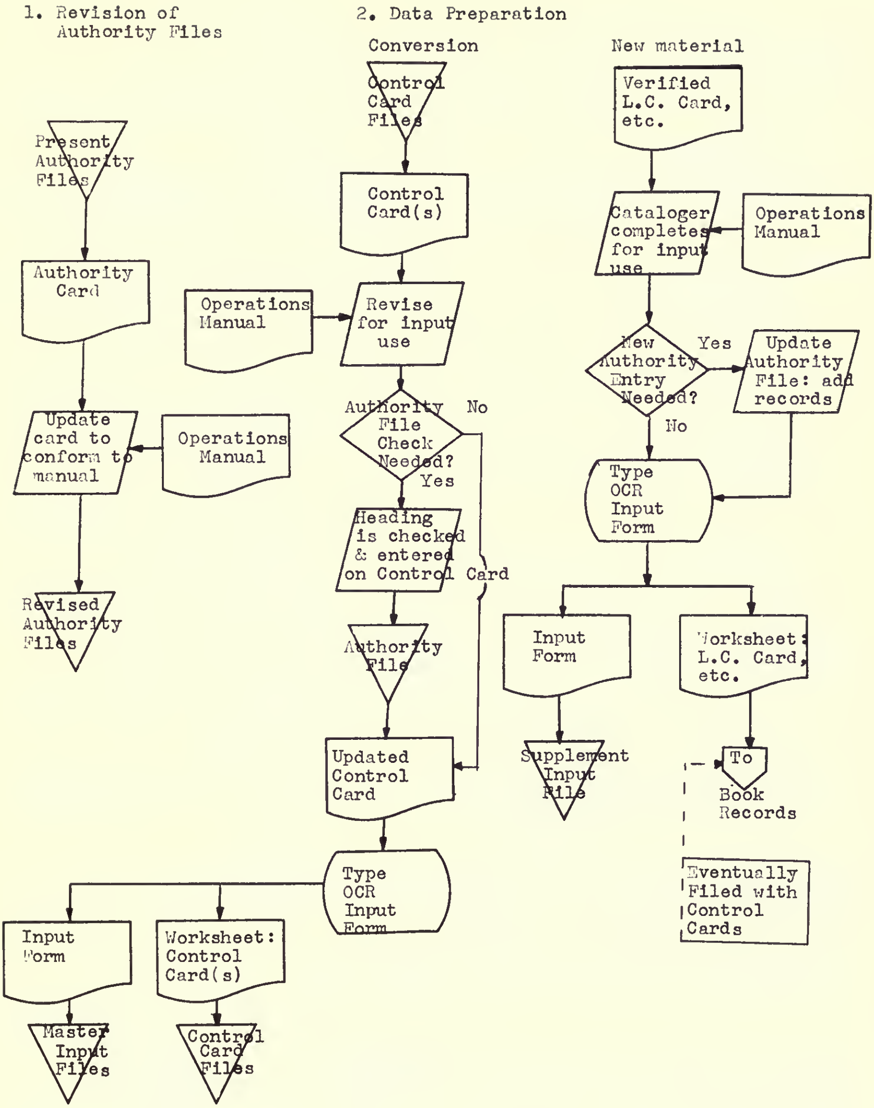

Figure 8
Computerized System now under Development at the Los Angeles County Public Library

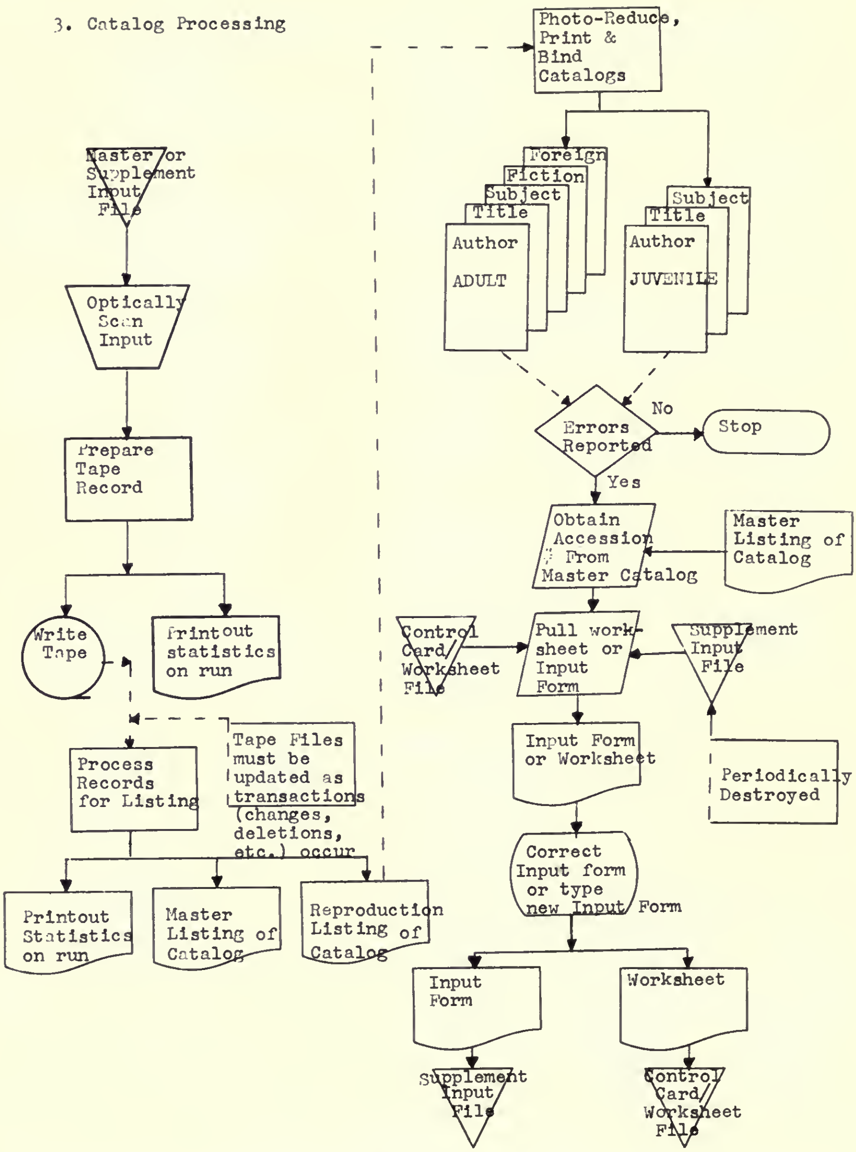

Figure 8 (cont.)
Computerized System now under Development at the Los Angeles County Public Library

REFERENCES

1. Hayes, Robert M., and Shoffner, Ralph M. The Economics of Book Catalog Production. Sherman Oaks, Calif., Hughes Dynamics, Inc., Advanced Information Systems Division, 1964.

2. IBM Federal Systems Division. Report of a Pilot Project for converting the Pre-1952 National Union Catalog to a Machine Readable Form. Rockville, Maryland, IBM, 1966.

3. Dyer, Ralph, et al. Optical Scanning for the Business Man. New York, Hobbs, Dorman, 1966.

4. Sparks, David E., et al. "Output Printing for Library Mechanization." In Barbara Evans Markuson, ed., Libraries and Automation (Proceedings of the Conference on Libraries and Automation held at Airlie Foundation, Warrenton, Va., May 26-30, 1963, under the sponsorship of the Library of Congress, National Science Foundation and Council on Library Resources, Inc.) Washington, D. C., Library of Congress, 1964, pp. 155-190.

5. Hines, Theodore C., and Harris, Jessica L. Computer Filing of Index, Bibliographic and Catalog Entries. Newark, N. J., Bro-Dart Foundation, 1966.

6. Proceedings of the Third Conference on Machine-Readable Catalog Copy (Discussion of the MARC Pilot Project). Washington, D. C., Library of Congress, 1966.

7. Nelson Associates, Inc. "Centralized Processing for the Libraries of New York State: A Summary," Bookmark, 25:243-246, April 1966.

8. Stein, Theodore. The New York Public Library Reference Department Catalog Study Report No. 14. New York, Theodore Stein Company, 1966.

9. Cartwright, Kelley L., and Shoffner, Ralph M. Catalogs in Book Form. Berkeley, Calif., University of California Institute of Library Research, 1967.

10. Henderson, John D. "The Book Catalog of the Los Angeles County Public Library." In Herbert Goldhor, ed., Proceedings of the 1963 Clinic on Library Applications of Data Processing. Urbana, Ill., University of Illinois Graduate School of Library Science, 1964.

11. Macquarrie, Catherine. "The Metamorphosis of the Book Catalogs," Library Resources & Technical Service, 8:370-378, Fall 1964.

AN ADMINISTRATOR'S APPROACH TO AUTOMATION AT THE PRINCE GEORGE'S COUNTY (MARYLAND) MEMORIAL LIBRARY

Elizabeth B. Hage

Prince George's County Memorial Library has been bitten hard by the automation bug, and it is one bug we are eager to cultivate. We began some two years ago, but I do not want to give the false impression that this paper will be full of technical information. I know little about this binary business. However, the planners of this clinic were kind enough to say that what they were interested in having was the approach to automation of just such a technically ignorant library administrator.

Perhaps first of all, some background information about Prince George's County may be of interest. Before World War II, Prince George's County was a pleasant rural county whose chief product was tobacco raised for the landed gentry by sharecroppers and day laborers, many of whose ancestors had probably worked the same land as slaves. However, the Federal government owns a large tract of land where the Department of Agriculture carries on experiments in many areas of its responsibility—the Beltsville turkeys, which are widely known, come from here. The new National Agriculture Library is being built on some of this land. Furthermore, the University of Maryland is located in the county. The Census Bureau, Goddard Space Agency, and Andrews Air Force Base are among other large installations in the county. It hardly needs to be pointed out that all these operations bring in ever-increasing numbers of people. The county seat, Upper Marlboro, was formerly a sleepy little rural community whose greatest activity took place at the tobacco warehouses in the spring when the auctions were—and still are—held. The town is still small, but its greatest activity now is at the court house, daily and all year round. The natives are beginning, it appears, to realize what has hit them since the war; for since then Prince George's County has become a bedroom county for the District of Columbia and one of the most rapidly growing counties in the country—a part of the eastern

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Elizabeth B. Hage is Director, Prince George's County Memorial Library, Hyattsville, Maryland.

seaboard megalopolis. People are moving in at the rate of a thousand a week. This is not said with any sense of bragging or pride, but rather as an item of information to indicate what has happened to our sleepy, pleasant, rural county. This rate of growth has been going on now for over two years; previously it was not quite so fast.

We at the library who are trying to cope with this growth from a service point of view feel as though we were on a treadmill—and at times, even, as though we were caught in a squirrel cage, or as though like Alice we must keep running and running just to stand still. But the picture is not all dark, for many of these people who have moved into the county come from areas where they enjoyed good library service. They have made their demands loud enough to be heard in the court house, and three years ago we opened the first county-owned library building in the county. It is a building of about 38,000 square feet, and in the first year it was open, half a million books were circulated. Previously the highest total circulation of twelve branches and three bookmobiles had only been about 600,000. A second building has now opened—a much smaller one, too small in fact for our county—and later this year another branch the size of the first will be opening. A third large one is under construction, a fourth about to go out for bid, and architects have submitted plans for two more. Our ten-year projection includes more, but these are all that are presently under way.

This expansion is mentioned to afford a better understanding of why we were so interested in the possibilities of automated processes when they began to appear feasible. The library, of course, has not been the only area of expansion and progress in the county, and some of the better pieces of it have been at the court house where the commissioners have realized what is happening, and that drastic steps—drastic to the antiquated thinking of post-war days, but certainly not in relation to requirements—needed to be taken to provide improvement in the mechanics of running the total operation. Two new positions were created, administrative assistant to the commissioners and a budget director. To fill the new positions, two highly qualified young men were hired. They came aboard at about the same time, and very soon began visiting the various departments and agencies of the county. The library was pretty far down the line on the visiting list—just as we had been, for many years, on the budget appropriations. One of our most lasting memories will surely be of that visit; for it was during that conversation that a computer, or computerized operations, was first mentioned among us. Few if any of us had supposed we could live long enough to have Prince George's County Memorial Library operations automated; we certainly were not large enough to warrant the cost of a computer for ourselves, and we were not at all enthusiastic about automating bits and pieces of the business—when we went, it should be the whole hog! Our visitors agreed that it would certainly be an interesting approach; but it is doubtful whether any of us really knew what we were talking about at that time. The budget director did a study of our accounting system during the next several days and reported to the commissioners and the Library Board that we knew what we were doing in the accounting and bookkeeping area and were doing it well.

About a year later, the administrative assistant called to say that the county was having a study done by a consultant to determine if it would be practical to shift from a tab operation to a computer. What the commissioners were interested in, primarily, were the departments right in the court house, but they would like the consultant to "touch base" with the other agencies of the county that were located outside the court house. That conversation with the consultant was the next milestone in the library's growth and development, for at the end of it, we asked if he would submit a proposal for doing a feasibility study, in depth, of the library alone. He did, and the Board accepted the proposal. It cost us $5,000.

Between the time of the signing of the contract for the study and when it actually began, we asked two young men on our staff who had previously indicated some interest in automation and data processing if they would be interested in taking IBM's aptitude test with the possibility of one of them being selected to come into headquarters (both were branch librarians) to work with the consultant during the study. Both took the tests, and both did well, but one a little better than the other. Since he had also expressed keener interest in the project when we first talked about it, he was selected to work with the consultant. This still appears to have been a good arrangement. The study was completed, we think, more quickly than it would have been without the librarian member of the team; and we are all convinced that it was completed with less pain and distraction for the departments studied because a librarian who was thoroughly familiar with the library system was working right along with the consultant. And, of course, we profited further in that our librarian began to learn a great deal about automation during the course of study. The consultant seemed to like the arrangement, too.

Before going any further, we should say that when the Library Board had accepted the proposal for the study, we began bringing the staff into the picture immediately. First, the administrative staff held animated, even excited, discussions of what this might mean for us. Next, we announced at what we call our branch meetings (a weekly meeting at administrative offices attended by branch librarians and/or librarians responsible for book selection for the branches) that the Library Board had hired a firm of consultants to do this study. At this time, with the branch librarians, it really was more of an announcement than a discussion, although any questions anyone had at the time we tried, at least, to answer. Even at that early date, however, we made it quite clear that if the study indicated that the library could "go computer," and if the county said we might have the money for it, there would be no library personnel without a job if the conversion were made. Of course such a statement was comparatively easy for us to make, for we were growing at such a rapid rate, that we always seemed to have vacancies. In our statements (or reassurances) we were careful to say, nevertheless, that there might well be some retraining needed, and different positions to be filled, and some positions eliminated, but no one was going to find himself without a job if he wanted one.

To return now to the report of the study done for the commissioners. That report recommended that the county should convert from the tab system being used in the treasurer's office to a computerized system which would take care of all county departments which could use automation. If this major premise were accepted, the consultant's next recommendation was that a data processing manager should be hired immediately so that specifications for the computer could be written and conversion work be started.

With those two recommendations in mind, let us consider the report made to the Library Board by the consultants. They said our operation alone was too small to warrant the cost of a computer. However, if the county government accepted the recommendations made in the feasibility study done for them, it was recommended that the county get a computer capable of handling all phases of the library's automated systems and include the library as one of the departments needing the computer.

By the time the report on the library study was turned in, the county had already hired a data processing manager, so it was apparent that if the county would accept the concept proposed for the library, we were in business. I might here insert a plea for departmental cooperation. There are not many public libraries in the country large enough to support a computer by themselves.

At this point, we ourselves ran into our first difference of opinion with with the county. We believed that the consultants who had made the study should be retained to implement it, because we had already invested $5,000.00 and about five months of time in indoctrination and training of the consultants in library procedures, and it was obvious to us that they had learned a lot. None of us was enthusiastic about going through it all again if it were not necessary—and we did not think it was. It was already evident that the county's data processing manager had more than he could handle with the help he had been able to hire. We were able to convince him of the soundness of our arguments, and he helped to justify it to the commissioners. So, once again, the Library Board entered into an agreement with the consulting firm, this time to implement their own study.

Their first effort was to write the computer specifications which would be needed to handle all the library's systems. With this assurance that our automation was on the way, we formalized the position of our librarian specialist in this area as chief of the library's data processing efforts, and he thereafter continued working closely with the consultants, while also learning more on the job. It took some months to prepare the specifications for bidding. During that time, and until a bid was accepted, there were untold hours of consultation with various computer vendors in an attempt to determine the computer which would do all the jobs needed for all the county departments and agencies. Our consultants were very deeply involved in this activity because our planned uses for the computer were far more sophisticated than those of any other department or agency at that time. The library also had a real "sticky wicket" in circulation control for the bookmobiles. This one problem alone may well have taken as much time in consultation as the rest of the operations put together—and it has not been solved to our complete satisfaction yet. The specifications for the library's total needs were written for on-line real-time response techniques. An alternate was given as using the off-line, punched paper-tape batch processing method. We all kept our fingers crossed during the bidding for the on-line method to be within the county's price range. We uncrossed them with relief when the county accepted the bid for the on-line feature. (Our bookmobiles, of course, cannot be on-line. And we are still grappling with this problem because of the space needed for the paper-tape punch machinery.)

After acceptance of the bid, including the on-line equipment, made going ahead with automated systems a sure thing, we once again talked with staff, telling them more and more about the wonders of this business and reassuring them again about their jobs. At this time, too, several key punch machines were delivered, and an aptitude test was given the typists in technical services. We started with technical services typists because these were the people who would be most deeply involved first, and were more likely than any others on the staff to have to be retrained. Several of them were started on initial training on the key punches.

Knowing what we know now, we might well lack the courage to start out again; for it has not been all beer and skittles! All the foregoing was undertaken over a year ahead of computer delivery time. We began with all the faith and exuberance of the ignorant. The terms of the county's contract with the vendor allowed for a period of testing and debugging programs prior to computer delivery. Mighty fine sounding phrases; but unless the software for operating the hardware is ready, you might as well turn over and take another nap, which is a lot easier on your constitution than trying to work with untried software. We were dealing with a third generation computer, and apparently it was so young that even the parents did not know the correct diet to make it operate properly. Our plans for having all our systems "go" when the computer was delivered in Upper Marlboro in June, 1967, became so riddled with frustrations that ultimately the consultants withdrew from the project.

But before this time we did have some successes. One of the things the consultants suggested that they might do for us was to hold a series of seminars in the evening so that any interested staff members could attend and learn some of the details of the projected programs. This seemed a fine idea. Since there would be some expense for materials used, we asked the State Division of Library Extension if they would fund the series from the LSCA money. We were not asking for much; they liked the idea and gave us the money. They requested, however, that we open the seminars to anyone from any library in the state who might care to attend. This we did, gladly, and for an eight-week period about thirty people (most of them from our own staff, but eight or ten from other libraries) learned about and discussed the miracles of automated library management. Further, before the consultants left the project, they held a day-long discussion program with our branch librarians and administrative staff. We hope to have more of these conducted by the county's data processing staff or the sales representatives.

The account so far might well give the impression that we have been left high and dry, half automated and half pencil-pushing. This is not the case, however. A systems designer from the vendor's offices and a programmer from the county's data processing staff have since arrived to carry on with the work begun by our consultants.

So far, I have not stressed that we plan for total library management by computer. It is perhaps time to describe further what all the systems being designed will provide (with apologies for repetition to those who may have read the account in the December 1966, issue of the Wilson Library Bulletin.*)

First of all, we will have our book catalog. We have an adult book catalog now, but it is done outside the library (by Science Press). With the computer, however, we will do our own—both adult and juvenile. Actually, of course, most of the other pieces of management depend on the information required for the book catalog. Previously I mentioned key punch machines and retraining some of our typists to do the job. With the departure of the consultants and the arrival of the vendor's representative, a new approach to the mechanics of conversion is being made. Since we began our conversion plans, something new has been added. An IBM Selectomatic typewriter, with paper-tape punch, reader, and editor is being manufactured by Dura Business Machines. We propose to use this instead of key punches for all input except book cards and borrowers' cards. The plan now

*Hage, Elizabeth B. "Computer Potential in Maryland," Wilson Library Bulletin, 41:401-403, Dec. 1966.

is to farm out the conversion project, although we have not yet received a firm proposal on cost. Our own typists, then, will carry on with current cataloging. This method has several distinct advantages over keypunching, it seems to us, the chief one being the fact that typists are already familiar with the machine. The tape, of course, can be batch-processed by the computer at night. At that time, too, labels for book pockets and spines will be printed by the computer.

Since this book information is in computer-processable form and is also an integral part of circulation control, the next operation to implement, it seems to us, is circulation control. For this, an on-line data collection device, linked, together with a teletype machine, to the computer, is needed at each charge-out area. A key-punched book card for each book will be in the pocket of the book. This card, and the borrower's punched identification card, are simultaneously put into separate slots of the data collection device (called an EDGE unit), and the machine is triggered for the computer in Upper Marlboro to make the charge. If anything unusual relative to that book charge is detected by the computer, a message comes back in a matter of seconds on the teletype. Of course, we have to think first of all the possible unusual things that might occur, so that we can program for them. We can then question the borrower about the problem, or look to our own records, depending on which unusual item is disclosed. Our reserves will also be flagged by computer, thus eliminating the bulk of personal searching. That is to say, when a borrower places a reserve for a book, the appropriate message will be sent to the computer via teletype, and the proper title will then be automatically flagged so that when it later comes up for discharge upon return, a message comes back via teletype telling the desk attendant that there is a reserve on the book. The desk attendant then consults the reserve file, holds the book, and mails the reserve card.

Overdues will be printed out automatically, during the night, after prime time, and we will also be able to prevent a delinquent borrower from borrowing more books until his record is clear. This will work for any branch in the system from any other branch in the system.

Periodical check-in will be another item for the computer, as will withdrawals from the shelf-list and catalog, and just think of the amount of time to be saved in filing and "un-filing" in the catalog and shelf-list! Our supplies-ordering and inventory will be done by computer; our personnel records and payroll will go on, too, since it is possible to lock certain information in the computer so that only authorized personnel may retrieve it.

The capability for "conversation" between us and the computer through the use of on-line equipment and programming seems to us most promising and immeasurably useful. Technical services, including acquisitions, will be able to do checking of all kinds more rapidly than is now possible. Administration can acquire information about practically anything in almost no time. If this sounds unduly enthusiastic about the program upon which we are launched (with the help of the county government) I apologize, but we are all excited about it—the staff, the Library Board, the county government. We do not expect these wondrous things to happen without our share of traumatic incidents, and we have had a few already. As a matter of fact, we feel, like others, that we should operate two parallel circulation control systems for some months in order to be sure that we are not asking some member of our borrowing public either to return or pay for the Hope Diamond which is long overdue; or that we are not charging out the atomic submarine fleet to a county commissioner, or something equally impossible—yet which may indeed happen according to what one reads about conversion to the machine. We anticipate fewer of these kinds of problems with our book catalog because we have been involved in this kind of production up to a point (although not actually processed in our library) for about three years now. But maybe we are overly optimistic there, too. We do know that we are going to get cooperation and help from the county government, because at this point without our systems they do not need anything like the expensive equipment which they have contracted for.

ASPECTS OF AUTOMATION VIEWED FROM THE LIBRARY OF CONGRESS

Barbara Evans Markuson

Introduction

The Library of Congress automation program is directed by the Coordinator of the Information Systems Office (ISO) who is assisted by a staff of some thirty librarians, computer systems analysts, programmers, and clerical assistants. This staff conducts investigations, manages projects, monitors contract efforts in systems analysis and computer programming, defines areas for investigation, and does long-range planning. For specific tasks, the ISO staff is usually augmented by other Library of Congress staff members who have special technical or language skills, by consultants from outside libraries, or by contract manpower.

Communication within the Office, within the Library, and within the library community about these projects and plans is vital to the automation effort. Staff members of ISO hold meetings almost daily with LC staff members and visiting librarians. Within the Library, the ISO projects are reviewed by an Automation Steering Committee whose members are drawn from the Processing, Reference, and Administrative Departments of the Library. This Committee evaluates programs and makes recommendations to the Librarian of Congress. The Librarian, and this Committee, have set a very liberal policy on reporting widely on LC's automation program; they believe that other libraries should profit by both our mistakes and our successes, and that constant involvement with the activities and plans of other automation groups is essential to orderly progress.

ISO staff members belong to such groups as the ALA Information Science and Automation Division, the United States Standards Association, the Association of Research Libraries, the American Documentation Institute, and the Federal Library Committee. In

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Barbara Evans Markuson is Chief, Library Methods Staff, Information Systems Office, Library of Congress.

addition, staff members serve on a number of panels and task forces appropriate to library automation programs.

The Library's automation program has been written about rather extensively and a bibliography of publications relating to this program is available upon request from the Information Systems Office. We hope that librarians throughout the country will accept the responsibility for keeping abreast with developments in this program and will offer comments and advice whenever they approve or disapprove of the Library's program. Obviously not all suggestions can be acted upon, but they serve in any case to provide additional insight for the system designer. Such feedback has already caused modifications in certain ISO projects.

The ISO staff is also vitally concerned with automation projects in other libraries. A LOCATE (Library of Congress Automation Techniques Exchange) staff has been organized within ISO to gather, organize, and disseminate information about such projects. ISO staff review this material before embarking on projects in order to avoid duplication of effort and to gain information about progress made in other institutions. All librarians are encouraged to send information (including published and unpublished reports, input forms, codes, flowcharts, proposals, etc.) to LOCATE.

There are two main thrusts to the LC automation program. One effort, the systems development program, is concerned with determining methods by which the internal bibliographic operations of the Library can be performed more efficiently with computer assistance. The second area of intensive effort is the development of a standard format for the interlibrary transmission of bibliographic data in machine-processable form. These two activities will be discussed in detail.

Automation of the Central Bibliographic System

For those unfamiliar with the background of the Library's automation program, a few comments may be in order. In the early 1960's the Library launched a feasibility study to "consider the practicability and advisability of applying mechanization to the total bibliographical system of a large research library."[1] The work was conducted by a team of technical experts which included: Gilbert W. King (Chairman), Don R. Swanson, Merrill M. Flood, Manfred Kochen, Harold P. Edmundson, Alexander Wylly, and Richard L. Libby. The team's report, Automation and the Library of Congress, states their unanimous conviction summarized below that:

(1) The services and products of the Library could be improved through automated techniques.

(2) Automation of bibliographic processing, catalog searching, and document retrieval would be feasible in large research libraries, but

(3) Retrieval of the intellectual content of books would not be.

(4) Automation at LC would facilitate the development of a national library system.[2]

The team further recommended that the Librarian of Congress (1) develop an internal staff to plan and administer the automation program (the Information Systems Office has accepted this responsibility), (2) request funds to secure the specifications for an automated system (such funds were requested and obtained in fiscal 1966 and 1967 and will be requested in 1968), and (3) upon completion of system specifications request funds for implementation. The third recommendation cannot be carried out at this time, since work is now under way on the system specifications, but there is every reason to believe that such a request will be made at the proper time.

The survey team indicated what needed to be done; they, of course, did not specify in detail exactly how such a large automated system was to be achieved. The Information Systems Office developed a plan of action which would permit the orderly accomplishment of the automation of the central bibliographic system. According to this plan of action, the system would be developed in a series of phases each of which was to be concerned with specific tasks. At the end of each phase there was to be some tangible product, such as flow charts, reports, or computer programs. The phases are briefly defined in Table 1.

It was the intention of the Library to develop a system with the use of contract assistance where desirable. Accordingly, contract help was sought for the accomplishment of parts of Phases I to III. (A large portion of the Phase I effort, especially that involving flowcharting of current Library operations, had already been completed by ISO staff members.) A Request for Proposal* was sent to more

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*In government usage a Request for Proposal (RFP) refers to a document which outlines a particular problem area for which contractor assistance is required. A prospective contractor responds by submitting a proposal which provides a detailed explanation of how he proposes to attack and solve the problem. In addition, he provides other required information such as descriptions of related work experience, manpower data, biographical information about his proposed project team, etc. A Request for Quotes (RFQ) asks for specific cost bids for the accomplishment of a project or the procurement of equipment. Those companies which responded to the Library's RFP with an acceptable technical proposal were asked to respond to a Request for Quotes.

than seventy prospective contractors in December of 1965, proposals were received and evaluated in the spring of 1966, and in June 1966 a contract was awarded to the United Aircraft Corporate Systems Center of Farmington, Connecticut. A full discussion of the work to be done in Phases I through III, including a detailed description of the information needed for an analysis of Library files, was presented in the Request for Proposal. This document was reprinted, essentially in its entirety, in the July 1966 issue of Library Quarterly.[3]

The neat schedule depicted in Table 1 is, of course, an idealized plan of action. In real life the cut-off between Phases may not be as neat and final as they appear on paper. However, such a plan does provide a framework for assignment of tasks and a set of goals against which achievement can be measured.

It may seem to some that an inordinate amount of time is allotted for Phases I and II. It is our firm belief that the future system will not be successful unless it is based on a thorough understanding of the functional and operational characteristics of the present system. By this we do not mean to imply that the systems will be alike, but rather that the new system must perform practical bibliographic operations which aid in the daily operation of the Library. This may seem obvious, but there is always the danger that systems will be designed to perform operations which fit some system designer's idealized concept of what should be done.

The foregoing statements imply that the Library of Congress puts a high premium on the involvement of librarians in system development. This is true. Much of the work cannot be delegated to contractors or to non-librarians. Librarians must identify essential functions clearly, state how they are to be performed, determine essential data, and evaluate alternatives presented by the systems staff. We endeavor to instill in our ISO staff, and in our contractors, a respect for the complexity of library data, an understanding of and a respect for the bibliographical skills of the Library staff, and an empathy toward the librarian and his problems. We also aim to instill a respect for and an understanding of the traditions of librarianship, while allowing absolutely free rein in questioning any of them.

At this point it is too early to predict what the future system might be like, but some concepts can be reported. We believe that, in general, the library community cannot expect to have companies put money into research and development for equipment to meet special library needs. In the computer field, for example, libraries for years to come will simply be too small a market. Minor modifications, such as special keyboards and character sets are, of course, possible if manufacturers are assured that the librarians are sufficiently in agreement. Our system development is posited, therefore, on the assumption that the equipment complex for the central bibliographic system will be assembled from that available on the market

Table 1. Phases in Development of LC Central Bibliographic System

Phase	Definition of Phase	Expected Product	Estimated Calendar Time and Man-years
I. Survey of present System	To describe and analyze the present operation	Detailed description of present system: flowcharts, statistical studies, analysis of file use, identification of needed changes and improvements	Feb. 65-Dec. 66 (completed) 9 man-years
II. System requirements analysis	To identify the objectives of the Library's bibliographic functions and to identify specific operational requirements	Detailed description of major functional requirements, projections of requirements into 1970's, and interfaces with other libraries; functional flowchart of system, showing magnitude of operations, identification of data elements needed in over-all system operation	Oct. 66-Apr. 67 (completed) 5 man-years
III. Functional description of new System	Development of a sound conceptual model for system development; development of one or more alternative systems meeting requirements developed in Phase II and encompassing various degrees of automation	Description of recommended automated systems indicating operations to be performed, personnel requirements, files to be converted, and new or eliminated functions	Apr. 67-Jan. 68 6-10 man-years

IV. System specifications*	Specification of types and capabilities of equipment needed to fulfill functional requirements; specification of operating and computer program requirements	Detailed report of specifications suitable for submission to equipment manufacturers; general report for non-technical use; cost estimated	Spring 68-
V. System design	Determination of specific equipment, operating procedures, computer programs, documentation, etc., required to implement new system	Equipment design; detailed presentation of conversion methods, plan for phasing in new system modules, development of training programs; specification of required building modification	———
VI. Implementation	To bring the "paper" system to reality	Equipment will be manufactured, programs written; equipment procured and installed; debugged computer programs; files converted; staff trained	———
VII. Operation of new System	LC staff to operate new system	Completely operational system (may be implemented in modules)	———

*Until further details about the new system are available, projections of time schedule and manpower for Phases IV-VII are lacking.

in the period 1970-1975. It would be easier, but far more dangerous, to design a system which was dependent on major breakthroughs in the technology—such as low cost, associative memory devices and a universal character reader.

The extent to which the new system would be based on the complete or partial conversion of either the National Union Catalog or the Official Catalog is unknown. It could turn out that a system might be developed in which only authority files would be converted to machine-readable form. Such a system would aid in the creation of new bibliographic entries and in file searching, but for full bibliographical details a manual card file of retrospective records would have to be consulted. Such a hybrid system might be developed as an interim system, because, even if full conversion were expected at a future time, it seems entirely probable that complete conversion of a four or five million item file would take several years. For example, if fifty workers each did an average of one hundred entries (including editing, tagging, punching, verification, and correction) a day for two hundred and fifty days a year, it would take four years to convert five million entries.

During the next year, the ISO staff and the systems contractor will be engaged in developing a number of alternative automated central bibliographic systems. The alternatives will arise in the variety of equipment used—that is, a system with minimal use of computers in a batch-processing mode of operation might represent one extreme in design, and a highly sophisticated system with a complex of consoles and large, high-speed memories permitting on-line access might represent another extreme. As mentioned previously, alternatives will also arise in the data base. The minimum data base in machine-readable form could be limited to current catalog output only; a maximum data base might be the full National Union Catalog, the Serial Record, and all authority files in machine-readable form.

As the study progresses, reports of general interest to the library community will be made available. In his final report, the contractor has been requested to recommend one of the alternative systems and to support this recommendation with cost figures, personnel requirements, and a description of the procedures by which functions would be performed. It is planned that a report on this system will be made available to the public. All librarians should study it carefully. The kind of system developed in the Library of Congress will obviously influence the characteristics of the national library system or network.

Although many aspects of the new system are conjectual at this point, some of its features can be predicted. The system will have as one of its end products the LC printed catalog card. It would be unthinkable to do away with a service upon which so much of the U. S. library economy depends. It seems entirely probable that this cataloging data will also be distributed in machine-readable form. Therefore, these end products can be isolated from the systems study and looked at in detail in parallel with the initial stages of the system development study.

Looking at the machine-readable catalog record readily permits us to:

(1) review carefully the bibliographical features of the catalog card;
(2) determine how the data elements on the catalog card could be handled in machine-readable form;
(3) discuss the machine-readable record with librarians who represent a number of special interest groups, e.g., school libraries, special libraries, and research libraries;
(4) experiment with methods of converting catalog records;
(5) experiment with methods of distributing catalog records to other libraries; and
(6) receive and evaluate comments on the utility of such records in actual library situations.

This careful analysis is extremely important because the constraints of computer processing require the librarian to be much more precise in defining and describing data elements than is required in manual systems. Furthermore, the cost of converting records to machine-readable form locally is fairly high and it would be advantageous to the library community if a record acceptable as a standard could be agreed upon.

In order to allow time for these discussions and to permit the results of them to be obtained in time for analysis by the system design team, a project in the production of machine-readable cataloging was launched. The next section of this paper will be devoted to a discussion of this project and what we expect to learn from it.

Project MARC (Machine-readable cataloging)

Early in 1965 three LC staff members were assigned to study in detail the requirements for handling, in machine-readable form, the information presently found on catalog cards. The results of this study were described in a report[4] in which these requirements are discussed and a preliminary standard format for conversion of catalog records proposed. This report served as the basis for a number of informal meetings with library specialists and was the raison d'être for two conferences at which representatives of various library interest groups discussed their needs and commented on the usefulness of the proposed standard to their group. The results of these meetings indicated that there was a consensus among librarians that at least a minimum acceptable standard was possible and that one should be adopted before too many libraries began to convert their files. There was also a universal feeling that the library community was ready to experiment with centrally produced machine-readable data and a number of libraries volunteered to cooperate in such a venture. In this spirit of cooperation, Project MARC was launched.

The goal behind the project was rather simple; the project itself required the solution of a number of complex problems. The Library of Congress would convert records for selected current catalog entries into machine-readable form and transmit them, via magnetic tape reels, on a regular basis for at least six months to participating libraries. The participants would use these records as input for local processing and for experiments and would report on their experiences. At issue were both the suitability of the data included in the records and the machine format in which the records were transmitted. To bring the project about, hundreds of consultations were held, more than forty computer programs involving some 33,000 machine instructions were written, manuals were prepared, staff trained, and equipment modified to meet Library of Congress requirements. The system planning was begun in February 1966, test data tapes were mailed in October and the first of the weekly tapes were sent out in November 1966. A brief review of the project is reported here; interested readers may secure project reports and related materials.[5,6]

MARC catalog records contain two different types of data: that contained in variable fields and that contained in fixed fields. Variable field data are comparable to the statements found on LC printed catalog cards and are entered on the worksheet and into the computer in natural language form—that is, written as English statements. Examples of variable fields are listed below (the numbers are tags to tell the computer what the field is; e.g., tag "10" equals main entry).

Main entry	10	Cottrell, Leonard.
Dewey class number	92	913.386
Notes	60	Bibliography: p. 193-195.
Subject tracing	70	Embryology.

The record also contains fields for which there are no equivalents on the present catalog card, although they are implied by statements on the card in most cases. These are fixed data fields and data are entered in them in a coded form. These fields have been chosen for addition to the record because it was the consensus of the librarians consulted that they represent categories by which librarians and users would want to search machine-readable records. (These fields provide the computer with the capability of "comparing" records just as a human being might, by noting language, type of entry, etc.) Examples of fixed fields include:

Type of entry	A	(A equals personal author)
Form of work	M	(M equals monograph)
Place of publication	ENLO	(ENLO equals London, England)
Language of work	GER	(GER equals German)

Thus, the machine record includes all the data with which the cataloger and reference librarian have long been familiar as well as certain new data elements which should provide for more complex searching of the catalog. The reader should note that the use of variable fields does away with the need to restrict the size of any part of the catalog record, e.g., a title could be twenty characters long or two hundred. Fixed fields, as the name implies, are the same length in every record (that is, the code for place is always a four-character code and language is always a three-character code) but they represent non-bibliographical fields.

In Project MARC the completed LC catalog card is photocopied onto a worksheet* and forwarded to project editors who tag the variable fields (that is, insert "10" before main entries, "70" before each subject heading, etc.) and add the fixed field codes (see Figure 1). These worksheets are then sent to typists who transcribe the data on punched-paper tape typewriters and the resulting punched-paper tape is read into the computer. The computer prints out each catalog record in a worksheet format with the fixed fields across the top of the page and the variable fields aligned vertically down the side. This format provides for ease in proofreading and editing. As the entries are proofed and verified, they are removed from the magnetic tape which contains the temporary records and added to a MARC Master Tape which contains verified records. Thus, only verified entries are distributed to other libraries.

At present, four separate files are included on the final tape mailed to MARC participants (see Figure 2). These include (1) the master catalog card record in LC card number sequence, (2) a brief author/title list with card number (this file is automatically generated by the computer from the master record), (3) a descriptive cross-reference tracing record (which includes information necessary for

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*The card is copied just before it is forwarded to the Library Branch of the Government Printing Office. At present it is impossible to determine whether records distributed on the tape might get data to the user sooner than the printed card.

utilization of name entries, such as cross-references, notice to cancel certain headings, etc.), and (4) a subject cross-reference tracing record (essentially the kind of data found in an entry in the LC List of Subject Headings). It may be noted that with files 3 and 4 the librarian in the field would be provided for the first time with the necessary information about the syndetic structure of the LC catalog as well as the catalog record provided in file 1.* File 2 is useful as a searching tool for those items for which the LC card number is not available at the local library.

Each participant receives a magnetic tape each week on which files 1 and 2 are cumulative (that is on the twelfth week all records entered into the system from the first week are interfiled) and on which files 3 and 4 are provided on a two-week basis only (that is on the twelfth week information about headings distributed on weeks 1 to 10 would no longer be available). It is expected that the local user would utilize files 3 and 4 to create his own cumulative master file of cross reference records. By June, 1967, some 14,000 master records are expected to be on tape. At present, only records for titles in English are in Project MARC because this was felt to comprise a set of most general use, but the system has the capability to handle most roman languages. Of course, many records for English language titles include headings and notes which require the use of diacritical marks.

In order that results from the MARC users be reported in time to be of use to the system designers, it was decided that the Library of Congress would supply a set of computer programs to each participant. These programs are primarily printing programs, that is, they allow the MARC user library to print out records from each of the four files described above. Libraries can print (1) a worksheet for local use in the same format as the MARC editor's proofsheet described above, (2) a full set of catalog cards with overprinted headings (the program will handle titles requiring up to two continuation cards), and (3) cross-reference tracing records for both name and subject entries. Figures 3 to 6 show examples of the printed output. (Librarians who are averse to upper-case computer printout will be pleased to know that these programs will print records in either upper-case or upper-and-lower case depending upon the equipment available in the local library. The Library of Congress computer print train has 120 characters including upper and lower case and the diacriticals for most European languages; bibliographical entries

---

*During the summer of 1967, distribution of files 3 and 4 was terminated. The files had been included in the experiment in order to test the validity of such a service and, due to the favorable response, an improved system for distributing cross-reference information in machine form is now being designed.

prepared on such a print train are perhaps superior to typed entries in legibility since the computer printer does not vary the impact from letter to letter as human typists often do.)

The user library receives a weekly tape and two printed packing lists: one is a list of the LC card numbers for the records on the tape and the other is a brief author/title-to-card number index of the tape. This allows the user library to search the printed products manually if access to a computer is not immediate and set aside those items for which machine-readable copy is available (see Figures 5 and 7).

The MARC system includes (1) manuals of procedures for editing, tagging, and punching catalog data, (2) code books for the fixed fields such as language, publisher, and place, (3) computer programs for generating the MARC records at LC, and (4) computer programs for production of printed products at the participating institutions. MARC users are responsible for producing additional programs for machine searching of bibliographic records, for production of special tools and indexes, and for other local uses. These programs will be made available to LC for analysis and distribution, as desired, to other participants.

There are sixteen MARC libraries: Argonne National Laboratory, University of California, University of Chicago, University of Florida, Georgia Institute of Technology, Harvard University, Indiana University, University of Missouri, Montgomery County (Md.) School system, Nassau County (N.Y.), National Agricultural Library, Redstone Arsenal (Huntsville, Ala.), Rice University, University of Toronto, Washington State Library (Olympia), and Yale University. Many of these libraries have accepted responsibility for duplicating tapes and programs for subsequent distribution to secondary users (distribution from LC is still restricted to the sixteen libraries listed above) in order to widen both the type of library involved in the program and the geographic area covered. Comments from both primary and secondary participants will be studied by LC in evaluating the project.

The participants are using the MARC tapes for a variety of products. Many are, of course, producing catalog cards. The catalog cards so produced can vary greatly depending upon local equipment used and local modifications made to the MARC computer programs for printing cards. Two examples of such local products are provided in Figure 8. At the University of Toronto Library the MARC tape is searched by LC card number for American imprints received in the Library. When the proper entry is located, the computer prints the Library worksheet, shown in Figure 9. This worksheet is perforated into sections to provide a cataloger's worksheet (the right portion of the sheet) which is forwarded for key punching of local information added by the cataloger, and a processing slip which remains in the book as a control device.

The MARC project experience will be analyzed to determine the kind of service which the Library of Congress should provide for distribution of machine-readable records on a permanent basis. Experience with the project will lead to evaluation of both the internal LC operation and the external use of the record by the participants. It is too early to summarize the results although perhaps two conclusions are already evident. At the Library of Congress it would be desirable to create the record by use of an "on-line" console tied directly to the computer, and it would be useful if at least some of the tagging were done by the catalogers instead of by project editors. There is already a feeling that it is time to agree upon a standard machine-readable record so that libraries can begin to develop programs and procedures with confidence that formats will not change drastically over the next few years. Such a standard will probably be developed by 1968.

Related Projects

There are a number of projects under way or in the initial planning stages which are related to the larger efforts described above. The previously mentioned Library of Congress Automation Techniques Exchange (LOCATE) is an agency within the Information Systems Office which seeks to identify every library in the U. S. or abroad which has an on-going automation project, and to gather documentation (reports, formats, informal descriptions, etc.) about each project. This file is a working tool for the ISO staff and will be the basis of a number of reports and bibliographies as the collection and service are developed. (The first bibliography produced with the aid of LOCATE staff and based to some extent on the LOCATE collection appears in the June, 1967, ALA Bulletin.)[7] Librarians are urged to report their automation projects to LOCATE.

The Processing Department at the Library is working jointly with ISO staff on two projects of great importance to further automation efforts. One project is the analysis of the subject headings used by the Library from the point of view of their suitability for computer processing. This analysis will be aided by having a data base in machine form for experimentation (the LC subject headings have been converted to machine-readable form and the seventh edition of the List of Subject Headings was produced by photocomposition from magnetic tapes). The second project is the analysis of filing rules to determine changes which might be needed either in the rules or the structure of the headings, or both, for computer manipulation of catalog records. Programming of the LC filing rules is a prerequisite for computer manipulation of entries and will be of great importance for sophisticated use of the computer in production of bibliographies, catalogs, and other printed listings. Reports on these projects, which are just now getting under way, will be made available as progress warrants.

Summary

From the developments noted in this article, it is clear that the library field is taking automation seriously. Experiments are under way, the results of which may influence each and every one of us as working librarians. If Project MARC proves that there is a market for machine-readable data (and many librarians already believe that to be an inescapable conclusion) it may be possible for any library in the country to have access to such data within the next decade. A catalog record in machine-form is not simply equivalent to the catalog card. There is nothing one can do with a catalog card beyond copying it and filing it. The information on the card is static and to use it in other ways requires a great deal of labor. Machine-readable data can be processed to provide many products—acquisition lists, catalog cards, book catalogs, labels, bibliographies—as well as utilized to perform searches, compile indexes, and so on. Bibliographic information is thus freed from the constraints of the printed card, but to use such data well librarians are forced to do a lot of hard thinking about their own libraries as systems and of their need for information within the system. Many of the developments which may result from the LC systems study may be transferable to other libraries—file organization, computer programming techniques, and converted data files would be available to those who could use them. Many smaller libraries will find these too sophisticated or too costly to duplicate; these libraries may have to develop their own systems, use service bureaus, or join regional groups. The experiences within the Library and in the field should contribute to an increased understanding of the role which automation will play during the next two decades—the experiences should complement one another, for the national libraries and the libraries in the nation should advance on compatible time schedules if an orderly network is to develop.

It has become increasingly clear that the library field will in the future need more, rather than fewer, people who understand thoroughly the fundamental theoretical concepts underlying our bibliographical practices. In addition to the theoreticians, we also need the advice of those with long years of practical experience to experiment with and to test new procedures and techniques. This is not a time for those ill-prepared for, and ill-acquainted with, the library profession.

Considering these problems, how can we at the Library of Congress improve the chances of developing a successful Library system? One way is to utilize the best librarians in the country both as formal and informal consultants. Another way is for each librarian to accept responsibility for keeping abreast of developments and offering comments and advice when they approve or disapprove of proposed features of the new Library of Congress system. Many improvements in the MARC Project resulted from unsolicited as well as solicited comments, and we encourage librarians in the field to view LC automation projects as something about which they have a right and duty to comment. Again, comments from the field may not be assimilated directly into the new system, but often an outsider's view will provide needed new insights and cause the systems analyst to rechannel his thinking.

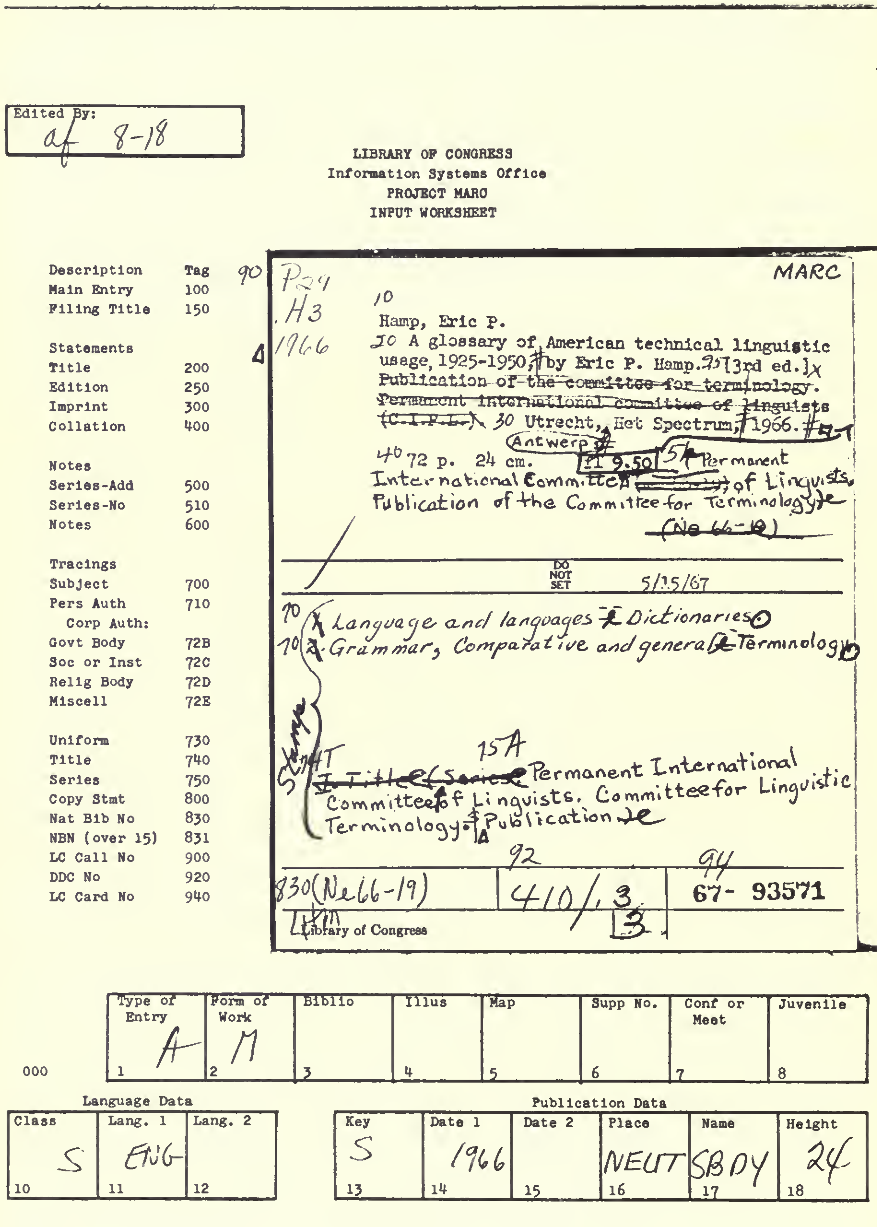
John Donne's statement that "No man is an island, entire of itself" is equally applicable to libraries. Even the largest library in the world is not self-sufficient—it has neither all the materials, the financial resources, nor the human talent required to solve the important problems of our time. This lack of self-sufficiency among libraries will become more and more apparent as we try to provide enriched service to an increasingly educated and sophisticated clientele. The need for monetary and human resources will be ever more evident as librarians acquire and use the complex machinery such as computers, on-line consoles, and photo-composers and as they begin to convert huge data files. Cooperation among libraries in both the planning and execution of automation programs is mandatory. The Library of Congress is pursuing its own program in this light; progress may be slower, but the benefits will be surer.

One of the critical problems which almost all practicing librarians face today is that they were not trained to deal with machine systems, nor indeed even to view libraries as systems at all. One has only to examine the literature of five years ago to conclude that we have come a long way; one has only to read current literature to conclude that we have a long way to go. It is a problem to those of us working at the national level, just as it is to those at state and local levels, to find out what is going on, to evaluate trends, and to determine from the literature how much of what is reported is operational and how much is conjectural.

Notwithstanding the tremendous technical problems which we face in designing an automated central bibliographic system for the Library, nor the problems in developing Project MARC into a full-blown distribution service, nor the problems which we face individually as librarians trying to deal with a new technology—I believe I am right in saying that, viewed from the Library of Congress, the future of library automation looks optimistic.

The entry of a number of "outsiders" into the library field in the 1950's and the early 1960's taught librarians a new self-respect for their own field, and it brought an increasing awareness of the complexity of the process of creating, storing, and using bibliographical files. This new view has in many ways revitalized the field.

With the next decade we will reach a new milestone in library history. The year 1976 will mark the hundredth anniversary of the American Library Association and, in some respects, of the American library movement. Succeeding generations will view our pioneering efforts toward automation as we regard those efforts a century ago to develop and apply the basic techniques of bibliographic control.



Edited By: af 8-18

LIBRARY OF CONGRESS
Information Systems Office
PROJECT MARC
INPUT WORKSHEET

Description	Tag
Main Entry	100
Filing Title	150
Statements	
Title	200
Edition	250
Imprint	300
Collation	400
Notes	
Series-Add	500
Series-No	510
Notes	600
Tracings	
Subject	700
Pers Auth	710
Corp Auth:	
Govt Body	72B
Soc or Inst	72C
Relig Body	72D
Miscell	72E
Uniform	730
Title	740
Series	750
Copy Stmt	800
Nat Bib No	830
NBN (over 15)	831
LC Call No	900
DDC No	920
LC Card No	940

MARC

90 P29 .H3 1966

10 Hamp, Eric P.

20 A glossary of American technical linguistic usage, 1925-1950, by Eric P. Hamp. 25 [3rd ed.] ~~Publication of the committee for terminology. Permanent international committee of linguists (C.I.P.L.)~~ 30 Utrecht, Antwerp, Het Spectrum, 1966.

40 72 p. 24 cm. ~~fl 9.50~~ 5A Permanent International Committee of Linguists. Publication of the Committee for Terminology ~~(No 66-19)~~

DO NOT SET 5/15/67

70 1. Language and languages—Dictionaries.
70 2. Grammar, Comparative and general—Terminology.

~~I. Title. (Series)~~ 15A Permanent International Committee of Linguists. Committee for Linguistic Terminology. Publication

830 (No 66-19) | 92 410/.3 | 94 67- 93571

Library of Congress

	Type of Entry	Form of Work	Biblio	Illus	Map	Supp No.	Conf or Meet	Juvenile
000	1 A	2 M	3	4	5	6	7	8

Language Data

Class	Lang. 1	Lang. 2
10 S	11 ENG	12

Publication Data

Key	Date 1	Date 2	Place	Name	Height
13 S	14 1966	15	16 NEUT	17 SBDY	18 24

Figure 1
MARC Pilot Project Input Worksheet.

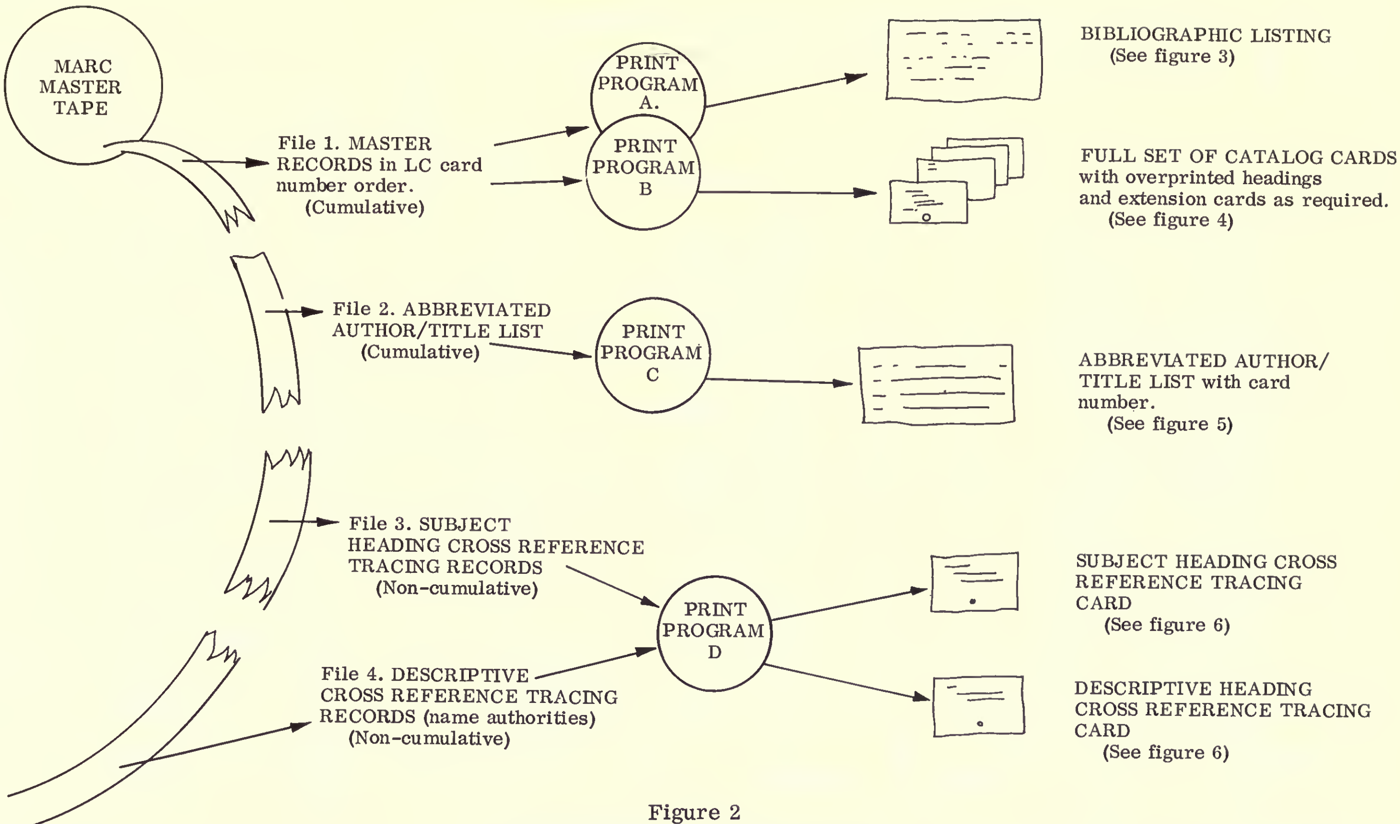


Figure 2
MARC Participant Programs and Products
(System as of April 1966)

```
                                   THE MARC PROJECT RECORD                          RECORD        67-093571
                                   MARK DIAGNOSTIC LISTING                          BATCH NO.     NM02114

TYPE OF         FORM OF                                       SUPPLEMENT  CONFERENCE      JUVENILE      RECORD
ENTRY(1)        WORK(2)         BIBLIO(3)  ILLUS(4)  MAPS(5)  NUMBER(6)   OR MEETING(7)   WORK(8)       INDICATOR(9)
PERSONAL AUTHOR MONOGRAPH       NO         NO        NO       NO          NO              NO            NEW THIS WK

LANGUAGE DATA                              PUBLICATION DATA
CLASS(10)       LANG 1(11)  LANG 2(12)     KEY(13)     DATE 1(14)  DATE 2(15)  PLACE(16)  NAME(17)      HEIGHT(18)
SINGLE          ENG                        SINGLE      1966                    NEUT       SBDY          24 CM

TYPE OF SECONDARY ENTRY-------GS           SERIES-YES         LENGTH OF RECORD-0641
VARIABLE FIELDS-

L. C. CALL NUMBER      90   P29.H3 1966

DEWEY CLASS. NUMBER    92   410/.3

MAIN ENTRY             10   Hamp, Eric P.

TITLE STATEMENT        20   A glossary of American technical linguistic usage, 1925-1950,# by Eric P. Hamp.

EDITION STATEMENT      25   [3rd ed.]

IMPRINT STATEMENT      30   Utrecht, Antwerp,# Het Spectrum,# 1966.#  fl 9.50

COLLATION STATEMENT    40   72 p. 24 cm.

SERIES NOTE            51   Permanent International Committee of Linguists. Publication of the Committee for
                            Terminology

SUBJECT TRACING        70   Language and languages--Dictionaries.

SUBJECT TRACING        70   Grammar, Comparative and general--Terminology.

TITLE TRACING          74   T

SERIES TRACING         75   APermanent International Committee of Linguists. Committee for Linguistic Terminology.$
                            Publication

NATL. BIBLIO. NUMBER  830   (Ne66-19)
```

Figure 3
The MARC Bibliographic Listing. (Computer produced.)

Banks, Charles Edward, 1854-1931.
The history of Martha's Vineyard, Dukes County, Massachusetts. Edgartown, Dukes County Historical Society [Mass.] 1966.
3 v. illus., facsims., maps, ports. 25 cm.
On label mounted on t.p.: Distributed by Regional Pub. Co., Baltimore, Md.
Reprint of the 1911-25 ed.
Contents.--v. 1. General history.--v. 2. Town annals.--v. 3. Family genealogies,
MARC (Cont. on next card)
66-008987

Banks, Charles Edward, 1854 -1931. The history of Martha's Vin... 1966 (Card 2)
1641-1800.
1. Martha's Vineyard, Mass.--Hist. 2. Martha's Vineyard, Mass.--Geneal. 3. Dukes Co., Mass.--Hist. I. Title.

MARC
66-008987
F72.M5B22 974.494

Main entry card & extension

Figure 4
Sample of Full Set of MARC Catalog Cards. (Computer produced.)

```
Martha's Vineyard, Mass.--Hist.

Banks, Charles Edward, 1854-1931.
   The history of Martha's Vineyard, Dukes
 County, Massachusetts. Edgartown, Dukes
 County Historical Society [Mass.] 1966.
   3 v. illus., facsims., maps, ports. 25
 cm.
   On label mounted on t.p.: Distributed by
 Regional Pub. Co., Baltimore, Md.
   Reprint of the 1911-25 ed.
   Contents.--v. 1. General history.--v. 2.
 Town annals.--v. 3. Family genealogies,
MARC                        (Cont. on next card)
                                      66-008987
```

```
Martha's Vineyard, Mass.--Hist.

Banks, Charles Edward, 1854 -1931. The
 history of Martha's Vin... 1966  (Card 2)
 1641-1800.
   1. Martha's Vineyard, Mass.--Hist. 2.
 Martha's Vineyard, Mass.--Geneal. 3.
 Dukes Co., Mass.--Hist. I. Title.

MARC
                                      66-008987
F72.M5B22                   974.494
```

Subject Heading No. 1 & extension

Figure 4 (cont.)

```
Martha's Vineyard, Mass.--Geneal.


Banks, Charles Edward, 1854-1931.
    The history of Martha's Vineyard, Dukes
  County, Massachusetts.  Edgartown, Dukes
  County Historical Society [Mass.] 1966.
    3 v. illus.  facsims., maps, ports. 25
  cm.
    On label mounted on t.p.: Distributed by
  Regional Pub. Co., Baltimore, Md.
    Reprint of the 1911-25 ed.
    Contents.--v. 1. General history.--v. 2.
  Town annals.--v. 3. Family genealogies,
MARC                         (Cont. on next card)
                                        66-008987
```

```
Martha's Vineyard, Mass.--Geneal.


Banks, Charles Edward,  1854 -1931. The
  history of Martha's Vin...  1966  (Card 2)
  1641-1800.
    1. Martha's Vineyard, Mass.--Hist. 2.
  Martha's Vineyard, Mass.--Geneal. 3.
  Dukes Co., Mass.--Hist. I. Title.



MARC
                                        66-008987
F72.M5B22                 974.494
```

Subject Heading No. 2 & extension

Figure 4 (cont.)

```
        Dukes Co., Mass.--Hist.


    Banks, Charles Edward, 1854-1931.
        The history of Martha's Vineyard, Dukes
      County, Massachusetts.  Edgartown, Dukes
      County Historical Society [Mass.] 1966.
        3 v. illus., facsims., maps, ports. 25
      cm.
        On label mounted on t.p.: Distributed by
      Regional Pub. Co., Baltimore, Md.
        Reprint of the 1911-25 ed.
        Contents.--v. 1. General history.--v. 2.
      Town annals.--v. 3. Family genealogies,
    MARC                      (Cont. on next card)
                                         66-008987
```

```
        Dukes Co., Mass.--Hist.


    Banks, Charles Edward,  1854 -1931. The
      history of Martha's Vin...  1966  (Card 2)
      1641-1800.
        1. Martha's Vineyard, Mass.--Hist. 2.
      Martha's Vineyard, Mass.--Geneal. 3.
      Dukes Co., Mass.--Hist. I. Title.




    MARC
                                         66-008987
F72.M5B22                  974.494
```

Subject Heading No. 3 & extension

Figure 4 (cont.)

```
The history of Martha's Vineyard,

Banks, Charles Edward, 1854-1931.
   The history of Martha's Vineyard, Dukes
 County, Massachusetts.  Edgartown, Dukes
 County Historical Society [Mass.] 1966.
   3 v. illus., facsims., maps, ports. 25
 cm.
   On label mounted on t.p.: Distributed by
 Regional Pub. Co., Baltimore, Md.
   Reprint of the 1911-25 ed.
   Contents.--v. 1. General history.--v. 2.
 Town annals.--v. 3. Family genealogies,
MARC                      (Cont. on next card)
                                   66-008987
```

```
The history of Martha's Vineyard,

Banks, Charles Edward,  1854 -1931. The
 history of Martha's Vin...  1966  (Card 2)
 1641-1800.
   1. Martha's Vineyard, Mass.--Hist. 2.
 Martha's Vineyard, Mass.--Geneal. 3.
 Dukes Co., Mass.--Hist. I. Title.

MARC
                                   66-008987
F72.M5B22              974.494
```

Title card & extension
(Note that computer has been programmed to pick up the actual title for the tracing "II. TITLE.")

Figure 4 (cont.)

```
    LIBRARY OF CONGRESS * THE MARC PROJECT * MAR 23, 1967        PAGE    1
               ABBREVIATED AUTHOR/TITLE LIST OF ALL MARC RECORDS-

      67-247        O BROIN, LEON,  1902
                      DUBLIN CASTLE AND THE 1916 RISING,  THE STORY OF SIR
                          MATTHEW NATHAN.

      66-28533      OZBUDUN, ERGUN.
                      THE ROLE OF THE MILITARY IN RECENT TURKISH POLITICS.

      66-16515/     SORM, FRANTISEK.
                      GUAIANOLIDES AND GERMACRANOLIDES (BY) FRANTISEK SORM
                          AND LADISLAV DOLEJS.

      66-77116      A LITTLE PRETTY POCKET-BOOK.

      66-66155      A SHORT HISTORY OF THE PARISH OF ST. JOHN THE BAPTIST,
                      RUDMORE, PORTSMOUTH.

      66-26340      A VISIT TO TEXAS.

      66-24622      AARON, THOMAS J.
                      THE CONTROL OF POLICE DISCRETION,  THE DANISH
                          EXPERIENCE,  BY THOMAS J. AARON. WITH A FOREWORD
                          BY HENRY...

   L  67-11008      ABBEY, MERRILL R.
                      THE WORD INTERPRETS US  (BY) MERRILL ABBEY.

   L  66-28817      ABBOTT, CHARLES CORTEZ,  1906
                      BASIC RESEARCH IN FINANCE,  NEEDS AND PROSPECTS.
                          EDITED BY CHARLES C. ABBOTT.

   N  67-849        ABBOTT, JOHN CAVE,  1919
                      AGRICULTURAL MARKETING BOARDS.  THEIR ESTABLISHMENT
                          AND OPERATION,  BY J. C. ABBOTT AND H. C. C9...

      66-24781      ABDULLAH, SYED.
                      HOUSE OF INDIA COOKBOOK.

      66-78257      ABEL, ELIE.
                      THE MISSILES OF OCTOBER.  THE STORY OF THE CUBAN
                          MISSILE CRISIS, 1962.

      66-24906      ABELL, WALTER.
                      THE COLLECTIVE DREAM IN ART,  A PSYCHO-HISTORICAL
                          THEORY OF CULTURE BASED ON RELATIONS BETWEEN THE
                          ARTS,

      66-77185      ABERCONWAY, CHRISTABEL MARY MELVILLE (MACNAUGHTON)
                          MCLAREN,  BARONESS, 1890
                      A WISER WOMAN.  A BOOK OF MEMORIES  (BY) CHR...

   L  67-72172      ABERCROMBIE, MICHAEL.
                      A DICTIONARY OF BIOLOGY  (BY) M. ABERCROMBIE, C. J.
                          HICKMAN, AND M. L. JOHNSON.

   N  67-12602      ABERSOLD, JOHN RUSSELL,  1902
                      CASES IN LABOR RELATIONS,  AN ARBITRATION EXPERIENCE
                          (BY) JOHN R. ABERSOLD (AND) WAYNE E....
```

Figure 5
Abbreviated Author/Title List. (Computer produced.)

SUBJECTS

Electronic data processing--Credit
management. ǂNEWǂ
x Credit management--Electronic data
processing

Chloroplasts. ǂNEWǂ
sa Chromatophores.
x Chloroplastids
xx Chromatophores

NEW means new heading
CAN means cancel

Note: These are not authority cards in that the tools used at LC to establish entries are not listed - only the headings to be used in the catalog are provided.

NAMES

International Association of Technological
University Libraries. ǂNEWǂ
x IATUL; Association internationale des
bibliothèques d@universités
polytechniques; Asociación
Internacional de Bibliotecas de
Universidades Tecnicas; Internation...
Vereinigung der Bibliotheke...
Technischer Hochs...

Kaneko, Hiroshi, 1933- ǂADDǂ
x Hiroshi, Kaneko

John G. Johnson art collection,
Philadelphia. ǂCANǂ

NEW means new heading
ADD means add new cross reference

Figure 6
MARC Cross-reference Tracing Records.

LIBRARY OF CONGRESS • THE MARC PROJECT • MAR 23, 1967 PAGE 2

L.C. CARD NUMBERS FOR ALL RECORDS IN MASTER- 66-8917 - 66-9462

66-8917	66-9050	66-9160	66-9284
66-8920	66-9052	66-9205	66-9287
66-8922	66-9053	66-9206	66-9292
66-8923	66-9055	66-9207	66-9293
66-8928	66-9056	66-9208	N 66-9297
66-8929	66-9057	66-9209	66-9306
66-8930	66-9058	66-9210	66-9309
66-8931	66-9059	66-9211	66-9311
66-8932	66-9060	66-9214	66-9312
66-8933	66-9062	66-9215	66-9314
66-8934	66-9063	66-9217	66-9315
66-8935	66-9064	66-9218	66-9321
66-8936	66-9065	66-9219	66-9324
66-8937	66-9077	66-9220	66-9325
66-8938	66-9079	66-9221	66-9326
66-8939	66-9080	66-9223	66-9327
66-8940	66-9085	66-9224	66-9328
66-8941	66-9087	66-9225	66-9333
66-8945	66-9088	66-9226	66-9334
66-8946	66-9090	66-9227	66-9336
66-8947	66-9091	66-9232	66-9338
66-8949	66-9092	66-9234	66-9344
66-8973	N 66-9093	66-9236	66-9347
66-8975	N 66-9094	66-9237	66-9349
66-8976	N 66-9095	66-9238	66-9351
66-8977	66-9096	66-9239	66-9352
66-8978	66-9097	66-9240	66-9355
66-8979	66-9100	66-9241	66-9356
66-8983	66-9107	66-9242	66-9388
66-8984	66-9108	66-9243	66-9389
66-8987	66-9111	66-9244	66-9390
66-8990	66-9112	66-9252	66-9391
66-8991	66-9121	66-9254	66-9394
66-9001	66-9123	66-9255	66-9396
66-9025	66-9125	66-9256	66-9410
66-9026	66-9129	66-9257	66-9411
66-9027	66-9132	66-9258	66-9412
66-9028	66-9134	66-9259	66-9425
66-9029	66-9138	66-9260	66-9426
66-9030	66-9148	66-9261	66-9427
66-9031	66-9149	66-9263	66-9428
66-9032	66-9152	66-9264	66-9429
66-9034	66-9153	66-9268	66-9431
66-9035	66-9134	66-9269	66-9434
66-9040	66-9148	66-9270	66-9436
66-9041	66-9153	66-9279	66-9437
66-9045	66-9155	66-9280	66-9440
66-9047	66-9156	66-9281	66-9442
66-9048	66-9157	66-9282	66-9460
66-9049	66-9158	66-9283	66-9462

N= NEW, L= NEW LAST WEEK, R= REVISED

Figure 7
The MARC Master Tape List. (Computer produced.)

```
RA        Read, Margaret.
418          Culture, health and disease:
R37       social and cultural influences on
          health programmes in developing
Hygiene   countries.  London, Sydney [etc.]
          Tavistock  Publications, 1966. -/25/-

             xvii, 142 p. table, diagrs. 22
          1/2 cm.

          Bibliography: p. 127-132.
                                  see next card

                  3  ul                 67070653
```

```
RA        Read, Margaret.
418       Culture, health and     ... 1966 card 2
R37

Hygiene   1. Hygiene, Public.  2. Social
          medicine.  I. Title

                  3  ul               67070653
                                (B66-16886)
```

A: Upper-and-Lower-Case Card Produced by Yale University Library

Figure 8
Examples of Catalog Cards produced from MARC Tapes by Participants.

```
HG179   NUCCIO, SAL.
.N8       GUIDE TO PERSONAL FINANCE.[1ST ED.]
        NEW YORK, HARPER & ROW [1967] XI, 240 P.
        22 CM.

          BASED ON THE AUTHOR"S ARTICLES IN THE
        NEW YORK TIMES.


     1. FINANCE, PERSONAL.
        NEW YORK TIMES.
        TITLE.

05/67      G    HSW:JPK        ENG     65-21019
STI
```

B: Upper-Case Card Produced by the Georgia Institute of Technology Library

Figure 8 (cont.)

PROCESSING SLIP

Wenger, Antoine.

Vatican II.# Translated by Robert J. Olsen.

BX830.1962.W413

LOC	COP	LOC	COP	LOC	COP	LOC	COP	LOC	COP

SEARCHING REPORT

CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC
CODE	IDENTITY	NOC / PS	NUC	A/T / S	LOC	LOC	LOC	LOC	LOC

CODE	IDENTITY	NOC / PS	NUC	ULS	NST	CLASSED TOGETHER		SEPARATELY ADDED ENTRY	
						ANAL	NO	YES	NO
CODE	IDENTITY	NOC / PS	NUC	ULS	NST	CLASSED TOGETHER		SEPARATELY ADDED ENTRY	
						ANAL	NO	YES	NO

COMMENTS:

HUMS	MAIN	GENR	REF(GEN)	POLE	POLEC	ENGI	ENGIN	NURS	NURS
PASC	P&AS	PASR	REF(P&AS)	UNIC	UC	FSCI	FSCI	PHAR	PHARM
BMED	B&M	BMER	REF(B&M)	ARCH	ARCH	HYGI	HYG		
WALR	WAL	HIST	HIST	BUSI	BUS	INDE	INDE		
PASX	RES(P&AS)	INNC	INN	CRIM	CRIM	MAPL	MAPLIB		
BMEX	RES(B&M)	NEWC	NEW	EAST	EAS	MUSI	MUSIC		

Figure 9
Library Processing Worksheet produced from MARC Tapes by the University of Toronto Library

UNIVERSITY OF TORONTO LIBRARY MARC DATA SHEET

L. C. CARD NUMBER	SEQUENCE NUMBER
66-016573	670617230245

FIXED FIELDS

TYPE OF ENTRY	FORM OF WORK	CONFERENCE	INTELLECTUAL LEVEL	BIBL	ILLUS	MAP	SUPPL NO	LANG. 1	LANGUAGE KEY	LANG 2
P	MON			x				ENG	T	UNK

DATE KEY	DATE 1	DATE 2	PLACE	PUBLISHER	HEIGHT	THICKNESS
MULT	1966	9999	MDWE	NEWM	24	

CALL: BX830.1962.W413

MAIN: Wenger, Antoine.

FILE: Vatican II. Eng.

TITL: Vatican II.# Translated by Robert J. Olsen.

IMPR: Westminster, Md.,# Newman Press,# 1966-#

COLL: v. 24 cm.

NOTE: Includes bibliographical references.

NOTE: Contents.--v. 1. The first session.

SUB:S: Vatican Council, 2d.

ADT:T:

hums[1]

HOLDINGS

LOC	COP	LOC	COP	LOC	COP	LOC	COP	LOC	COP	LOC	COP

SEARCHED BY:	DATE	EDITED BY.	DATE	TYPED BY.	DATE	VERIFIED BY	DATE

Figure 9 (cont.)

REFERENCES

1. King, Gilbert W., et al. Automation and the Library of Congress. Washington, D. C., U.S.G.P.O., 1963, p. 1.

2. Ibid., p. 2.

3. Markuson, Barbara Evans. "A System Development Study for Library of Congress Automation Program," Library Quarterly, 36:197-233, July 1966.

4. U. S. Library of Congress. Information Systems Office. Planning Memoranda No. 3. (A proposed format for a standardized machine-readable catalog record. A preliminary draft prepared by Henriette D. Avram, Ruth S. Freitag, and Kay D. Guiles.) Washington, D. C., 1965.

5. U. S. Library of Congress. Information Systems Office. A Preliminary Report on the MARC (Machine-Readable-Catalog) Pilot Project. Washington, D. C., 1966.

6. Avram, Henriette D., and Markuson, Barbara Evans. "Library Automation and Project MARC: An Experiment in the Distribution of Machine-Readable Cataloguing Data." In John Harrison and Peter Laslett, eds., The Brasenose Conference on the Automation of Libraries (Proceedings of the Anglo-American Conference on the Mechanization of Library Services held at Oxford). London and Chicago, Mansell, 1967, pp. 97-127.

7. McCune, Lois C., and Salmon, Stephen R. "Bibliography of Library Automation," ALA Bulletin, 61:674-694, June 1967.

THE SPECIAL LIBRARIES ASSOCIATION-AMERICAN LIBRARY ASSOCIATION/LIBRARY TECHNOLOGY PROGRAM SURVEY OF LIBRARY AUTOMATION ACTIVITIES: A SUMMARY REVIEW

Eugene B. Jackson

Before one can determine the extent of progress in a field, it is necessary to have a baseline to describe the situation at a particular point in time. For library mechanization in mid-1966, this need has largely been filled by the Survey under review.

The SLA-ALA/LTP Survey[1] was a unique undertaking in several respects; it combined the skills of one SLA Division's members, the financial resources of an ALA project, and the mailing lists of a third documentation association and a veteran library publisher. It appeared at about the time when a new ALA Division was born (Information Sciences and Automation), when another ALA Division was searching for a listing of book catalog projects, when at least one state needed an inventory of library mechanization activities (Texas), when SLA annual convention sessions were being increasingly devoted to the subject (even including the Museum Division), when special interest groups on the subject were evolving in the American Documentation Institute, when the U. S. Office of Education was bringing a clearinghouse on library research into being, when the Library of Congress was undertaking the distribution of cataloging data in machinable form to fifteen libraries, when the engineering profession reported its plans for a united engineering information corporation, when the President of the United States was appointing his Commission and Committee on Libraries (especially to consider the network potentials and problems), and when the humanities were establishing a center for the application of computers to their unique problems under the sponsorship of the American Council of Learned Societies.

It was in this yeasty milieu that the SLA-ALA/LTP Survey saw the light of day. An analysis of its principal revelations follows. The arrangement by sections of the original survey has been retained, so that material appears in the order given below:

Eugene B. Jackson is Director, Information Retrieval and Library Services, IBM, Armonk, New York.

Sections I-II: Preface and Introduction.

Section III: Background Tables (see especially Tables A, B, C, D, F and G).

Section IV: Detailed Tables of Libraries with EAM/ADP Equipment (see especially Tables J, K, P^1, T and U).

Section V: Detailed Tables of Libraries Having Plans for Use of EAM/ADP Equipment (see especially Tables HH, II, JJ, KK, NN, OO, AAA^1, BBB).

Section VI: Listing of Libraries Having Equipment, Arranged by State, Function and Type of Equipment (see especially Table DDD and Figure 1).

SLA-ALA/LTP Survey, I and II. Preface and Introduction

The need for quantifying the extent of library mechanization was becoming clear to the Documentation Division of the Special Libraries Association and to the Library Technology Program of the American Library Association in late 1965 and early 1966. The former had developed a questionnaire that was subsequently refined by a commercial research organization. From funds provided by the Council on Library Resources, the ALA/LTP undertook the financing of the resulting questionnaire survey, which was made in the summer of 1966 by Creative Research Services, Inc. Some 15,734 surveys were sent to those on professional society and commercial mailing lists. It is estimated that 10,000 different institutions were represented, and single replies were desired from each. Some 6,150 responses by the cutoff date represent a creditable 39 percent return of the surveys. Nearly one in five of the replies indicated either active mechanization procedures of authorized plans for one or more such functions (in a total of 1,130 institutions).

Available funds permitted tabulations occupying 160 pages in the original Survey report but did not permit analysis of the significance of the results. It is the purpose of the present paper to fill this gap. Each table in the Survey is summarized and an interpretation made. Certain recapitulations also are presented and conclusions drawn.

The results of the Survey are, of course, not definitive, but they do form a pioneer baseline inventory that can be of service to and be augmented by all concerned with aspects of library mechanization.

Accordingly, attention may be invited first to the following summary picture of the typical mechanized library, as revealed by the Survey results.

THE TYPICAL MECHANIZED LIBRARY
(according to findings of the SLA-ALA/LTP Survey, October 1966)

1. Is a university or special library;
2. has more than 50,000 books;
3. has more than 1,000 periodical titles;
4. has a small technical reports collection;
5. has a minimum staff of 10 and a maximum staff of 20, evenly divided between professional and non-professional members;
6. has its serials control function running on EAM (unit record) equipment;
7. has its accounting function running on ADP (computer) equipment;
8. is utilizing its host organization's machine equipment rather than having its own;
9. does not use a service bureau;
10. has plans for extending mechanization to circulation control and accessions lists functions in the next one to two years;
11. is located in California or New York.

For the interpretation of these and other data, the following definitions and functions cited in the Survey may also be clarified at this point.

DEFINITIONS USED

EAM:	refers to Electrical Accounting Machines equipment such as tabulators, card sorting equipment, but not computers.
ADP:	refers to Automated Data Processing, i.e., computers or computer installations.
AUTOMATION:	is limited to the use of EAM or ADP equipment or the equivalent, and does not include manual systems or semi-automated systems such as edge-notched cards, Peek-A-Boo and other cartridge microfilm equipment.
SERVICE BUREAU:	is a commercial data processing firm or other institution that processes your data.

FUNCTIONS CONSIDERED

A. Accounting (library payroll, bookkeeping)
B. Acquisition of library materials (may include initial cataloging)
C. Serials control (subscription renewals, check-in, preparation of routing slips and binding records)
D. Circulation control
E. Classified document control
F. Catalog card production
G. Book catalog production
H. Accessions lists and announcement bulletins
I. KWIC (Key-Word-In-Context Indexes)
J. Retrospective searches (document retrieval)
K. Retrospective searches (data retrieval)
L. Current awareness service (includes SDI System)
M. Union lists
N. Microform materials—storage and retrieval (e.g., microfilm, microfiche, aperture card)
O. Inter-library communications (telecommunication devices—telephone tielines, TWX, data links, WATS lines)
P. Other.

SLA-ALA/LTP Survey, III: Background Tables*†

TABLE A

Users of Automation

Of 638 Users	31.1%	are	College and University
	33.4		Industrial
	12.2		Public
	12.3		Government
	10.3		All Other

---

*The Mode is the largest item in a series, or the most popular response. The Median is the point in the series dividing the two halves of the population. From the distribution of the responses to the present Survey, the figures for Modes seem more significant as a rule than those for Medians.

†In the following tables, there are some apparent inconsistencies in totals. The reason is that librarians do not always answer surveys perfectly, and some contradictory and incomplete replies were received. An effort was made to salvage all usable replies to each question in the survey.

Interpretation: Over three-fourths of the present-day users of data processing equipment in libraries are university and special librarians. Thus it would seem that the leadership of the immediate future for such groups as the ALA Information Science and Automation Division would most probably come from the university-oriented members. Further, it would seem that special librarians play an influential role in library mechanization. It is believed that the availability of data processing equipment in industrial, governmental and trade association facilities is an important reason for the high incidence of users in those categories. Recent studies show that information facilities that are most convenient to use are the ones most used. Similarly, the convenience of access to data processing facilities results in the tendency towards their use for library purposes.

TABLE B

Kinds of Institutions planning to use Automation

Of 942 Planners	39.9%	are	College and University
	25.5		Industrial
	9.9		Public
	12.0		Government
	12.0		All Other

Interpretation: The increase in proportion of university librarians who are now being included in the planning stages is dramatic evidence of the serious problems faced by such libraries and the need for pushing demonstration projects in those areas, such as those being undertaken by the University of Chicago. There does not seem to be as great an awareness among the public librarians of the potential of data processing equipment for meeting their needs as there is among the industrial segment. In automation, government libraries can be influential out of proportion to their number because of security and other pioneering efforts.

TABLE C

Number of Books in a Library

	Mode	Median
*†1,130 Users and Planners	Over 50,000 = 42%	20,001 to 50,000
638 Users	Over 50,000 = 41%	20,001 to 50,000
415 Colleges & Universities	Over 50,000	Over 50,000
310 Industrial	3,001 to 6,000	3,001 to 6,000
122 Public	Over 50,000	Over 50,000
143 Government	Over 50,000	20,001 to 50,000
131 All Others	1,001 to 3,000	6,000 to 10,000

Interpretation: Users of mechanization are large libraries (by special libraries standards) including over 50,000 books and over 1,000 serial titles but less than 1,000 technical report titles. The Median and the Mode are identical for university and public libraries showing over 50,000. It is interesting that the government libraries have a Mode for most usual response of over 50,000 but a Median of somewhat less. That the trade associations represented in the "All Others" use serials more than monographs is shown by their Mode of 1,000 to 3,000 for their books. The Mode and Median is identical for the industrial users and planners—the 3,000 to 6,000 category. One significant fact is that any mechanized system contemplated for wide utilization would have to handle bibliographic items for collections of well over 50,000 books. The Median and Mode differ on the users and planners and the Mode is felt to be far more significant here.

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*The figure 1,130 given in Tables C-I refers to separate institutions and does not allow for the overlap between 638 "users" and 942 "planners" (c.f. Tables A and B).
†For Tables C-F, nine institutions did not report holdings.

TABLE D

Number of Current Serial Titles in a Library

	Mode	Median
1,130 Users and Planners	Over 1,000 = 31%	501 to 750
638 Users	Over 1,000 = 34%	Over 1,000
415 Colleges & Universities	Over 1,000	Over 1,000
310 Industrial	301 to 500	301 to 500
122 Public	Over 1,000	301 to 500
143 Government	Over 1,000	501 to 750
131 All Others	Over 1,000	301 to 500

Interpretation: Clearly, any mechanized system intended for widespread use must handle those problems peculiar to serials in a quantity exceeding 1,000 periodicals. Probably if a second survey were to evolve from the results of the one reported here, there should be more categories for this reply to determine whether the Mode would not probably settle around 1,400 periodicals rather than say 1,800, for example. Serials are a prime problem. There is widespread interest in adapting machine methods to their control. Most typically those organizations doing work in the "hard sciences" have access to mechanized equipment and the greatest felt need for its utilization.

TABLE E

Number of Technical Report Titles in Library

	Mode		Median
1,130 Users and Planners	0 to 1,000 = 32%		5,001 to 10,000
638 Users	0 to 1,000	25%	10,001 to 20,000
415 Colleges & Universities	0 to 1,000		1,001 to 5,000
310 Industrial	0 to 1,000		5,001 to 10,000
122 Public	0 to 1,000		Over 80,000
143 Government	0 to 1,000		40,000 to 80,000
131 All Others	0 to 1,000		5,001 to 10,000

Interpretation: The Median figures are felt to be more significant in this table than the Mode figures. It was surprising that the largest collections are in Public libraries and Government libraries, though it is felt that there would be considerable overlap of commonly-held titles in these libraries; whereas the Industrial technical report titles are probably less duplicative. This has significance when one is considering the preparation of Union Lists as resources in a geographic area. Except for necessary considerations such as patent and proprietary matters, there could possibly be a greater net addition to the information resources of an area if its industrial libraries' holdings could be tapped than through addition of highly duplicative holdings for certain other libraries.

TABLE F

Number of Full Time Professional Staff Members in Library

	Mode		Median
1,130 Users and Planners	1	= 21%	4
638 Users	5-10	20%	5-10
415 Colleges & Universities	5-10		5-10
310 Industrial	1		2
122 Public	21-50		11-20
143 Government	5-10		5-10
131 All Others	1		2

Interpretation: In this table, probably the Median figure of four full time professionals is more significant than the Mode figure of 1. It is closer to the Mode figure for both total users and universities of 5-10 persons. Overall, the 235 institutions reporting one professional and the 219 institutions having five to ten professionals are fairly close. The Modes for both Industrial and All Others are one professional staff member, and the Medians are 2 staff members; thus accounting for the discrepancy between the over-all Median and Mode.

TABLE G

Number of Non-Professional Full Time Staff Members in Library

	Mode		Median
1,130 Users and Planners	5-10	= 18%	5-10
638 Users	5-10	20%	5-10
415 Colleges & Universities	5-10		11-20
310 Industrial	5-10		3
122 Public	Over 50		21-50
143 Government	5-10		5-10
131 All Others	1		3

Interpretation: There is very substantial agreement that a library that has mechanized procedure is apt to have 5-10 non-professional staff members. The over-all staff then for a typical mechanized library would have a minimum of ten staff members and a maximum of 20.

TABLE H

Type of Library

	Mode Category	No. Institutions	
1,130 Users and Planners	Coll. & Univ.	415 = 37%	
638 Users	Industrial	213	33%

Interpretation: Interest in mechanization of libraries is more world-wide in universities than in any other type of library, but in the proportion of actual users industrial libraries are higher at this time. Where agreement in Modes of these two types of libraries occurred in the tables, it is believed particularly significant.

TABLE I

Is Library Part of a Larger System?

	Yes		Mode No		No Reply
1,130 Users and Planners	221 = 19% [of respondents]		889 = 81%		20
638 Users	137	21%	494	79%	7

Interpretation: It appears that the mechanization effort is more apt to occur at the headquarters of a library system than at an individual unit (such as a departmental library in that system).

SLA-ALA/LTP Survey, IV: Detailed Tables of Libraries with EAM/ADP Equipment

TABLE J

Functions For Which EAM Equipment Is Used

	Mode Category	No. Institutions	
638 Users	Serials Control	131 = 20%	
199 Colleges & Universities	Serials Control	57	28%
213 Industrial	Serials Control	40	18
78 Public	Accounting	26	33
79 Government	Serials Control	15	19
66 All Others	Accounting	15	22
	Serials Control	15	
	Accessions Lists	15	

Interpretation: In this table, and the majority of those that follow, the Mode Category is the response and the figures are those that made that particular response. For example, of 199 colleges and universities, 57 indicated that they used EAM equipment for Serials Control, while 40 out of 213 Industrials reported similarly. More EAM equipment is used currently for Serials Control than for any other library function, while such use is nearly non-existent in Public libraries. This may be partly due to the prominence of Serials as reference sources in the other types of libraries as compared to Public libraries. All Serials are less regular than those concerned with their handling would prefer; still there is a significant content of repetitiveness that makes them attractive for mechanization.

TABLE K

Functions For Which ADP Equipment Is Used

	Mode Category	No. Institutions	
638 Users	Accounting	163 = 25%	
199 Colleges & Universities	Serials Control	52	26%
213 Industrial	Serials Control	57	26
78 Public	Accounting	35	44
79 Government	Accounting	21	26
66 All Others	Accounting	21	30

Interpretation: This table is atypical in that the Mode for total Users differs from those for Universities and Industrials. That Universities and Industrials use more sophisticated equipment in handling Serials Control reinforces the above observation that Serials Control is a major source of concern to those libraries. If "round tables" of users were to be convened for the purpose of exchanging experiences and noting similarities in programs, the most fertile field would be that of Serials Control.

TABLE L

Functions For Which Library Owns Equipment

	Mode Category	No. Institutions	
638 Users	Catalog Card Prod.	41 = 6%	
199 Colleges & Universities	Catalog Card Prod.	16	8%
213 Industrial	Retro. Searches Docu. Retrieval	10	4
	Microform material	10	
78 Public	Accounting	6	7
	Circulation Control	6	
	Catalog Card Prod.	6	
79 Government	Catalog Card Prod.	10	12
66 All Others	Catalog Card Prod.	2	3
	Accessions Lists	2	
	Interlibrary Comm.	2	

Interpretation: The most popular function running on library-owned equipment is Catalog Card Production, with the most popular equipment being automatic typewriters. Government libraries join Universities in selecting this most popular function, but Industrials diverge.

TABLE M

Functions For Which Library Rents Equipment

	Mode Category	No. Institutions	
638 Users	Circulation Control	64 = 10%	
199 Colleges & Universities	Circulation Control	31	15%
213 Industrial	Accessions Lists	12	5
	Retro. Searches Doc. Retr.	12	
78 Public	Circulation Control	14	17
79 Government	Interlibrary Comm.	6	7
66 All Others	Accessions Lists	8	12

Interpretation: Libraries rent more equipment for Circulation Control than any other function, with Universities representing nearly half the Mode total. Public libraries join the Universities in establishing the popularity of this function.

TABLE N

Function For Which Host Institution Owns Equipment

	Mode Category	No. Institutions	
638 Users	Serials Control	84 = 13%	
199 Colleges & Universities	Serials Control	29	14%
213 Industrial	KWIC Indexes	40	18
78 Public	Accounting	11	14
79 Government	Accounting	14	17
66 All Others	Accounting	7	10
	Acquisitions	7	

Interpretation: The Host Institution is the business office of the University or the data processing department of the Industrial firm or the city comptroller's department or other activity to which the library is administratively equal or subordinate. There is divergence between Universities and Industrials with the former favoring Serials Control and the latter Key-Word-In-Context Indexes. Government and Public did their Accounting in this manner.

TABLE O

Function For Which Host Institution Rents Equipment

	Mode Category	No. Institutions	
638 Users	Accounting	102 = 15%	
199 Colleges & Universities	Accounting	42	21%
213 Industrial	KWIC Indexes	28	13
	Retro. Searches Docu. Retr.	28	
78 Public	Accounting	24	30
79 Government	Serials Control	8	10
66 All Others	Accounting	10	15

Interpretation: Once again there is divergence between Colleges and Universities and the Industrials in this table. It seems that the Accounting function is the one most familiar to central groups with mechanized equipment; therefore, it is a first candidate for mechanization of the library functions. It would seem that existing routines could be best applied in this area as well.

TABLE P*

Functions For Which a Service Bureau Is Used

	Mode Category	No. Institutions	
638 Users	Accounting	18 = 2%	
199 Colleges & Universities	Accounting	3	1%
	Acquisitions	3	
	Union Lists	3	
213 Industrial	Retro. Searches Docu. Retr.	7	3
78 Public	Accounting	9	11
79 Government	KWIC Indexes	4	5
66 All Others	Accounting	4	6

Interpretation: Service Bureaus are commercial organizations that provide a mechanized service for a fee. They supply the programs and the machine operators. The relatively low use of Service Bureaus was not expected, and the possibility exists that this might be an avenue for inter-library cooperation in the future. If a Serials Control procedure could be agreed to by the libraries in an area, their check-in cards and the like could be run in a Service Bureau, thus relieving their host organizations of a machine load and sidestepping the priority problem that affects some libraries who are sharing equipment time with others in their host organizations.

*Table P[1] summarizes the facts shown in Tables L through P.

TABLE P[1]

Recapitulation of Tables L through P

Functions Run on Equipment:	638 Users		199 Coll. & Univer.		213 Industrial		78 Public		79 Government		66 All Others	
Owned by Lib.	240	656	81	238	63	175	35	93	46	88	11	59
Rented by Lib.	416		157		112		58		42		48	
Owned by Host Org.	665	1,311	175	412	304	545	75	115	102	167	52	107
Rented by Host Org.	646		237		241		40		65		55	
By Service Bur.	139		16		51		26		26		19	

Interpretation: This table is a recapitulation of Tables L through P. They show that twice as many library functions are on equipment under the control of their host organizations as compared to equipment under the libraries' own control. It is more noticeable in Industrial libraries where three times as many functions are run on host organizational units as on those of libraries. The relatively smaller size of Industrial libraries as compared to Public, Governmental and College and University libraries is a major contributing factor. In contrast to the above, Public libraries control nearly as many functions on their own machines as on those under their host organization. This should ensure greater independence in operation in the Public library area than in the Industrial area. The urgencies of business requirements would be such that the Industrial libraries would be more subject to being "bumped" by higher priority assignments in the central computing facility than other libraries surveyed. The use of service bureaus by libraries is an avenue that could merit further attention.

TABLE R

Type of Equipment Used For Accounting*

	Mode Category	No. Institutions	
235 Equipment Users	Small Computers	95 = 40%	
71 Colleges & Universities	EAM	36	50%
52 Industrial	Small Computers	24	46
54 Public	Small Computers	18	33
	EAM	18	
29 Government	Small Computers	11	38
28 All Others	Small Computers	10	35
	EAM	10	

Interpretation: ADP equipment will normally have EAM equipment as peripheral units; thus some institutions will be reporting twice under a function in Tables R through GG. Accounting is currently the most mechanized function. The increasing level of sophistication in handling Accounting is shown by the Modal value of 95 equipment users using Small Computers for this function. Industrials and Government agree, but Universities give EAM equipment first notice.

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*See Table LL for Planners in Accounting.

TABLE S

Type of Equipment Used for Acquisition of Library Materials*

	Mode Category	No. Institutions	
102 Equipment Users	EAM	51 = 50%	
39 Colleges & Universities	EAM	24	61%
24 Industrial	Small Computers	9	37
17 Public	Small Computers	7	41
16 Government	EAM	9	56
6 All Others	EAM	5	83

Interpretation: The general level of sophistication of the Acquisition function mechanization is shown by the Modes being EAM equipment for all except Industrial and Public, and they are small numerically. Efforts such as the shared cataloging program of the Library of Congress are bound to increase the utilization of high level equipment in the relatively near future.

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*See Table MM for Planners in Acquisition.

TABLE T

Type of Equipment Used for Serials Control*

	Mode Category	No. Institutions	
209 Equipment Users	EAM	112 = 53%	
75 Colleges & Universities	EAM	46	61%
82 Industrial	[Small Computers	38]	46
	[EAM	38]	
7 Public	Small Computers	5	70
23 Government	EAM	13	56
22 All Others	EAM	12	54

Interpretation: This function is the second most widely mechanized and is still largely on EAM equipment.

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*See Table NN for Planners in Serials Control.

TABLE U

Type of Equipment Used for Circulation Control*

	Mode Category	No. Institutions	
165 Equipment Users	EAM	100 = 60%	
56 Colleges & Universities	EAM	37	66%
55 Industrial	EAM	27	49
30 Public	EAM	20	66
14 Government	EAM	8	57
10 All Others	EAM	8	80

Interpretation: Circulation Control is the third most popular function of mechanization at this time. Note that all Modes show use of EAM equipment. The programs will vary between types of libraries because of present concepts of circulation control needs. These needs will merit reconsideration when real time equipment becomes generally available.

*See Table OO for Planners.

TABLE V

Type of Equipment Used for Classified Document Control*

	Mode Category	No. Institutions	
57 Equipment Users	Small Computers	25	= 43%
	EAM	25	
6 Colleges & Universities	Small Computers	3	50%
31 Industrial	Small Computers	17	54
0 Public	- - -	--	--
9 Government	EAM	4	44
11 All Others	EAM	5	45

Interpretation: This function appears to be the least frequently mechanized (or else those institutions having large classified document collections chose not to respond to the survey). As this function is related to the inventory function that is so highly mechanized, it would appear to command wider attention than shown in this table. Accordingly, Table V is believed to be less reliable than others.

*See Table PP for Planners.

TABLE W

Type of Equipment Used for Catalog Card Production*

	Mode Category	No. Institutions	
101 Equipment Users	Small Computers	27 = 26%	
30 Colleges & Universities	Automatic Typewriters	18	60%
32 Industrial	Small Computers	11	34
8 Public	Automatic Typewriters	4	50
22 Government	Automatic Typewriters	13	59
8 All Others	EAM	4	50

Interpretation: Divergence is shown here between the Mode calling for Small Computers as reinforced by the Industrial libraries with the remaining libraries being largely on Automatic Typewriters. Book Catalog Production shown on the next table overshadows the efforts in Catalog Card Production.

*See Table QQ for Planners.

TABLE X

Type of Equipment Used for Book Catalog Production*

	Mode Category	No. Institutions	
125 Equipment Users	Small Computers	63 = 50%	
33 Colleges & Universities	Small Computers	22	66%
49 Industrial	Small Computers	22	44
16 Public	EAM	11	68
14 Government	Small Computers	9	64
12 All Others	EAM	6	50

Interpretation: Considerable interest in Book Catalog Production is shown here with essential agreement among the leaders that Small Computers are essential for their production. The agreement among Universities, Industrial and Government is significant here.

*See Table RR for Planners.

TABLE Y

Type of Equipment Used for Accessions Lists*

	Mode Category	No. Institutions	
170 Equipment Users	Small Computers	67 = 39%	
51 Colleges & Universities	Small Computers	24	47%
63 Industrial	Small Computers	27	42
10 Public	EAM	5	50
25 Government	EAM	9	36
21 All Others	EAM	8	38

Interpretation: This function is the fourth most popular mechanized function. The heavy users are on Small Computers with Public and Government installations showing EAM equipment.

*See Table SS for Planners.

TABLE Z

Type of Equipment Used for Key-Word-In-Context Indexes*

	Mode Category	No. Institutions	
135 Equipment Users	Small Computers	74 = 54%	
19 Colleges & Universities	Small Computers	11	57%
85 Industrial	Small Computers	48	56
1 Public	[Small Computers	1]	100
	[EAM	1]	
16 Government	Small Computers	7	43
13 All Others	Small Computers	7	53

Interpretation: In this table, it is virtually unanimous that Small Computers are required.

*See Table TT for Planners.

TABLE AA

Type of Equipment Used for Retrospective Searches - Document Retrieval*

	Mode Category	No. Institutions	
131 Equipment Users	Small Computers	52 = 39%	
18 Colleges & Universities	Large Computers	6	33%
76 Industrial	Small Computers	29	38
0 Public	- - -	--	--
22 Government	Small Computers	10	45
15 All Others	Small Computers	9	60

Interpretation: This function clearly calls for sophisticated equipment as shown by the inclusion for the first time in the Mode of Large Computers. Applications in this sub-function are less difficult than those in the following function—Data Retrieval.

*See Table UU for Planners.

TABLE BB

Type of Equipment Used for Retrospective Searches - Data Retrieval*

	Mode Category	No. Institutions	
66 Equipment Users	Small Computers	21 = 31%	
10 Colleges & Universities	[Small Computers EAM]	3 3	30%
41 Industrial	Small Computers	15	36
0 Public	- - -	--	--
9 Government	Large Computers	5	55
6 All Others	Large Computers	3	50

Interpretation: Data Retrieval is probably the most complicated function included in the study. It is clear that very large storage capacities are required for these operations.

*See Table VV for Planners.

TABLE CC

Type of Equipment Used for Current Awareness Service*

	Mode Category	No. Institutions	
91 Equipment Users	Small Computers	41 = 45%	
15 Colleges & Universities	Small Computers	4	26%
43 Industrial	Small Computers	24	55
3 Public	EAM	2	66
20 Government	Small Computers	11	55
10 All Others	Large Computers	5	50

Interpretation: ADP equipment is clearly required for significant services in this function. Virtually complete agreement among the types of libraries is noted.

*See Table WW for Planners.

TABLE DD

Type of Equipment Used for Union Lists*

	Mode Category	No. Institutions	
133 Equipment Users	EAM	62 = 46%	
55 Colleges & Universities	EAM	32	58%
53 Industrial	EAM	17	32
5 Public	EAM	2	40
12 Government	EAM	5	41
8 All Others	EAM	6	75

Interpretation: Increasing emphasis on library networks implies increasing importance of such projects as Union Lists, as shown in this table. The Modes for all types of libraries show that this function is now on EAM equipment.

*See Table XX for Planners.

TABLE EE

Type of Equipment Used for Microform Materials*

	Mode Category	No. Institutions	
48 Equipment Users	All Other	14 = 28%	
5 Colleges & Universities	No Answer	3	60%
31 Industrial	All Other	11	35
0 Public	- - -	--	--
7 Government	EAM	2	28
4 All Others	No Answer	3	75

Interpretation: The intention here was to survey those libraries that utilized microfiche, micropaques and microfilms as an integral part of their mechanized procedures. The general divergence in replies to this question shows that the question should have been phrased differently. The results are not believed to be a reliable inventory.

*See Table YY for Planners.

TABLE FF

Type of Equipment Used for Inter-Library Communications*

	Mode Category	No. Institutions	
71 Equipment Users	Communica. Devices	45 = 63%	
20 Colleges & Universities	Communica. Devices	15	75%
21 Industrial	Communica. Devices	11	54
13 Public	Communica. Devices	10	76
11 Government	Communica. Devices	6	54
6 All Others	Communica. Devices	3	50

Interpretation: This question was included in the survey because of the indications that library networks are to assume greater importance in the future. The figures for Universities and Industrials are believed low and do not include the Communication Devices available to their host organizations. Thus the problem here is a switching device from the host organizations' communications nerve center to the library so as to include it fully in the net. (Contact with the institutions' electrical engineering department could be useful in this connection.)

*See Table ZZ for Planners.

TABLE GG

Type of Equipment Used for Other Functions*

	Mode Category	No. Institutions	
99 Equipment Users	Small Computers	38 = 38%	
32 Colleges & Universities	EAM	16	50%
33 Industrial	EAM	12	36
6 Public	EAM	3	50
16 Government	Small Computers	7	43
12 All Others	Small Computers	7	58

Interpretation: From a number of libraries using Small Computers for unspecified functions, a resurvey of those replying affirmatively on this function should be made.

*See Table AAA for Planners.

SLA-ALA/LTP Survey, V: Detailed Tables of Libraries Having Plans for Use of EAM/ADP Equipment

TABLE HH

Functions Planned for Automation

	Mode Category	No. Institutions	
942 Planners	Serials Control	452 = 47%	
376 Colleges & Universities	Serials Control	233	61%
240 Industrial	Retro. Searches Docu. Retr.	107	44
93 Public	Circulation Control	65	69
113 Government	Serials Control	59	52
113 All Others	Serials Control	39	34

Interpretation: The need for Serials Control in the future is emphasized in the Modal responses of the Planners with the Industrial and Public librarians giving other functions preference. The figures here differ from those in Table KK and subsequently in that the latter list authorized studies only. This table thus contains the “wishers,” who number more than 400 institutions for Serials Control, Circulation Control, Accessions Lists and Acquisitions.

TABLE II

Functions For Which EAM Equipment is on Order

	Mode Category	No. Institutions	
942 Planners	Circulation Control	53 = 5%	
376 Colleges & Universities	Acquisition	36	9%
240 Industrial	Retro. Searches Docu. Retr.	9	3
93 Public	Circulation Control	11	11
113 Government	Catalog Card Prod.	7	6
	Accessions Lists	7	
113 All Others	Circulation Control	4	3

Interpretation: While the Modal value here is 53 for Circulation Control, a near tie resulted from a total of 52 for institutions for Acquisition and 50 for Serials Control. There is no one clear "favorite function" for which EAM equipment is on order.

TABLE JJ

Functions For Which ADP Equipment is on Order

	Mode Category	No. Institutions	
942 Planners	Serials Control	99 = 10%	
376 Colleges & Universities	Serials Control	62	16%
240 Industrial	Retro. Searches Docu. Retr.	27	11
93 Public	Circulation Control	17	18
113 Government	Serials Control	12	10
113 All Others	Accounting	6	5
	Retro. Searches Docu. Retr.	6	

Interpretation: Serials Control, mentioned frequently above, is clearly the function for which ADP equipment has already been most ordered. A near second is Circulation Control with 90 institutions having this function's mechanization as an objective.

TABLE KK

Functions For Which There is an Authorized Automation Study Underway

	Mode Category	No. Institutions	
942 Planners	Circulation Control	244 = 25%	
376 Colleges & Universities	Acquisition	122	32%
240 Industrial	Retro. Searches Docu. Retr.	71	29
93 Public	Circulation Control	43	46
113 Government	Book Catalog Prod.	37	32
113 All Others	Retro. Searches Docu. Retr.	20	17

Interpretation: There are more authorized studies underway for Circulation Control than for any other function. It is important, though, that the 244 total just exceeds that for Serials Control, listed by 242 institutions. Other functions involving more than 200 institutions include Acquisition—226, Accessions Lists—220, and Book Catalog Production—201.

TABLE LL

When Will Study Recommendations Be Implemented for Accounting?

	Mode Category	No. Institutions	
111 Planners	Within 1 to 2 Yrs.	42 = 37%	
72 Colleges & Universities	Within 1 to 2 Yrs.	27	37%
7 Industrial	Within 1 to 2 Yrs.	3	42
13 Public	Within next year	5	38
8 Government	Within 1 to 2 Yrs.	3	37
10 All Others	Within 1 to 2 Yrs.	4	40

Interpretation: The Accounting function seems to have some maturity in inter-library communications should be higher. It was encouraging that a number plan to implement their procedures within one to two years, while the Government respondents plan to implement theirs within the next year. Sharing their resources and facilities will be an urgent necessity of the future and the efforts included here are necessary groundwork.

TABLE MM

When Will Study Recommendations Be Implemented for Acquisitions?

	Mode Category	No. Institutions	
226 Planners	Within 1 to 2 Yrs.	86 = 38%	
122 Colleges & Universities	Within 1 to 2 Yrs.	45	36%
30 Industrial	Within 1 to 2 Yrs.	12	40
37 Public	Within 1 to 2 Yrs.	15	40
25 Government	Within 1 to 2 Yrs.	10	40
11 All Others	[Within next year	4]	36
	[Within 2 to 5 Yrs.	4]	

Interpretation: Twice as many institutions are planning to implement Acquisitions programs as Accounting. This is the third largest group of Planners and reinforces the need felt by the ALA/LTP in conducting a research study on the Acquisitions function in college libraries. The urgency is shown by the desire to implement the plans within the next two years on the part of the institutions surveyed.

TABLE NN

When Will Study Recommendations Be Implemented for Serials Control?

	Mode Category	No. Institutions	
242 Planners	Within 1 to 2 Yrs.	78 = 32%	
119 Colleges & Universities	Within 1 to 2 Yrs.	38	31%
45 Industrial	Within next year	18	40
21 Public	Within 1 to 2 Yrs.	9	42
36 Government	Within next year	11	30
18 All Others	Within 1 to 2 Yrs.	6	33

Interpretation: Many institutions plan to institute Serials Control automation procedures as Circulation Control, and all plan to implement within the next two years. The critical nature of the Serials Control problem has been repeatedly mentioned in the interpretations thus far.

TABLE OO

When Will Study Recommendations Be Implemented for Circulation Control?

	Mode Category	No. Institutions	
244 Planners	Within 1 to 2 Yrs.	79 = 32%	
113 Colleges & Universities	Within 1 to 2 Yrs.	36	31%
42 Industrial	Within 1 to 2 Yrs.	17	40
43 Public	Within 2 to 5 Yrs.	14	32
29 Government	Within 1 to 2 Yrs.	12	41
16 All Others	Within 2 to 5 Yrs.	6	37

Interpretation: Circulation Control is the function most planned for the future, with the Modes showing Universities, Industrials and Government all planning to initiate action within the next two years. Interestingly enough, the Public libraries have a more relaxed view, planning to implement in two to five years' time. Perhaps the sheer magnitude of the workload involved for them and a more realistic financial view is the reason for this conservatism.

TABLE PP

When Will Study Recommendations Be Implemented for Classified Document Control?

	Mode Category	No. Institutions	
52 Planners	Within next year	18 = 34%	
10 Colleges & Universities	- - -	--	--
20 Industrial	Within next year Within 1 to 2 Yrs.	8 8	40%
0 Public	- - -	--	--
13 Government	Within next year	7	53
4 All Others	- - -	--	--

Interpretation: This appears to be a minor function in future plans unless some institutions involved chose not to reply for sufficient reasons.

TABLE QQ

When Will Study Recommendations Be Implemented for Catalog Card Production?

	Mode Category	No. Institutions	
139 Planners	Within 2 to 5 Yrs.	43 = 31%	
65 Colleges & Universities	Within 2 to 5 Yrs.	26	40%
22 Industrial	Within next year	9	40
21 Public	Within 1 to 2 Yrs.	7	33
24 Government	Within next year	10	41
6 All Others	Within 2 to 5 Yrs.	3	50

Interpretation: Catalog Card Production plans are considered by one in nine of the Planners, but are numerically exceeded by the plans for Book Catalog Production. Those planning for Catalog Card Production have plans to implement Catalog Card Production later than those in Table RR.

TABLE RR

When Will Study Recommendations Be Implemented for Book Catalog Production?

	Mode Category	No. Institutions	
201 Planners	Within 1 to 2 Yrs.	55 = 27%	
73 Colleges & Universities	Within 1 to 2 Yrs.	18	24%
50 Industrial	Within next year	24	48
30 Public	Within 2 to 5 Yrs.	11	36
37 Government	Within 1 to 2 Yrs.	12	32
10 All Others	Within next year	4	40
	Within 1 to 2 Yrs.	4	

Interpretation: Plans for Book Catalog Production are among the most popular functions for the future, and a significant number plan to implement within the next one to two years. Availability of on-line inquiry equipment would affect the popularity of this function in the next several years.

TABLE SS

When Will Study Recommendations Be Implemented for Accessions Lists?

	Mode Category	No. Institutions	
220 Planners	Within next year	78 = 35%	
93 Colleges & Universities	Within next year	35	37%
55 Industrial	Within next year	25	45
22 Public	Within 1 to 2 Yrs.	9	40
32 Government	[Within next year	10]	31
	Within 1 to 2 Yrs.]	10]	
17 All Others	Within next year	6	35

Interpretation: This is one of the most popular functions with Planners and its immediacy is seen from the nearly unanimous desire to implement the plans within the next year.

TABLE TT

When Will Study Recommendations Be Implemented for Key-Word-In-Context Indexes?

	Mode Category	No. Institutions	
98 Planners	Within next year	37 = 37%	
27 Colleges & Universities	Within next year	13	48%
44 Industrial	Within next year	17	38
2 Public	- - -	--	--
12 Government	Within next year	3	25
12 All Others	Within next year	4	33

Interpretation: KWIC Indexes have been a popular machine application for some time. It is noted that the nearly 100 Planners wish to implement their Key-Word-In-Context Indexes within the next year.

TABLE UU

When Will Study Recommendations Be Implemented For Retrospective Searches -- Document Retrieval?

	Mode Category	No. Institutions	
156 Planners	Within 2 to 5 Yrs.	43 = 27%	
35 Colleges & Universities	Within 2 to 5 Yrs.	13	37%
71 Industrial	Within next year	25	35
5 Public	Within 1 to 2 Yrs.	2	40
24 Government	Within 2 to 5 Yrs.	7	29
20 All Others	Within next year	5	25

Interpretation: The complexity of implementing Document Retrieval systems for retrospective searches is shown by the general response that the Planners do not plan to implement this system until two to five years from now. However, the Industrial libraries (that typically would have more immediate programming support available than the other types of libraries) plan to implement their procedures within the next year. Some of the delays foreseen by Planners in this field could be due to the diversity in theory still evident. Some interesting current work by documentalists and engineers is going to have a great impact in this area.

TABLE VV

When Will Study Recommendations Be Implemented for Retrospective Searches -- Data Retrieval?

	Mode Category	No. Institutions	
105 Planners	Within 2 to 5 Yrs.	34 = 31%	
31 Colleges & Universities	Within 2 to 5 Yrs.	12	38%
40 Industrial	Within 2 to 5 Yrs.	12	30
6 Public	- - -	--	--
17 Government	Within 2 to 5 Yrs.	5	29
10 All Others	Within 2 to 5 Yrs.	4	40

Interpretation: One hundred and five Planners plan to implement projects in Data Retrieval within two to five years. This is in spite of the assertion by some that true data retrieval systems are years away. The number of individual institutions and projects for study underway in this field are real causes for optimism. Widespread shortages of programming talent are among the sources of delays in the implementation of this function on a broad basis.

TABLE WW

When Will Study Recommendations Be Implemented for Current Awareness Service?

	Mode Category	No. Institutions	
137 Planners	Within 1 to 2 Yrs.	47 = 34%	
40 Colleges & Universities	Within 1 to 2 Yrs.	13	32%
54 Industrial	Within 1 to 2 Yrs.	21	38
6 Public	Within 1 to 2 Yrs.	3	50
20 Government	Within next year	6	30
	Within 2 to 5 Yrs.	6	
16 All Others	Within 1 to 2 Yrs.	4	25
	Within 2 to 5 Yrs.	4	

Interpretation: Current Awareness Services as part of the information dissemination program of literature activities is well recognized in importance. There was considerable agreement that the recommendations must be implemented within the next one to two years. Organized procedures should result in more prompt and more flexible alerting services.

TABLE XX

When Will Study Recommendations Be Implemented for Union Lists?

	Mode Category	No. Institutions	
123 Planners	Within 1 to 2 Yrs.	39 = 31%	
56 Colleges & Universities	Within 1 to 2 Yrs.	20	35%
24 Industrial	Within 1 to 2 Yrs.	8	33
18 Public	Within 1 to 2 Yrs.	6	33
16 Government	Within next year	4	25
	Within 2 to 5 Yrs.	4	
8 All Others	Within 2 to 5 Yrs.	4	50

Interpretation: The importance of Union Lists in the upcoming interlibrary cooperative efforts has been previously mentioned. It is noted that most institutions plan to implement their projects within the next one to two years.

TABLE YY

When Will Study Recommendations Be Implemented for Microform Materials ?

	Mode Category	No. Institutions	
81 Planners	Within 2 to 5 Yrs.	28 = 34%	
22 Colleges & Universities	Within 2 to 5 Yrs.	8	36%
27 Industrial	Within 1 to 2 Yrs.	10	37
5 Public	Within 1 to 2 Yrs.	2	40
13 Government	Within 2 to 5 Yrs.	5	38
13 All Others	Within 2 to 5 Yrs.	6	46

Interpretation: As mentioned elsewhere, this question did not receive sufficient replies and should have been asked in a different manner. It is not considered as reliable as the majority of tables included in this report.

TABLE ZZ

When Will Study Recommendations Be Implemented for Inter-Library Communications?

	Mode Category	No. Institutions	
90 Planners	Within 1 to 2 Yrs.	26	= 28%
	Within 2 to 5 Yrs.	26	
42 Colleges & Universities	Within 1 to 2 Yrs.	13	30%
11 Industrial	Within 2 to 5 Yrs.	5	45
15 Public	Within 2 to 5 Yrs.	6	40
12 Government	Within next year	7	58
9 All Others	Within 2 to 5 Yrs.	4	44

Interpretation: The number of libraries planning to institute projects in inter-library communications should be higher. It was encouraging that a number plan to implement their procedures within one to two years, while the Government respondents plan to implement theirs within the next year. Sharing their resources and facilities will be an urgent necessity of the future and the efforts included here are necessary groundwork.

TABLE AAA*

When Will Study Recommendations Be Implemented for Other Functions?

	Mode Category	No. Institutions	
44 Planners	Within next year	14 = 31%	
16 Colleges & Universities	Within next year	6	37%
15 Industrial	Within 1 to 2 Yrs.	5	33
	Within 2 to 5 Yrs.	5	
2 Public	Within next year	1	50
	Within 1 to 2 Yrs.	1	
6 Government	Within next year	3	50
4 All Others	Within 2 to 5 Yrs.	2	50

Interpretation: Probably each institution responding in this category should be resurveyed to determine if there are significant functions for mechanization excluded from the questionnaire.

*Table AAA[1] summarizes the facts shown in Tables R through AAA.

TABLE AAA[1]

Recapitulation of Tables R through AAA

Functions Mechanized in Order of Frequency:

	Users	Planners	Total	% of 1130 Institu-tions*
Serials Control	209	242	451	40
Circulation Control	165	244	409	36
Accessions Lists	170	220	390	34
Accounting	235	111	346	31
Acquisitions	102	226	328	29
Book Catalog Production	125	201	326	28
Retro. Searches - Docu. Retr.	131	156	287	25
Union Lists	133	123	256	23
Catalog Card Production	101	139	240	21
KWIC Indexes	135	98	233	20
Current Awareness Service	91	137	228	20
Retro. Searches - Data Retr.	66	105	171	15
Inter-library Communications	71	90	161	14

TABLE AAA[1] (cont.)

	Users	Planners	Total	% of 1130 Institutions*
Other Functions	99	44	143	12
Microform Materials	48	81	129	11
Classified Document Control	57	52	109	9
	1,938	2,269	4,207	

*See note on Table C above.

Interpretation: This recapitulation of library mechanization functions clearly shows the preeminence of Serials Control and Circulation Control as functions of major concern. Virtually 40 percent of the 1,130 institutions that were Users and Planners have mechanized or authorized studies for implementing the former. Thirty-six percent of the institutions have projects or authorized plans for Circulation Control. Further, there are more planners for this function than for any other function.

Accessions Lists have been repeatedly mentioned and 34 percent of the 1,130 institutions are actively mechanizing this function. While Accounting is the highest populated mechanized function at this time, with 235 institutions involved, the relative level of saturation is shown by the fact that only 111 are involved in plans for the future, or 30 percent overall.

If there were professional round tables established by the professional societies or others to pool experiences and share common programming efforts, they could be established in the above four functions and cover 38 percent of all the library functions in use or planned for 1,130 institutions. Addition of round tables in Acquisitions and Book Catalog Production would bring the total functions covered for these cooperative approaches to over 53 percent of the functions mechanized or planned for mechanization. Currently there is an average of 3.0 functions mechanized per User, while Planners have authorized studies underway for an average of 2.3 functions per library. The over-all average is that the 1,130 different institutions are concerned with the mechanization of 3.7 library functions each. Probabilities are highest that these functions are Serials Control, Circulation Control, Accessions Lists and Accounting, making three administrative functions compared to one dissemination function.

TABLE BBB

Responses in Descending Order of Agreement Among the Several Types of Libraries

(1)	Unanimous		
	Users	Number of Technical Report Titles	(Table E)
	Users	Equipment for Circulation Control	(Table U)
	Users	Equipment for KWIC Indexes	(Table Z)
	Users	Equipment for Union Lists	(Table DD)
	Users	Equipment for Inter-Library Communications	(Table FF)
(2)	Planners	When Will Acquisition Be Implemented?	(Table MM)
(3)	Planners	When Will Current Awareness Be Implemented?	(Table WW)
(4)	Planners	When Will Union Lists Be Implemented?	(Table XX)
(5)	Users	Function Using EAM Equipment	(Table J)
	Users	Equipment for Serials Control	(Table N)
	Planners	When Will Accounting Be Implemented?	(Table LL)
	Planners	When Will Accessions Lists Be Implemented?	(Table SS)
(6)	Users	Equipment for Book Catalog Production	(Table X)
	Planners	When Will Circulation Control Be Implemented?	(Table OO)
(7)	Users	Number of Non-Professional Full Time Staff Members	(Table G)
	Users	Equipment for Current Awareness Service	(Table CC)
(8)	Users	Equipment Used for Accessions Lists	(Table Y)
(9)	Planners	When Will KWIC Indexes Be Implemented?	(Table TT)
	Planners	When Will Retro. Searches (Data Retrieval) Be Implemented?	(Table VV)
(10)	Users	Equipment for Classified Document Control	(Table V)
	Users	Equipment for Retro. Searches (Data Retr.)	(Table BB)
(11)	Users	Equipment Used for Serials Control	(Table T)
	Users	Functions for Which Library Owns Equipment	(Table L)
(12)	Users	Number of Books	(Table C)
	Planners	When Will Other Functions Be Implemented?	(Table AAA)
(13)	Planners	When Will Serials Control Be Implemented?	(Table NN)
(14)	Users	Function for Which Host Institution Rents Equipment	(Table O)
	Users	Function for Which Libraries Utilize Service Bureau	(Table P)
(15)	Users	Function for Which Library Rents Equipment	(Table M)

TABLE BBB (cont.)

(16)	Users	Equipment Used for Acquisition	(Table S)
	Planners	When Will Microform Materials Be Implemented?	(Table YY)
(17)	Planners	When Will Inter-Library Communications Be Implemented?	(Table ZZ)
(18)	Planners	Functions Planned for Automation	(Table HH)
	Planners	When Will Book Catalog Production Be Implemented?	(Table RR)
(19)	Planners	Functions for ADP Equipment on Order	(Table JJ)
	Planners	When Will Retro. Searches (Document Retrieval) Be Implemented?	(Table UU)
(20)	Users	Number of Full Time Professionals	(Table F)
(21)	Planners	When Will Catalog Card Production Be Implemented?	(Table QQ)
(22)	Users	Function for Which Host Institution Owns Equip.	(Table N)
(23)	Users	Equipment Used for Accounting	(Table R)
(24)	Users	Equipment Used for Catalog Card Production	(Table W)
(25)	Users	Equipment Used for Retro. Searches (Doc. Retr.)	(Table AA)
(26)	Planners	When Will Classified Document Control Be Implemented?	(Table PP)
(27)	Users	Equipment Used for Microform Materials	(Table EE)
(28)	Users	Functions Used for ADP Equipment	(Table K)
(29)	Users	Equipment Used for Other Functions	(Table GG)
(30)	Planners	Functions for EAM Equipment on Order	(Table J)
(31)	<u>Least Agreement</u>		
	Planners	Functions for Authorized Study Underway	(Table KK)

<u>Interpretation</u>: There is substantial agreement in responses of all types of libraries through category 6; agreement between the users or planners as a whole, the Universities and the Industrials from 7 through 10, of the overall Users or Planners and Universities for 11 through 22, of the Users or Planners and the Industrials of 23 through 27, with general lack of agreement between 28 and 31.

SLA-ALA/LTP Survey, VI: Listing of Libraries Having Equipment Arranged by State (in order of 1960 population), Function and Type of Equipment

The first entry in this hundred-page section of the Survey shows that the Albany Medical College (Albany, New York) uses a small computer for its mechanized Accounting function. The very last entry shows that the University of Toronto Library (Toronto, Canada) is using a combination of a small computer, EAM equipment and automatic typewriters for "Other Functions."

On the assumption that most library mechanization could be expected in metropolitan areas, under each function the arrangement is by states in order of 1960 census. It turned out that a better order would have been on the basis of 1965 population estimates for the states, or in order of Research and Development personnel or R&D grants received. The users of mechanization by states are summarized on Table CCC beginning on the next page, and rank order for the leaders are given in Table DDD.

It is evident that California leads in mechanized functions, followed by New York, Massachusetts, Pennsylvania and Ohio. (Each of these is noted to have several metropolitan areas, government installations and R&D establishments.) A total of nine states and the Dominion of Canada account for half of all mechanization with the remaining states dividing the other half. Book Catalog Production is the function having the most geographic concentration, with Microform Materials being the most diffuse.

Figure 1 below compares the degree of mechanization in the major states with their membership totals in two of the three leading professional organizations in the field, the American Library Association and the Special Libraries Association. There is a considerable similarity in the curves. However, the New Jersey "hump" in SLA membership is not accompanied by increased level of activity in mechanization, while the California and Massachusetts peaks indicate a higher productivity per professional society member in mechanization.

It would seem that efforts to increase participation of libraries in mechanization could best be concentrated in the states listed on Figure 1. (See p. 180.) They include at least half of the 638 Users (319 institutions) and presumably half of the 492 Planners only (246 institutions) or a presumed total of 565 libraries and information centers.*

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*A geographic list of Planners was made available only to the officials of the ALA Library Technology Program, the ALA Information Sciences and Automation Division, the Documentation Division of the SLA, the Library of Congress and the Council on Library Resources, and accordingly was not available for this analysis.

TABLE CCC

Geographical Distribution of 638 Users by Function and Equipment

Note: States are in order of population at 1960 census.

	Accounting	*A	B	C	D	E	F	G	H	J	Acquisition	A	B	C	D	E	F	G	H	J
N. Y.	19	11	2	2	-	3	-	-	-	5	15	7	3	-	-	7	2	3	1	1
Calif.	29	8	8	3	-	13	-	1	-	2	9	4	2	-	-	4	1	1	-	1
Penn.	10	3	1	2	-	5	-	1	1	1	3	-	1	-	-	3	-	-	-	-
Illinois	10	2	3	-	-	5	-	-	-	3	6	3	-	-	1	3	-	-	-	-
Ohio	11	5	-	2	2	4	-	-	-	1	5	3	-	-	-	2	1	2	-	-
Texas	9	2	2	-	-	3	-	-	-	2	2	1	-	-	1	1	-	-	-	-
Mich.	6	4	-	-	1	5	-	1	-	-	7	3	-	-	1	3	1	-	-	-
N. J.	5	4	-	-	-	2	-	-	-	-	1	-	-	-	-	1	-	1	-	-
Mass.	6	3	1	-	-	4	-	-	-	-	6	1	-	-	-	4	-	1	-	-
Florida	8	4	1	-	1	4	-	1	-	-	2	2	-	-	-	1	-	-	-	-
Indiana	9	8	-	-	-	3	-	-	-	1	3	2	-	-	-	3	-	1	-	-
N. C.	3	2	-	-	-	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mo.	4	1	-	-	-	4	-	-	-	-	3	2	-	-	-	3	1	1	-	-
Va.	3	2	-	-	-	1	-	-	-	-	4	2	-	-	-	2	-	1	-	-
Wisconsin	4	2	1	-	1	3	-	1	-	-	2	2	-	-	1	2	-	1	-	-
Georgia	4	3	-	-	-	2	-	-	-	-	3	2	-	1	-	1	-	-	-	-
Tenn.	3	1	-	-	-	2	-	-	-	1	2	2	1	-	-	2	-	-	-	-
Minn.	6	4	1	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Ala.	1	-	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
La.	2	1	-	-	-	2	-	1	-	-	1	1	-	-	-	1	-	1	-	-
Md.	8	4	2	-	-	4	-	-	-	-	3	1	1	-	-	2	-	1	-	-
Ky.	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Wash.	4	2	-	-	1	1	-	-	-	-	3	-	-	-	1	2	1	1	-	-
Iowa	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Conn.	5	3	-	-	-	2	-	-	-	1	0	-	-	-	-	-	-	-	-	-
S. C.	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Okla.	3	1	1	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Kan.	3	1	1	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Miss.	1	1	-	-	-	1	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Ark.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Oregon	2	1	-	-	1	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Colo.	5	2	-	-	-	2	-	-	-	2	2	-	-	-	-	1	-	-	-	1
Nebr.	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Ariz.	4	4	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-

*A - Computers, Small
B - Computers, Medium
C - Computers, Large
D - Computer-Related Equip.
E - Electrical Acctg. Machines
F - Terminals
G - Autotypewriter
H - Commun. Devices
J - Other Equipment

TABLE CCC (cont.)

	Accounting	*A	B	C	D	E	F	G	H	J	Acquisition	A	B	C	D	E	F	G	H	J
N. M.	2	1	-	1	-	2	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
R. I.	1	-	-	-	-	1	-	-	-	-	2	1	-	-	-	1	1	-	-	-
D. C.	3	1	-	-	-	1	1	1	-	-	3	1	-	-	-	3	-	-	-	-
S. D.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	2	1	-	-	-	2	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	2	1	1	-	1	-	-	-	-	-	2	-	-	-	1	1	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Dela.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Vt.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Alaska	1	-	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	8	5	1	-	-	3	1	1	-	1	4	2	-	-	-	1	1	1	-	-

	Serials Control	A	B	C	D	E	F	G	H	J	Circulation Control	A	B	C	D	E	F	G	H	J
N. Y.	20	10	5	1	-	9	-	1	-	3	19	13	2	-	2	1	-	-	-	-
Calif.	27	13	4	5	-	12	-	2	-	1	29	5	4	4	-	19	-	-	1	1
Penn.	7	1	1	2	-	6	-	-	-	1	4	-	-	-	-	4	-	1	-	-
Illinois	10	6	2	-	-	7	-	-	-	-	7	3	2	-	1	4	-	-	-	1
Ohio	12	7	-	-	-	6	1	1	-	2	1	-	-	-	-	1	-	-	-	-
Texas	8	4	2	1	2	4	-	-	-	1	5	1	-	1	1	-	-	-	-	1
Mich.	6	2	1	-	1	4	1	1	-	-	5	4	-	-	-	3	-	1	-	-
N. J.	2	2	-	1	-	2	-	-	-	-	6	3	1	1	-	6	-	-	-	-
Mass.	16	9	1	2	-	10	1	3	-	-	9	1	1	1	-	7	-	1	-	-
Florida	3	3	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-
Indiana	5	5	1	-	-	2	-	-	-	-	3	2	-	-	-	1	-	-	-	-
N. C.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mo.	4	2	-	-	-	4	-	1	-	-	6	4	-	-	4	4	-	2	-	-
Va.	4	2	-	-	-	1	-	1	-	-	4	3	-	-	-	2	-	-	-	-
Wisc.	2	2	-	-	-	2	-	-	-	-	4	1	-	-	-	4	1	-	-	-
Ga.	2	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Tenn.	2	1	-	1	-	1	-	-	-	-	1	-	-	1	1	-	-	-	-	-
Minn.	4	2	-	-	-	2	-	-	-	-	2	1	-	-	-	1	-	1	-	-
Ala.	2	-	1	-	-	1	-	-	-	-	2	-	-	-	-	2	-	-	-	-
La.	2	1	-	-	-	1	-	-	-	-	2	-	-	-	1	2	-	-	-	-
Md.	3	1	-	1	-	3	-	-	-	-	9	4	1	-	-	6	-	-	-	-

TABLE CCC (cont.)

	Serials Control	A	B	C	D	E	F	G	H	J	Circulation Control	A	B	C	D	E	F	G	H	J
Ky.	3	3	-	-	-	2	-	1	-	-	1	-	-	-	-	-	-	1	-	-
Wash.	2	-	-	1	1	2	-	-	-	-	2	1	-	-	1	1	-	-	-	1
Iowa	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Conn.	1	-	-	-	-	-	-	1	-	-	0	-	-	-	-	-	-	-	-	-
S. C.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Okla.	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Kan.	2	2	-	-	-	2	-	-	-	-	1	1	-	-	1	1	-	-	-	-
Miss.	2	1	-	-	-	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ark.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ore.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Colo.	9	1	1	3	-	4	-	2	-	-	2	-	-	-	-	1	-	-	-	1
Nebr.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ariz.	1	1	-	-	-	-	-	-	-	-	2	1	-	-	-	1	-	-	-	-
N. M.	2	1	-	2	-	2	-	-	-	-	3	1	-	1	1	3	-	-	-	-
Utah	1	1	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	1
R. I.	1	1	-	-	-	1	-	-	-	-	2	1	-	-	-	1	1	-	-	1
D. C.	7	4	1	-	-	5	-	-	-	-	2	1	-	-	-	2	-	-	-	-
S. D.	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	1	1	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
N. H.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Dela.	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Vt.	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	11	4	3	-	2	6	-	-	1	1	8	3	1	-	2	6	-	-	3	-

	Classified Doc. Control	A	B	C	D	E	F	G	H	J	Catalog Card Production	A	B	C	D	E	F	G	H	J
N. Y.	4	3	-	-	-	1	-	-	1	-	13	8	-	-	-	3	2	6	-	-
Calif.	12	6	3	1	-	4	-	2	-	-	8	3	1	2	-	2	2	2	-	-
Penn.	1	-	-	-	-	1	-	-	-	-	3	1	-	-	-	1	-	2	-	-
Illinois	1	1	-	-	-	1	-	-	-	-	2	1	-	-	-	1	-	2	-	-
Ohio	0	-	-	-	-	-	-	-	-	-	6	1	-	-	-	1	1	3	-	-
Texas	0	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	1	-	-	-
Mich.	1	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	2	1	-	-

TABLE CCC (cont.)

	Classified Doc. Control	A	B	C	D	E	F	G	H	J	Catalog Card Production	A	B	C	D	E	F	G	H	J
N. J.	4	3	–	1	1	3	–	–	–	–	1	1	–	–	1	–	–	–	–	–
Mass.	5	2	2	–	–	2	–	2	–	–	7	1	1	–	–	4	1	1	–	–
Florida	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Indiana	1	1	–	–	–	–	–	–	–	–	3	2	–	–	–	1	–	–	–	–
N. C.	0	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–
Mo.	0	–	–	–	–	–	–	–	–	–	3	–	–	–	–	1	1	2	–	1
Va.	3	1	–	2	–	1	–	1	–	–	4	1	1	–	–	1	–	3	–	–
Wisc.	0	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–
Ga.	2	1	–	1	–	–	–	–	–	–	2	1	–	–	–	–	–	1	–	–
Tenn.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Minn.	1	1	–	–	–	1	–	–	–	–	3	–	–	–	–	2	–	1	–	–
Ala.	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–
La.	1	1	1	–	–	1	–	–	–	–	4	1	1	–	–	1	–	3	–	–
Md.	6	1	–	1	–	5	–	2	–	–	7	2	1	–	–	1	–	2	–	–
Ky.	1	1	–	1	–	–	–	–	–	–	1	1	–	–	–	–	–	1	–	–
Wash.	1	–	–	1	–	1	–	–	–	–	3	–	–	–	–	–	–	3	–	–
Iowa	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Conn.	1	–	–	–	–	1	–	1	1	–	1	1	–	–	–	1	–	1	–	–
S. C.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Okla.	0	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–
Kan.	1	1	–	1	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–
Miss.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Ark.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Ore.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
W. Va.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Colo.	0	–	–	–	–	–	–	–	–	–	3	–	–	–	–	1	–	2	–	–
Nebr.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Ariz.	0	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–
N. M.	2	1	–	2	–	–	–	1	–	–	2	1	–	–	–	1	–	–	–	–
Utah	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
R. I.	0	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–
D. C.	0	–	–	–	–	–	–	–	–	–	4	2	–	1	–	–	–	1	–	–
S. D.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Idaho	1	–	–	–	–	1	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Mont.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Hawaii	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
N. H.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Dela.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Vt.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Wy.	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
Alaska	0	–	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–	–	–
CANADA	0	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	3	–	1

TABLE CCC (cont.)

	Book Catalog Production	A	B	C	D	E	F	G	H	J	Accessions Lists	A	B	C	D	E	F	G	H	J
N. Y.	17	10	1	3	3	6	-	-	1	2	21	14	2	5	1	10	3	3	-	-
Calif.	22	8	6	9	-	8	1	3	-	4	21	9	5	5	-	6	1	3	-	2
Penn.	3	1	-	1	-	3	-	-	-	-	5	2	-	1	-	3	-	1	-	-
Illinois	2	1	-	1	-	2	-	-	-	-	5	1	1	-	-	3	-	1	-	-
Ohio	3	2	-	-	-	1	1	-	-	-	7	5	-	1	1	4	-	-	-	-
Texas	4	3	-	-	-	2	-	-	-	-	4	2	-	-	1	1	-	1	-	-
Mich.	2	-	1	-	-	1	1	-	-	-	6	1	-	-	-	3	2	1	-	-
N. J.	3	2	-	1	-	2	-	-	-	-	7	4	-	2	1	4	-	2	-	-
Mass.	8	5	2	3	-	3	1	-	-	-	12	4	4	3	-	2	-	1	-	-
Florida	1	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Indiana	2	1	-	-	-	2	-	-	-	-	5	3	-	1	-	2	-	-	-	-
N. C.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Mo.	1	1	-	-	-	-	-	-	-	-	2	1	-	-	-	1	-	-	-	-
Va.	3	2	-	-	1	-	-	2	-	-	5	3	-	2	1	1	-	1	-	-
Wisc.	2	2	-	-	-	1	-	-	-	-	2	2	-	-	-	1	-	-	-	-
Ga.	2	1	-	1	-	-	-	-	-	-	2	1	-	1	-	1	-	-	-	-
Tenn.	1	-	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Minn.	4	3	-	-	-	2	-	1	-	-	3	3	-	-	-	-	-	-	-	-
Ala.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
La.	2	2	1	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Md.	7	5	1	1	-	2	-	1	-	1	8	1	3	1	-	1	-	3	-	1
Ky.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Wash.	5	4	1	2	1	3	-	1	-	-	4	2	-	1	1	1	-	2	-	-
Iowa	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Conn.	0	-	-	-	-	-	-	-	-	-	2	1	-	-	1	-	-	2	-	1
S. C.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Okla.	3	1	1	1	1	2	-	-	-	2	2	-	2	-	1	-	-	-	-	-
Kan.	1	1	-	-	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	1
Miss.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ark.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ore.	2	1	1	-	-	1	-	-	-	1	0	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Colo.	3	2	1	-	-	1	-	-	-	-	5	1	-	-	-	3	-	2	-	-
Nebr.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ariz.	1	-	-	-	-	-	-	1	-	-	2	1	-	-	-	-	-	1	-	-
N. M.	4	2	1	1	-	3	-	-	-	-	4	2	2	-	-	3	-	-	-	1
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
R. I.	3	1	-	-	-	2	1	-	-	1	2	1	-	-	-	1	-	-	-	-
D. C.	1	-	-	-	-	-	-	1	-	-	4	2	-	1	-	2	-	1	-	-
S. D.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-

TABLE CCC (cont.)

	Book Catalog Production	A	B	C	D	E	F	G	H	J	Accessions Lists	A	B	C	D	E	F	G	H	J
Dela.	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Vt.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	9	2	2	1	-	2	1	-	-	-	6	3	2	-	-	2	-	-	-	-

	KWIC	A	B	C	D	E	F	G	H	J	Retro. Searches Doc. Retrieval	A	B	C	D	E	F	G	H	J
N. Y.	11	8	2	3	-	3	1	-	-	1	10	6	-	4	-	5	-	1	-	-
Calif.	18	13	6	8	-	2	-	3	-	1	17	8	7	9	-	3	-	-	-	-
Penn.	7	4	2	1	-	-	-	-	-	-	12	4	1	5	-	4	-	1	-	-
Illinois	4	2	1	-	-	1	-	-	-	1	3	2	1	-	-	-	-	-	-	-
Ohio	4	2	-	1	-	1	1	-	-	-	9	6	-	2	1	5	-	-	-	-
Texas	4	3	-	-	-	-	-	-	-	1	5	2	2	1	-	-	-	-	-	-
Mich.	4	2	1	1	-	-	-	-	-	-	5	2	-	-	1	4	-	-	-	-
N. J.	9	6	-	3	-	3	-	-	-	1	7	3	-	2	1	4	-	1	-	1
Mass.	4	1	1	1	-	1	-	-	-	-	6	2	-	3	-	1	1	-	-	-
Florida	1	1	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
Indiana	4	4	-	-	-	-	-	1	-	-	5	2	-	3	-	1	-	-	-	-
N. C.	2	2	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mo.	2	2	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Va.	4	3	-	1	-	-	-	1	-	-	5	3	2	2	-	-	-	-	-	-
Wisc.	3	2	1	-	-	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ga.	2	1	-	1	-	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-
Tenn.	1	-	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Minn.	3	3	-	-	-	-	-	-	-	-	3	2	-	1	-	2	-	-	-	-
Ala.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
La.	1	-	1	1	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Md.	4	1	2	-	-	1	1	-	-	-	9	6	2	2	-	2	-	1	-	-
Ky.	1	-	-	1	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-
Wash.	2	1	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Iowa	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Conn.	1	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-
S. C.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Okla.	2	1	1	-	-	-	-	-	-	1	2	-	1	1	1	-	-	-	-	-
Kan.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-

TABLE CCC (cont.)

	KWIC	A	B	C	D	E	F	G	H	J	Retro. Searches Doc. Retrieval	A	B	C	D	E	F	G	H	J
Miss.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ark.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ore.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Colo.	4	1	2	-	-	-	-	-	-	-	3	-	1	1	-	2	-	-	-	-
Nebr.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ariz.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. M.	2	1	-	1	-	1	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
R. I.	1	-	-	-	1	-	-	1	-	-	0	-	-	-	-	-	-	-	-	-
D. C.	3	2	1	1	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
S. D.	1	1	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Dela.	1	-	-	1	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-
Vt.	0	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	7	4	1	-	-	2	-	-	-	1	5	2	1	-	1	4	-	-	-	1

	Retro. Searches Data Retrieval	A	B	C	D	E	F	G	H	J	Current Awareness	A	B	C	D	E	F	G	H	J
N. Y.	10	4	1	2	-	4	1	-	-	1	9	4	-	4	-	4	-	2	-	1
Calif.	7	1	3	5	-	1	-	-	-	-	6	3	3	2	-	-	-	1	-	-
Penn.	6	3	1	1	-	2	-	-	-	-	5	2	-	1	-	3	-	1	-	-
Illinois	2	1	-	-	-	1	1	-	-	-	4	2	1	-	-	2	-	-	-	-
Ohio	6	3	-	-	1	3	-	-	-	1	6	4	-	1	-	3	-	-	-	-
Texas	2	-	1	-	-	-	-	-	-	1	3	1	-	1	-	-	-	1	-	1
Mich.	1	1	-	-	-	-	-	-	-	-	2	1	1	-	1	1	-	-	-	-
N. J.	3	2	-	1	-	2	-	-	-	1	8	4	-	2	-	6	-	2	-	-
Mass.	5	1	1	2	-	-	-	1	-	1	5	3	-	1	-	-	-	-	-	1
Florida	1	-	1	1	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-
Indiana	2	-	-	1	-	1	-	-	-	-	6	3	-	2	-	1	-	1	-	-
N. C.	0	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

TABLE CCC (cont.)

	Retro. Searches Data Retrieval	A	B	C	D	E	F	G	H	J	Current Awareness	A	B	C	D	E	F	G	H	J
Mo.	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Va.	2	-	-	2	-	-	-	-	-	-	3	2	-	1	-	-	-	-	-	-
Wisc.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-
Ga.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Tenn.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Minn.	0	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-
Ala.	0	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	1
La.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Md.	1	-	-	1	-	-	-	-	-	-	6	4	1	3	-	1	-	-	-	1
Ky.	1	1	-	1	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Wash.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Iowa	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Conn.	1	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-
S. C.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Okla.	1	-	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Kan.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Miss.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ark.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ore.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
W. Va.	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Colo.	3	1	2	-	-	1	-	-	-	-	4	2	2	-	-	2	-	2	-	-
Nebr.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ariz.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. M.	0	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
R. I.	0	-	-	-	-	-	-	-	-	-	2	1	-	1	-	1	-	-	-	1
D. C.	2	-	-	1	-	1	-	-	-	-	2	-	-	2	-	-	-	-	-	-
S. D.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Dela.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Vt.	0	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	2	1	-	-	-	2	-	-	-	1	3	2	1	-	-	1	-	-	-	-

TABLE CCC (cont.)

	Union Lists	A	B	C	D	E	F	G	H	J	Microform	A	B	C	D	E	F	G	H	J
N. Y.	23	13	6	2	1	15	-	-	-	1	3	1	-	1	-	2	-	-	-	-
Calif.	8	3	2	1	-	3	-	1	-	-	4	-	-	-	-	2	-	-	-	2
Penn.	5	1	1	-	-	2	-	-	-	1	3	1	-	-	-	-	-	-	-	2
Illinois	3	1	-	-	-	1	1	1	-	1	1	-	1	-	-	-	-	-	-	-
Ohio	2	1	-	-	-	1	-	1	-	-	2	1	-	-	-	1	-	-	-	1
Texas	2	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Mich.	6	1	-	2	1	2	1	1	1	-	1	-	-	-	-	-	-	-	-	1
N. J.	2	1	-	1	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	2
Mass.	7	4	-	1	-	4	1	1	-	-	4	1	-	-	-	1	-	1	-	2
Florida	4	3	-	-	-	2	-	-	-	-	1	-	1	-	-	1	-	-	-	-
Indiana	3	1	1	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	1
N. C.	2	2	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mo.	3	1	-	-	-	3	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Va.	1	1	-	-	-	1	-	-	-	-	2	-	-	1	-	-	-	-	-	1
Wisc.	3	1	-	-	-	1	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Ga.	1	-	1	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Tenn.	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Minn.	6	3	-	-	-	4	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Ala.	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
La.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Md.	5	1	-	1	-	5	1	-	-	-	1	-	-	-	-	-	-	-	-	1
Ky.	3	1	-	1	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Wash.	3	1	1	-	1	2	-	1	-	-	0	-	-	-	-	-	-	-	-	-
Iowa	2	1	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Conn.	1	-	-	-	-	-	-	1	-	1	0	-	-	-	-	-	-	-	-	-
S. C.	1	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Okla.	2	-	1	-	-	1	-	-	-	1	0	-	-	-	-	-	-	-	-	-
Kan.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Miss.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ark.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ore.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Colo.	5	2	-	3	-	2	-	1	-	1	0	-	-	-	-	-	-	-	-	-
Nebr.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Ariz.	1	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. M.	2	1	-	1	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
R. I.	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
D. C.	2	1	1	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
S. D.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Idaho	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Mont.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Hawaii	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Dela.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-

TABLE CCC (cont.)

	Union Lists	A	B	C	D	E	F	G	H	J	Microform	A	B	C	D	E	F	G	H	J
Vt.	1	-	-	-	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-
CANADA	7	1	1	-	-	3	-	-	-	2	1	-	-	-	-	-	-	-	-	1

	Interlibrary	A	B	C	D	E	F	G	H	J	Other Functions	A	B	C	D	E	F	G	H	J	Users of ADP/EDP Equip.-Type not specified
N. Y.	9	3	1	-	-	2	3	-	5	-	8	8	-	1	-	3	-	-	-	1	1
Calif.	5	-	1	1	-	-	-	-	4	1	11	3	2	-	1	5	-	2	-	2	5
Penn.	2	-	-	1	-	-	-	-	1	-	3	2	-	-	-	1	-	-	-	-	2
Illinois	1	-	-	-	-	-	-	-	1	-	1	1	1	1	-	-	-	-	-	-	1
Ohio	1	-	-	-	-	-	-	-	1	1	3	1	-	-	1	1	-	-	-	1	2
Texas	1	-	-	-	-	-	-	-	1	-	2	1	2	-	-	1	1	-	-	-	2
Mich.	4	-	-	-	-	1	-	-	3	-	1	-	-	-	-	-	-	-	-	1	2
N. J.	3	-	-	-	-	-	1	-	1	-	3	2	-	1	-	2	-	1	-	-	3
Mass.	1	1	-	-	-	-	-	-	-	-	5	3	-	2	-	3	-	-	-	-	1
Florida	2	-	-	-	-	-	-	-	2	-	1	-	1	-	-	1	-	-	-	-	-
Indiana	6	-	-	-	-	-	-	-	6	-	3	-	-	1	-	1	-	1	-	-	-
N. C.	3	-	-	-	-	-	-	-	3	-	0	-	-	-	-	-	-	-	-	-	2
Mo.	2	-	-	-	-	-	-	-	2	-	2	1	-	-	-	2	-	1	-	-	2
Va.	4	-	-	-	-	-	-	-	4	-	1	1	-	-	-	-	-	-	-	-	1
Wisc.	1	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-
Ga.	1	1	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-	-	-	-	-
Tenn.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	1
Minn.	0	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	2
Ala.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
La.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Md.	1	-	-	-	-	-	-	-	1	-	3	1	1	1	-	1	-	-	-	-	1
Ky.	2	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	1	-	-	-
Wash.	0	-	-	-	-	-	-	-	-	-	3	2	1	2	-	1	1	1	-	-	-
Iowa	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1
Conn.	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	1

TABLE CCC (cont.)

	Interlibrary	A	B	C	D	E	F	G	H	J	Other Functions	A	B	C	D	E	F	G	H	J	Users of ADP/EDP Equip.-Type not specified
S. C.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Okla.	1	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-
Kan.	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-
Miss.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Ark.	1	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-
Ore.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
W. Va.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Colo.	1	-	-	-	-	-	-	1	-	-	3	1	-	1	-	2	-	-	-	1	1
Nebr.	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-
Ariz.	1	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-
N. M.	0	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-
Utah	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
R. I.	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	-
D. C.	1	-	-	-	-	-	-	-	1	-	8	6	1	1	-	4	1	3	-	1	3
S. D.	0	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-	-
Idaho	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Mont.	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-
Hawaii	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
N. H.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Dela.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Vt.	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-
Wy.	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Alaska	0	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
CANADA	5	-	-	-	-	-	-	-	5	-	5	2	-	-	1	3	-	2	-	-	3

TABLE DDD

Leading States (plus Dominion of Canada) by Mechanized Function

Function	1st Place	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Accounting	Calif. 29	N. Y. 19	Ohio 11	Illinois 10	Penn. 10	Tex. 9	Ind. 9	Fla. 8	Md. 8	CAN 8
Acquisition	N. Y. 15	Calif. 9	Mich. 7	Illinois 6	Mass. 6	Ohio 5	Va. 4	CAN 4		
Serials	Calif. 27	N. Y. 20	Mass. 16	Ohio 12	CAN 11	Ill. 10	Colo. 9	Tex. 8	D. C. 7	Penn. 7
Circulation	Calif. 29	N. Y. 19	Mass. 9	Md. 9	CAN 8	Ill. 7	N. J. 6	Mo. 6	Tex. 5	Mich. 5
Classified Documents	Calif. 12	Md. 6	Mass. 5	N. Y. 4	N. J. 4					
Catalog Card Production	N. Y. 13	Calif. 8	Md. 7	Mass. 7	Ohio 6	D. C. 4	La. 4	Va. 4		
Book Catalog Production	Calif. 22	N. Y. 17	CAN 9	Mass. 8	Md. 7	Penn. 5	Wash. 5	Tex. 4	Minn. 4	N. M. 4
Accessions Lists	Calif. 21	N. Y. 21	Mass. 12	Md. 8	N. J. 7	Ohio 7	Mich. 6	CAN 6		
KWIC	Calif. 18	N. Y. 11	N. J. 9	Penn. 7	CAN 7					
Retro. Search Documents Retrieval	Calif. 17	Penn. 12	N. Y. 10	Ohio 9	Md. 9	N. J. 7	Mass. 6	(Mich. (Tex. 5	(Va. (Ind. 5	CAN 5
Retro. Search Data Retrieval	N. Y. 10	Calif. 7	Penn. 6	Ohio 6	Mass. 5	N. J. 3	Colo. 3			
Current Awareness	N. Y. 9	N. J. 8	Calif. 6	Ohio 6	Ind. 6	Md. 6	Penn. 5	Mass. 5		
Union Lists	N. Y. 23	Calif. 8	Mass. 7	CAN 7	Mich. 6	Minn. 6	Penn. 5	Md. 5	Colo. 5	
Microform	Calif. 4	Mass. 4	N. Y. 3	Penn. 3						
Interlibrary	N. Y. 9	Ind. 6	Calif. 5	CAN 5	Mich. 4	Va. 4				
Other	Calif. 11	N. Y. 8	D. C. 8	Mass. 5	CAN 5					

The above tabulations represent typically around half of the total libraries having the function mechanized.

For Accounting, the above represents 121 of 235 institutions, or 52%.

For Acquisition, the above represents 56 of 102 institutions, or 55%.

For Serials, the above represents 127 of 209 institutions, or 60%.

For Classified Document Control, the above represents 103 of 165 institutions, or 63%.

For Catalog Card Production, the above represents 53 of 101 institutions, or 52%.

For Book Catalog Production, the above represents 85 of 125 institutions, or 70%.

For Accessions Lists, the above represents 88 of 170 institutions, or 52%.

For KWIC, the above represents 52 of 135 institutions, or 39%.

For Retro. Search, Document Retrieval, the above represents 95 of 131 institutions, or 72%.

For Retro. Search, Data Retrieval, the above represents 40 of 66 institutions, or 60%.

For Current Awareness, the above represents 51 of 91 institutions, or 56%.

For Union Lists, the above represents 72 of 133 institutions, or 54%.

For Microform Materials, the above represents 14 of 48 institutions, or 29%.

For Interlibrary Communications, the above represents 33 of 71 institutions, or 43%.

For Other Functions, the above represents 37 of 99 institutions, or 36%.

With 47 of the 50 states and the Dominion of Canada represented (Maine, North Dakota and Nevada are missing), it seems that the most geographically concentrated function is Book Catalog Production and the most dispersed is that related to Microform Materials.

Conclusion

This SLA-ALA/LTP Survey was the first full-scale inventory of data processing equipment used by libraries and information centers. It revealed the kinds of institutions where mechanization is most prevalent, the kinds of library functions that they have mechanized now and plan to mechanize in the immediate future, the geographic concentration of libraries with mechanized functions, and the preference for mechanizing administrative functions rather than cataloging and public service functions.

As Jesse Shera observes in his article, "Beyond 1984,"[2]:

> The library problem, like the problem of education, is not storage but retrieval. . . .
>
> Librarianship is not going to be untouched by the machine. . . . There is a computer in your future, there is no doubt about that, and whether one regards it as a monster of a Frankenstein or the harbinger of a new industrial revolution will not change the course of events. . . . The machine, if librarians will but prepare themselves for its coming, will raise librarianship to new levels of intellectual strength and attainment. . . .

When the library process becomes an integrated system built upon a sound body of theory derived from precise knowledge of man's use of communication and recorded knowledge, when library service is the fruit of all relevant scholarship, then, and only then, can librarianship be said to have achieved professional maturity and qualify as a science in its own right.

A giant stride forward has been made. The momentum must be maintained.

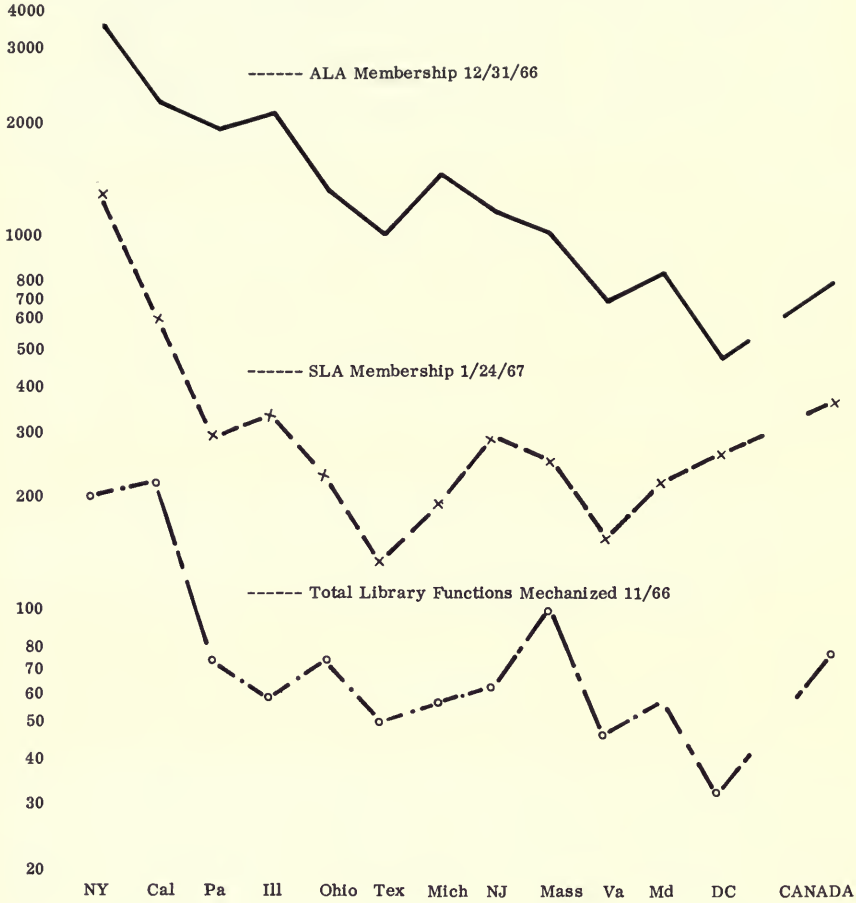

Figure 1.
Functions Mechanized Compared to ALA and SLA Membership per State

REFERENCES

1. Creative Research Services, Inc., comp. The Use of Data Processing Equipment by Libraries and Information Centers. (A Survey Prepared for Documentation Division, Special Libraries Association, and Library Technology Program, American Library Association, with funds provided by the Library Technology Program under a grant from the Council on Library Resources.) Chicago, ALA, Library Technology Program, 1966.

2. Shera, Jesse H. "What is past is prologue. Beyond 1984," ALA Bulletin, 61:37, 41-42, 47, Jan. 1967.