
Library Automation: Data for Processing and Processing for Data

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INTRODUCTION

For those librarians involved in any aspect of library automation (or networking), 1979 was a tumultuous year. More and more librarians were affected by automation. Systems and networks proliferated, invading libraries and pervading departments within libraries that until 1979 had been immune to their effects. Librarians in administrative and managerial positions who had been content to leave library automation to the automation experts now find themselves taking "crash courses" to be able to make intelligent decisions regarding its effective use. The learning process goes on at all levels: conferences feature programs on automation and networking; workshops by the dozens are held; rarely does an issue of a library journal appear without at least one major story concerning some aspect of automation.

Despite the avalanche of printed and spoken words, the amount of published literature that provides important new technical insights is surprisingly sparse; much more is said about "data" than about data "processing"; much of the literature simply reports, exhorts, and repeats. When an occasional journal article on a technical topic does appear, it often covers a very specialized topic.

Part of the explanation for the disproportionate emphasis on nontechnical topics is accounted for by the political maelstrom that has developed as a result of the rapid spread of automation and networking. There now exists a complex web of alliances and dependencies among libraries, networks and utilities. Involvement in some form of networking is essential politically as well as economically. Systems and programming specialists who formerly worked in a rather sheltered environment, content with talking to one another and maintaining relative anonymity, now must make a choice: they can either come out of their protective cocoons and involve themselves in the fray, in the hope of providing some intelligent direction, or they can

allow the host of "instant experts" and "automation dilettantes" to make decisions, the results of which may be disastrous. Many have responded to the challenge but in the process no longer have time to do the kind of study and research that makes for a good "literature year." Also, because of the frenetic nature of the work in which they are involved, they often prefer to make presentations at conferences rather than prepare formal papers. Some of these presentations are made available to participants at the conference in written form, but they are rarely available for wider distribution. Many conference papers are never published. Part of the disinclination to publish these papers is related to the transient nature of the topic; data that were perfectly valid at the time of a presentation are out of date by the time they can be published as conference papers. Such papers also are variable in quality.

Journals such as the *Journal of Library Automation*, long the "standby" source of library automation literature, published only two issues in 1979. The *Journal of the American Society for Information Science* seemed to stress "information science" much more than "library automation."

Offsetting the few published papers are numerous reports of meetings. In fact these are often our only source for determining what is really going on, and much is going on. Despite problems with library literature, 1979 has been a good year for library automation itself.

It was a year of consolidation, a year in which technical specialists began to see a light at the end of the tunnel. It became obvious that if the strengths of one system could be combined with the strengths of other systems, the net effect could be a great increase in library efficiency and effectiveness.

Spurred by this realization, librarians who had been confirmed skeptics about the potential of automation in the library are now actively "shopping for systems." This "shopping" has generated problems; the cooperation between technical people that characterized earlier years is now beginning to be replaced by competition. Managers of bibliographic utilities (still euphemistically billed as "cooperative cataloging networks") as well as commercial vendors recognize that too much information about the way their systems work may jeopardize their hard-won position. If they are not silent about what they plan to do, they must at least not be too explicit as to how they plan to do it. The growing proprietary attitude about processes and products partly accounts for the fact that the literature contains few detailed descriptions of the system and programming techniques used in the various library systems.

As more and more software/hardware packages become available and as the amount of machine-readable data grows, the need for criteria for judging those systems and guiding future actions intensifies. A few basic principles are being recognized, which this chapter attempts to identify.

Because of the volume of the automation-related literature and the complexity of its subject matter, the treatment given to any single aspect must be very general. Because of time and size limitations, most of the literature from countries other than the United States and Canada had to be excluded even though some of this literature, such as that in the British publication *VINE*, was quite significant. Only the major functional areas (cataloging, acquisitions, and circulation) could be covered; important topics, such as resource

sharing via networks, are omitted. Hardware is given cursory treatment, as are most management issues.

Illustrative of the amount of literature that has poured forth during 1979, the initial bibliography comprised more than 300 entries. This list was reduced by half by eliminating items that were "newsy," although some news items had to be included or a particular topic would not have been treated at all. Although publications such as the microfiche series *Alternative Catalog Newsletter* provided some valuable insights as to emerging trends, individual papers in this series could not be covered in any detail.

The most frustrating aspect of reporting on developments is that almost before a paper is written, the situation may change. During February 1980, for example, literally dozens of new books, articles, and news reports appeared that supply followup material on various topics. No matter how one attempts to avoid transitory issues, it is difficult to differentiate transient from permanent issues.

This review can only identify issues and problems; most of these issues will be around for some time, and definitive solutions are often extremely elusive. What are these issues and problems?

DATA FOR PROCESSING

For more than a decade in the United States, as well as in other countries, large numbers of machine-readable bibliographic records have been created. The most prestigious and authoritative set of records is produced by the Library of Congress (LC), and this file is widely distributed as part of its MARC (Machine-Readable Cataloging) Distribution Service.

To this base of LC cataloging data, the users of OCLC, Inc. have been adding records at a phenomenal rate, to the point where it now consists of over five million records (OCLC, INCORPORATED).

OCLC has been followed, in succession, by other bibliographic utilities, such as RLIN (Research Libraries Information Network), WLN (Washington Library Network), and UTLAS (University of Toronto Library Automation Systems), whose participants have been contributing records to shared databases. Commercial vendors have also become involved in converting bibliographic records to machine-readable form, and some individual libraries with systems developed in-house have accumulated substantial quantities of machine-readable records.

Outside the United States the National Library of Canada (NLC) and the British Library have large databases, as do other countries.

These records cover many types of materials. In addition to books, there are over 200,000 records for serials in the CONSER (Conversion of Serials) database, a cooperatively developed database maintained by various users of OCLC. The U.S. Government Printing Office (GPO) now has its current records in machine-readable form. The cataloging of the National Library of Medicine (NLM) is in machine-readable form. The number of records covering music, maps, film, and manuscripts, although still limited, is increasing.

Records reflect cataloging in all of the Roman alphabet languages, and more and more cataloging data for materials in non-Roman alphabets are appearing, with more slated to appear as LC steps up its effort to include more Romanized cataloging in their MARC Distribution Service.

Although LC's MARC Distribution Service began only a little more than ten years ago, many research libraries have since transcribed substantial quantities of LC records derived from the National Union Catalog (NUC). As part of the COMARC (Cooperative MARC) project, some of these records were sent to LC and "authenticated" and redistributed.

A tremendous amount of bibliographic data is created by the abstracting and indexing industry as a by-product of publication programs; these would be extremely valuable if they could be reconciled with "library" bibliographic data.

Government and private agencies are contributing to the expansion of bibliographic databases by funding projects to convert valuable or unique collections to machine-readable format. For example, the National Endowment for the Humanities (NEH) funded a project at Northwestern University to convert and to make available for distribution authenticated cataloging of institutions that collect African materials.

In addition to records created for use in cataloging, there have been created over the years many millions of machine-readable bibliographic records for use in circulation systems. Most such records are "brief and dirty," often not in a format that could be translated into a reasonable approximation of the MARC format.

Any discussion of the size and scope of the national bibliographic data store must mention authority records. LC has developed an authority record format and is now systematically converting to machine-readable form name headings occurring in its current cataloging. In addition, a retrospective conversion project is under way to convert name headings that have appeared three or more times in the LC/MARC database. LC has determined that there were 757,431 unique headings in 1,930,310 records (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979b). A recent project was launched by LC whereby certain institutions will contribute name authority records to augment the LC authority files. NLC and LC are also experimenting in the cooperative establishment of authority records for names.

Both WLN and UTLAS have name authorities databases. The New York Public Library had one of the first automated authority control systems, and it is reasonable to expect that its authority records will eventually be incorporated into the RLIN database. NLM also has an automated authorities database, as does NLC. LC has an automated subject authorities file that contains LC subject headings.

Access to Data

The net result of these database-building efforts is a large store of bibliographic and authority records, many of them duplicative and uneven in quality. These records could be used to create a national bibliographic database, but there is no single organization responsible for collecting these data,

normalizing them, and making them available to the widest possible user group. Even if they could be collected, the cost of eliminating duplicates, upgrading the quality of the data, and bringing them under authority control would be substantial.

A phenomenon of the 1970s has been the growth of bibliographic utilities that furnish cataloging data in various forms—e.g., OCLC with a user group of nearly 2,000.

UTLAS, in Toronto, Canada, offers an impressive list of services and a large database and has many participants, but because of its location and lack of publicity, U.S. libraries have not rushed to take advantage of those services.

Until recently RLIN had few users until it was chosen by RLG (Research Libraries Group) as a cataloging/processing system. RLIN's files, while large, do not compare in size with those of OCLC, and unlike OCLC, RLIN's system is geared to the needs of large research libraries.

WLN has relatively few users, most being public libraries. Its database, except for LC/MARC records, is not large. WLN has also indicated that it is not prepared to offer national service, preferring to have its system replicated by other networks.

To date few commercial suppliers have offered online cataloging support services. Most commercial services are concerned with creating and maintaining offline databases needed for circulation conversion or producing computer-output-microfilm (COM) catalogs, although one vendor does offer a turnkey minicomputer system, with the LC/MARC database on diskettes. Although these utilities and commercial organizations are gradually building their databases, many would like to have access to the OCLC files, access that has not been readily available because of OCLC's restrictive policy on third-party use of their records. OCLC may be forced to change this policy if many research libraries begin to defect to other networks.

A few libraries do not use any outside bibliographic services, preferring to subscribe to and to process LC/MARC tapes with in-house systems. Although such systems can sometimes provide a less costly method of acquiring catalog data than a utility, they lack the convenience of the full LC/MARC file online. Unfortunately, the cost of cataloging through the utilities is high, and there is a pressing need for utilities to revise their pricing structure.

Many libraries are locked into a particular utility, and until recently there was little incentive to develop more equitable and flexible price structures. As competition between OCLC and RLIN grows, this may change.

Particularly frustrating to some libraries has been OCLC's policy of requiring a library to use OCLC for all their cataloging or for none. This too may change. JONES, of the Council on Library Resources (CLR), speaking to an ARL (Association of Research Libraries) meeting in May 1979, believes that a library has a right to a choice of utilities from one moment to the next.

Unfortunately, OCLC's data monopoly also restricts the availability of records that were converted with private or public funds for the express purpose of making them widely available. OCLC is not entirely to blame for this condition; in most cases the agencies that created the records do not have the facilities to maintain their records outside OCLC in a form in which they can be distributed; there is no central organization responsible for distributing

them, and many libraries do not have the facility to process them if they were available.

The CONSER file is a case in point. Because LC lacks the resources to authenticate and to distribute the contributed records as fast as they are produced, over half of them are unavailable except through OCLC. As an interim solution, a "snapshot" of the CONSER file was delivered to LC in December 1979, which will be made available for a fee; however in the eyes of many this is a poor substitute for an ongoing distribution service.

LC unfortunately does not have an efficient method whereby contributed machine-readable records from other institutions can be incorporated into a unified database, updated as required, and distributed in a timely fashion. In an effort to develop a method for collecting, authenticating, and distributing records from multiple institutions, LC and Northwestern University participated in a joint project to develop an Africana database, consisting of records from those institutions that specialize in African materials. The project was successful in building an Africana database that is consistent with LC. Thus, it is a model for other projects, which unfortunately cannot be undertaken without special funding until LC has a machine method for checking headings and the computer resources to incorporate such records into their regular distribution service.

One method by which a library can have access to the largest possible database is for the utilities to be directly interconnected. Although technically feasible, the problems associated with this concept are formidable and are discussed in the section on processing systems. On an interim basis utilities can develop reciprocal agreements for exchanging data. Although RLIN and WLN expect eventual direct system links, they have agreed to share data and, according to SHAW, speaking at a 1979 ARL meeting, they are also developing a proposal to work together on an internetwork authority system.

Such utility interlinkage, whether direct or indirect, would be only a partial solution to the problem of data access. If libraries are to realize maximum benefit from shared cataloging, cataloging data from various cataloging systems should be capable of being consolidated into a single non-duplicative consistent database. An efficient method of consolidating and unifying multiple databases has eluded us so far.

Assuming that the mechanics can be developed for the free flow of data among utilities and other data-producing organizations, the sticky problem of cost recovery remains. Should agencies that do high-quality cataloging through one utility be reimbursed for it in some way? Should utilities that initially process and transfer the records to another utility be reimbursed if their records are used by customers of that utility? Is a national agency needed to set rates and to ensure fair use?

Over and above the problem of how best to improve access to existing machine-readable data is the problem of how to create those data in the first place. One method of increasing the amount of available authoritative cataloging is to designate certain libraries with large acquisitions programs in specific areas as cataloging centers. Such libraries, using LC-approved practices, would search headings against all available LC sources (including LC's machine-readable authority files). If LC had not established a heading, the

center would submit the heading to LC for inclusion in the automated authorities file. At the same time the center would channel the bibliographic record to LC for incorporation in LC's bibliographic file. Although this procedure seems simple and eminently logical, a practical mechanism for implementing it does not exist. Would such libraries enter data directly into the LC database or would records be transmitted over communications lines or would the exchange be accomplished by magnetic tape sent through the mail? If the transfer were indirect and delayed, what about duplicates? These are a few of the questions that need answers.

Regardless of how much and how good the contributed cataloging is, LC cataloging is and will continue to be a critically essential element in any national program. Libraries complain because LC does not catalog enough titles and does not catalog them fast enough. LC acknowledges the problem but maintains that it does not have the resources to do better. One way to increase the availability of LC cataloging is for NPAC (National Program for Acquisitions and Cataloging) libraries to be put online to LC files to test the concept of assigning or changing priorities at LC; although LC might not increase its volume, it would cover the items most wanted by libraries and would provide the data faster (U.S. LIBRARY OF CONGRESS NETWORK DEVELOPMENT OFFICE).

A number of libraries would like to have access to LC's online database. They would also like to be able to extract and to transfer records directly from LC's computer to their own, in MARC format. Obviously if many libraries were to operate in this manner, the load on LC's system would be increased. One compromise is for regional or local systems to maintain part of LC's MARC file online locally and to consult LC's files as a last resort. This was the approach taken by a project that aimed to link the computers of LC and the New York Public Library. The reason for abandoning this project is not entirely clear, although the decision of RLG to join RLIN undoubtedly contributed. Because this approach has so much potential, it is hoped that a similar project can be revived. For now, however, the ability of LC to participate in the development of such a scheme is clouded by congressional action that restricts LC's development of expanded facilities pending a study on how best to distribute machine-readable bibliographic data and the cost-benefit of various alternatives on LC, outside libraries, and congressional users (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979i).

Creation/Conversion of Data

Before data can be made available, they must be converted to machine-readable form—a costly process no matter how it is done or who does it. Pending the availability of a comprehensive, high quality, consistent, national bibliographic database, with centralized authority control, libraries that are starting any kind of automated activity—i.e., circulation, acquisitions, serials control, or cataloging—must convert some or all of their data into machine-readable form. Naturally they wish to keep such activity to a minimum.

One of the most difficult decisions is what to do about retrospective data. The strategies vary widely. Ten years ago librarians talked optimistically

about optical character recognition (OCR) devices that could be used to read directly from catalog cards; the resulting raw data could then be manipulated by automatic format recognition (AFR) that would translate them into MARC format. The promise of these techniques for bypassing keying has not materialized. The literature gives no indication that a large catalog has yet been successfully converted by this method. MALINCONICO & FASANA feel that results with AFR have been disappointing, and the results are marginal even when applied against data that have been keyed since editing the data after AFR manipulation requires technically trained staff. It is their opinion that shared cataloging systems such as OCLC are a better answer to a library's data-conversion problems.

The best way to convert data is for one to sit down at a terminal connected to a comprehensive authoritative database and, using a minimum length, easily derived search key with "comprehensive recall" capability, instantly cause to be displayed one or a small group of records from which a choice can be made. Under ideal conditions, it should not be necessary to review any part of the data. No such system exists.

Some librarians have used OCLC for this purpose; however, MARTIN (1978) doubts whether this approach is effective. To the author's knowledge, no large research library has converted retrospectively in this manner.

It has long been recognized that the conversion of LC's shelf list to machine-readable form would greatly benefit librarians who want to convert retrospectively. Although complete conversion of its catalog appears unlikely, AVRAM (1979) reports that recent studies by LC indicate that some form of image storage is feasible. Coupled with brief machine-readable records that would include major access points this eventually could greatly assist libraries with their conversion problems.

Numerous other problems are encountered in conversion efforts, including the problem of extended character sets, typographic errors, and errors in content designation. Obsolete cataloging practices make it difficult to derive satisfactory search arguments for use in searching a resource database and interfere with easy integration of found data with other data in the catalog. At this time, the author agrees with MALINCONICO & FASANA that full retrospective conversion programs are justified only when applied to large national or regional files of authoritative data.

In the meantime the most common reason for retrospective conversion is in conjunction with installing a circulation system, and for this commercial vendors offer various services. Using machine-readable "skeletal" data, with search keys consisting of LC card numbers, international standard book numbers (ISBN), or author/title search codes, the vendor's resource database is searched. BUTLER ET AL. (1978) note that this is not completely satisfactory since the retrieved records must be compared manually against the original record, and inconsistencies must be resolved. Because keys are imprecise, some records are missed. Some keys retrieve too many records, and records that cannot be matched must then be directly keyed.

A library may choose to key the entire shelf list directly instead of trying to match against a resource database. BUTLER ET AL. (1978) note that it

may be more cost-effective to key a short record directly to be used for circulation than to cope with the difficulty of deriving search codes, editing, and so forth.

Libraries that do not elect to do complete retrospective conversions may wish to convert certain valuable collections, to convert as books are circulated, or to convert as books are added to their collection. BUTLER ET AL. (1978) indicate that partial conversion often costs more in administrative headaches, staff and patron confusion, dual operations, and exception procedures than it saves; however, in some large institutions it may be the only available option.

Whether or not to convert full bibliographic data or a subset of it is another knotty problem, as is the decision about whether to supply all the codes and content designators provided by the MARC format. Almost invariably libraries implementing circulation systems have opted for abbreviated data. In many cases these data, even though they may have been extracted from a MARC record, cannot be translated back into MARC format. Consequently, a library will encounter problems if it later decides to change from a simple circulation system to a machine-readable catalog.

Attempts to upgrade records or to transfer from one system to another or to merge records in multiple formats can be frustrating as well as costly. BRAITHWAITE notes the difficulty of building a new system that relies on the inadequacies of past records. Often data from a previous project simply have to be scrapped.

A similar problem is facing many libraries and regional networks as they begin to develop machine-readable catalogs using OCLC tapes. HOLLEY & FLECKER report that Yale University has encountered difficulty in processing their OCLC tapes because of problems of undated multiple-record occurrences, lack of explicit content designation in local fields, and the tendency of staff to post changes to the catalog cards and not to upgrade the OCLC records. They report on a structured notation system that they have developed to alleviate some of the problems, and they recommend that each library study its operations carefully before using archive tapes for any printed or microform products.

Other utilities can provide their users with archival tapes, and records from a utility that allows a library to maintain a local version in the central database, together with detailed holdings, should be easier to process than OCLC records.

Quality of Data

The fundamental issue in the period ahead is how best to develop and to enforce workable standards that will result in authoritative bibliographic data that can be shared efficiently, nationally and internationally. These standards fall into three basic categories: 1) those relating to content, 2) those relating to record structure and format, and 3) those relating to data transfer. Content standards fall into two, somewhat overlapping categories: 1) those that are strictly bibliographic and 2) those that are needed for data control (content designation, standard numbers, etc.). Although many standards have been developed during the past ten years that are today widely accepted, including

the MARC format, ISBD (International Standard Bibliographic Description), ISBN, and ISSN (International Standard Serial Number), much remains to be done.

Standards development in general. MALINCONICO & FASANA note that LC has played a crucial role in our progress by developing the MARC format and by promulgating standards to facilitate data exchange. In a study conducted by the U.S. LIBRARY OF CONGRESS NETWORK DEVELOPMENT OFFICE, libraries surveyed agreed that LC should continue their leadership role in promoting standards. Despite problems with securing adequate funding, LC appears still committed to playing an active role in the development and maintenance of bibliographic standards to promote consistency in a comprehensive national database derived from multiple sources.

CLR has established a Bibliographic Services Development Project (BSDP), which will study "how best to create, maintain, assign responsibility for, access and use bibliographic databases." According to JONES & GWINN, the project will involve the development of national and international standards.

A CLR-funded committee, the Network Advisory Committee (NAC), which serves as an advisory committee to LC and focuses on policies and planning, is also interested in standards, as is the Network Technical Architecture Group (NTAG). The latter group, inactive as of late 1979, is composed primarily of computer and communications specialists. When they were active, they addressed some of the technical standards for data that are needed to access and to transfer data among systems.

The activities of the American National Standards Institute (ANSI) Z39 committees are also being accelerated, to try to develop standards that affect automated library systems, including a standard for a user/retrieval system interface language. A 1979 revision of the ANSI standard for bibliographic information interchange on magnetic tape is now available from the American National Standards Institute, Inc.

The International Standards Organization (ISO) Technical Committee 46 is studying language conversion, filing principles, bibliographic record formats, an application level protocol, bibliographic data elements, and so forth. They have a draft standard for Extended Latin Character Sets (ISO 5426).

The International Federation of Library Associations (IFLA) also has groups working on bibliographic-related standards of content and format and has a working group concerned with international name authority control. The United Nations Educational, Scientific, and Cultural Organization (Unesco) also is active in standards and is investigating the feasibility of establishing a common communication format.

The American Library Association (ALA) has numerous committees involved in standards work, including one that is concerned with filing rules as well as several that concentrate on more technical standards.

Data formats. Although MALINCONICO & FASANA note that common formats are the least part of the problem of achieving compatibility among bibliographic systems, much work is being done to ensure that formats are as cordial as possible to the data that they carry.

One problem with the MARC formats is that they are in a state of flux. Some 61 proposals for changes to one or more of the formats were considered by ALA's MARBI (Machine-Readable Bibliographic Information) Committee at ALA's summer 1979 conference (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979h). As a result of this instability, many data elements and codes in one format are now incompatible with comparable elements and codes in other formats. The rate of change makes it difficult for subscribers to keep their computer systems current. Most documents that describe these formats are also completely out of date, with revisions having been made to revisions.

The *JOURNAL OF LIBRARY AUTOMATION* reports that in an effort to update the formats, identify areas of inconsistency, and promote uniformity, LC and RLIN are jointly building a machine-readable database describing the U.S. MARC data elements in all formats. This database will be used to publish a loose-leaf composite edition that can be updated more easily.

There are now established formats for virtually all library materials, including monographs (books), serials, maps, films, music, and manuscripts. A format for in-process materials has been developed but has been changed little since its original publication several years ago. Technical reports can now be accommodated as an extension to the format for books. An analytics format is in draft form. Preliminary experience indicates that it may provide some level of commonality between library cataloging and journal article indexing data, to facilitate what MALINCONICO & FASANA call a "harmonious articulation" of these separate facets of a total bibliographic system.

An authority format for names and subjects is now available, and a draft expansion, which will include series, was announced in the November 23, 1979 issue of the *LIBRARY OF CONGRESS INFORMATION BULLETIN* (1979j).

The authorities format may provide a long-awaited breakthrough in the problem of how to achieve consistency in headings and provide references to those headings. LC is putting the format to the first real test as it begins to build an automated name authorities database for headings in current and retrospective cataloging. It is expected that these authority records will ease the transition from the first to the second edition of the Anglo-American Cataloging Rules (AACR).

Some types of materials still do not fit well into the existing formats. The format is weak for early printed books. As more libraries begin to use the music format, problems are arising, but many of them stem from cataloging practices rather than from the format itself. There is also a study going on as to how best to "interinstitutionalize" the bibliographic formats, removing the "LC-centricity" that has hampered use of the format by libraries other than LC. Finally, not all formats are for bibliographic data. ANSI Z39 is also interested in developing a format for machine-readable orders and invoices.

Other efforts are under way to facilitate data sharing; these are not directly related to formats but involve data content, some of which might be termed bibliographic and some of which are needed for control. JONES & GWINN report that there is need for a standard institutional code as well as an agreed-on method for expressing copy-level holdings. An ANSI standard

for summary serials holdings has now been completed (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979h), and work has begun on developing a standard for detailed holdings statements. It is unfortunate that the committee to look at the detailed holdings statement was so long in being formed, but it is hoped that it will consider the theoretical work of GROSCH (1977) in developing a scheme by which serial holdings can be structured to permit a high degree of automatic manipulation without loss of human interpretability. The practical experience of those few institutions that have completely automated their serial records should also be considered. Other standards needed for automated library systems include codes for library patron identification, serial publication pattern, computer-to-computer title update format, and journal article identification.

Catalog data content. Difficult as it is to develop and to implement standard record formats, standard codes, and data conventions, the problem of ensuring the quality and consistency of the cataloging data is even more difficult. The second edition of AACR is an attempt to establish rules that can be applied uniformly, but success can only be assessed when libraries start using them in 1981.

Although librarians at all levels are concerned with completeness and consistency of machine-readable cataloging data, not all members of the library community are convinced that a high degree of standardization is required at all levels. SALTON points out that although manual catalogs require consistency, an automated catalog, because it can have various access points, may not need this same degree of consistency. MALINCONICO & FASANA, on the other hand, note that as long as library catalogs are judged by the degree to which they achieve "comprehensiveness of recall," the quest for standards in cataloging must go on.

Regardless of published catalog codes, LC practice has become the de facto standard for most of the nation's libraries. This can both help and hinder libraries as they move toward a national network since LC, like many other libraries, uses practices that are often based on expediency and will often choose options and adopt exception practices that may not correspond to the needs of all libraries. The real test of LC as the arbiter of catalog standards will come when libraries start applying the new AACR.

Unfortunately, libraries that are trying to conform to LC practice do not have access to LC's tools and files. The difficulty of achieving consistency with LC's form of names is one example. An LC call number cannot be assigned in the field exactly as LC would assign it. LC subject heading assignment is also hampered because a remote cataloger does not have access to LC's authority files. In an attempt to assess the impact of this problem, LC conducted a study whereby a Northwestern University Library cataloger assigned subject headings to the same group of books twice, once at Northwestern and once at LC. When the results of this study become available, they should be interesting.

Although many differences in cataloging practices exist among institutions, there are some indications that they are declining as libraries realize that if they are to get high quality cataloging, they must give it in return. However, there is increasing recognition that various "levels" of cataloging are

inevitable and must be provided for in any large bibliographic database that contains cataloging from many libraries that differ in cataloging resources and whose users have different needs. How to reconcile two conflicting requirements of providing high quality cataloging without imposing too great an economic burden on the suppliers of that cataloging is one of the challenges faced by today's system designers and catalogers.

In writing about the difficulty libraries have in adhering to a single bibliographic code, BATTIN challenges libraries to change their emphasis from "local deviation" to "enrichment." The concept of enrichment requires that we alter the method by which we maintain a shared bibliographic database. It also requires changes in the MARC format and computer systems.

As a start toward this goal, a National Level Bibliographic Record (NLBR) was proposed (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979j). This record would be "self-defining," with codes that identify various cataloging levels. Contributors to the national database would be required to follow these standards.

A major change from past practice is the idea of a "minimal-level record." According to the *LIBRARY OF CONGRESS INFORMATION BULLETIN* (1979c), LC is considering using such minimal-level cataloging for some of the materials in its collection and may decide to distribute these records through its distribution service. Although all records must carry full description regardless of level, it is not clear how much control will initially be exercised over headings, although everyone agrees that ideally all headings should be under centralized authority control.

According to GORMAN (1979a), implicit in any system that permits minimum-level cataloging is a means of either bumping or augmenting data. He suggests that NLBR makes it possible for a hybrid record to be created. Although the Network File Structure (NFS) of RLIN speaks of a "clustered" record, in which the modifications of each library using the record would be retained, the difference between a hybrid and a clustered record is not clear. Both techniques would have a profound effect on file organization and processing in that they require a single physical record to be the product of multiple libraries.

While research is going on to find ways to ensure the highest quality of cataloging and make it available to the largest user group, utilities continue to fight against substandard cataloging by their participants.

When the OCLC system was designed, no one could have foreseen the long-range effect of lack of quality control. Even if it had been recognized, neither machine techniques nor human resources were available to combat it. Because of this and because of the size of its database and the diversity of its user group, OCLC has been severely criticized. In its defense, advocates minimize its lack of quality control and point out its compensating virtues. MALINCONICO & FASANA note that although the OCLC database does not qualify as a catalog, it is a prodigious and effective bibliography. MARKUSON also points out that network participation may have done more to raise the quality of cataloging than any other event since the beginning of LC's Card Distribution Service because each cataloger's cataloging is so visible to other members of the network.

However, the fact remains that so far OCLC has few machine checks and only limited manual checks. A central staff corrects errors reported by users. The Peer Council tries to monitor quality, and detailed standards manuals have been developed, supplemented by training sessions. KILGOUR also reports that OCLC is developing an enhancement that will allow specially authorized participating libraries, including LC, to correct the master record online. OCLC's consultant, GORMAN (1979a), recommends that an authority system be developed as soon as possible, based on a shared authority file with "central monitoring." OCLC has made available for display the LC name authorities file and eventually plans to add the LC subject authority file and has announced that "authority control" procedures are being discussed.

The quality control exercised by WLN over its database appears to be excellent. According to WOODS (1979b), WLN participants accept LC's choice and form of entry and adhere closely to LC's descriptive and subject cataloging practices, although "library-dependent" data are permitted in the local record. WLN also has a means by which an individual library's provisional headings for items that are on order or in process may be retained without affecting data integrity. The system is flexible in that it is designed to support multiple "collections," each under separate authority control.

WLN has an extensive training program. All applicable data elements in the MARC format are mandatory. Unfortunately, it costs more to use the WLN system than OCLC. A central staff reviews all cataloging and is responsible for authority control. There is some doubt that such manual review would be feasible in a large network.

The cataloging system of UTLAS has machine-based authority control with machine-assigned links; however, VELAZQUEZ states that use of this capability is optional. UTLAS also has machine aids to assist in revising records, a factor that should assist libraries in maintaining quality.

It is still too early to assess the quality control capabilities of RLIN, although its pricing encourages the production of quality data, and one library can "upgrade" the substandard cataloging of another institution. At present mechanical control over data appears limited to checking for valid tags, indicators, and subfield codes, plus monitoring required fields and rejecting multiple fields defined as nonrepeatable. Substantive errors found in LC/MARC records are reported to LC for correction; RLIN users are notified of any errors found in their records by other users. Authority control, with links, is on their list of goals with a short-term project to make LC/MARC authority records available online. One can surmise that since cataloging inadequacy was among the reasons given by many RLG libraries for pulling away from OCLC, there will be a great emphasis on high-quality cataloging in RLIN.

The real test of the utilities will come when the new cataloging rules are implemented. It is assumed that each utility will be able automatically to change headings in the existing records of its members using the MARC authorities format, although GORMAN (1979a) is pessimistic about the practicality of making retrospective changes in the OCLC database. WLN should have no trouble because of its file structure, although it, like all utilities, will have to cope with many changes in the beginning.

The utilities are not the only organizations that will have problems with changes in headings caused by the new rules. NLM has an online authority file and is pleased with the ease with which headings can be changed. SUSAN MILLER of Ohio State University expects a "maintenance" capability that will change a subject heading in all records in which it appears. The present system prints out subject headings that are "new to the file" for evaluation by staff. CHRISTOFFERSON feels that the University of Georgia's MARVEL system should be able to handle name authority control with no problem, and the capability for global changes exists.

Another aspect of effective catalog access related to authority control is the provision of "see" and "see also" references. The MARC authority format provides for these references, but much research is needed to determine how best to incorporate them into machine-readable catalogs.

MARKUSON suggests that we may have to alter our concept of authority control. She recommends a separate authority file, with cross-references against which all entered data might be screened, but which would not require the establishment of machine links. The authority file would then become similar to an online thesaurus to be used by the searcher to develop a search strategy before the catalog file is accessed.

To avoid the system complexity that accompanies machine-linked records, FURLONG reports that NOTIS (Northwestern Online Total Information System) intends to use indexes to accomplish the linking function without explicit links. BRATHWAITE points out the difficulty of linking and unlinking records in a multi-institution environment, even using a sophisticated computer system. JONES believes that a "national bibliographic database" will have to accommodate a variety of authority control systems and sees a national authority file as simply the raw resource for individual authority control systems.

LC is in the beginning stage of developing a "national" name authority file derived from multiple sources. GPO, Northwestern University Library, the University of Texas Library, the Texas State Library, and the University of Wisconsin will be contributing authority records (*LIBRARY OF CONGRESS INFORMATION BULLETIN*, 1979m). Cooperative projects among LC, NLM, and the National Agricultural Library (NAL) should also result in an enriched national authority file.

The *LIBRARY OF CONGRESS INFORMATION BULLETIN* (1979l) reports that the libraries of ABACUS (Association of Bibliographic Agencies of Britain, Australia, Canada, and the United States) have agreed that each will be responsible for names of corporate bodies in its own country, but it is unclear whether or not these names will be incorporated into the U.S. national authorities file. BRATHWAITE recommends a North American authority file system.

MARTIN (1978) summarizes the situation when she states that "in the face of the second edition of the Anglo-American Cataloging Rules, authority control appeared to be the major need of North American libraries in 1978 and 1979."

Data duplication. In building a "quality" database composed of records from multiple institutions, one of the most difficult problems is the identification and prevention of duplicates. Duplicates occur inevitably in card

catalogs of single institutions; they are endemic in an uncontrolled database such as OCLC's; they are a problem even with the rigid central control maintained by WLN.

MARTIN (1978) points out the problems OCLC had in trying to update its files with LC/MARC data because of duplicates. Other utilities have probably experienced the same problems.

KILGOUR estimates that 9% of the OCLC database is duplicates. HICKEY & RYPKA point out that it is difficult for even skilled librarians to identify duplicates. They state that RLIN hopes to control duplication caused by slight differences of interpretation by using the concept of a "work," for which there can be various expressions. However this still involves human judgment, and an efficient machine method to detect duplicates is badly needed.

Identifiers such as LC card number and ISBN, although they offer the best method available for detecting duplicate records for books, are still not completely reliable. A recent proposal by LC and NLC for a "unique serial identifier" indicates that the ISSN and "key title" have not solved the duplicate problem for serials.

KILGOUR reports that OCLC is working on an algorithm to prevent online insertion of duplicate records. HICKEY & RYPKA say that what is needed is a good duplicate detection algorithm that is not excessively time consuming and that could operate online. It should be as short as possible and should tolerate cataloging variations. They propose a relatively short (52-byte) key.

WILLIAMS & MACLAURY also report on the development of a machine algorithm for locating and pairing duplicates in machine-readable bibliographic files, preliminary to creating a union catalog. It overcomes typographic and spelling errors, differences in case, spacing, and punctuation, variations in cataloging, and differences in form of entry. MACLAURY also reports on research that used different-length fixed keys to detect duplicates.

Even when duplicates have been identified, there are operational problems. OCLC, for example, cannot delete a record as long as there are any holdings symbols associated with it, nor can holdings symbols be transferred by central staff.

Data for Data Transfer

Although much valuable work has been done by NCLIS (National Commission on Libraries and Information Science) and NBS (National Bureau of Standards) and by other groups on developing standard protocols needed for accomplishing computer-to-computer data transfer, much more needs to be done to develop a uniform method of interconnecting systems and implementing a national bibliographic network that is not tied to the mails for exchanging tapes. The December 1978 issue of the *JOURNAL OF LIBRARY AUTOMATION* reported on the NBS project that aims to develop "the technical foundation for future computer interface standards through close industry-government cooperation." The report went on to say, "the interface technology project will focus on computer systems and network architectures and interconnection techniques likely to be in widespread use in the next five to ten years."

LITTLE describes the NCLIS/NBS "applications level protocol" that has been developed. The NETWORK TECHNICAL ARCHITECTURE GROUP, a subgroup of LC's NAC, issued a network planning paper in 1978 outlining a "message delivery system for a national network."

Another Network Planning Paper prepared by LONG and edited by David C. Hartmann, entitled "Study of Message Text Formats: Bibliographic Search Queries" was based on the work of the NTAG committee and is an attempt to devise a standard means of formulating search arguments.

Partly because such efforts depend on high-level computer and communications technologies, which are in a state of flux, and partly because the application of these technologies to the library task is tentative and untested, it is hard to evaluate them or to see just how they might be pieced together to accomplish effective intersystem communication. About all that can be said is that there appears to be reason for cautious optimism.

PROCESSING FOR DATA

Over and above the problems associated with size, quality, and accessibility of existing and future bibliographic data stores and catalog databases, there is the problem of the adequacy of systems for processing those data. Almost every librarian using machine-readable bibliographic records feels qualified to judge the adequacy of bibliographic records (although criteria vary from one person to another); however, the same sense of confidence is lacking when it comes to judging the systems that manipulate the data. As more functions are automated, as systems proliferate, and as technology advances, evaluation is complicated even further.

Not many years ago the only choice was between OCLC and a home-grown system; now there are many systems from which to choose, each offering different functions and products and each using different techniques for providing those functions and products. WLN, UTLAS, and RLIN now compete with OCLC; commercial circulation systems are everywhere. Commercial acquisitions systems are available from book dealers, and OCLC has announced acquisitions and serials check-in subsystems. Some of the circulation systems offer some acquisitions capabilities, and some have a limited ability to function as an online "catalog." HORNY reports that software for NOTIS has been offered to other institutions for use on local computers, and WLN's system is now available for replication.

System Efficiency

As the choice of systems increases, how does one evaluate them, both as to their present and future functions and costs? This evaluation process is so complex that no two technical experts can agree. However, certain design principles are emerging that can be used to judge a particular system at a particular time.

Distributed vs. centralized processing. The realization is growing that a system should not be allowed to become too big. All indications are that

"distributed processing" is an idea whose time has come, although the definition of this term is still nebulous.

GROSCH (1979) points out that although centralization was essential when computers cost several million dollars, it no longer represents true economy with the new, less costly computers. The new trend is to use many small computers that are linked to a central computer or host that performs only those tasks which it alone can do. Grosch also notes that research is being done on how best to distribute "databases" as well as how to distribute processing.

What will distributed processing/distributed databases do to our present utilities? MARKUSON notes that there is a growing feeling that the utilities will simply not be able to support online catalogs and circulation from a centralized computer. MARTIN (1978) stresses the need to identify those functions that have minimal value at the network level but which have very high transaction levels, and she suggests that local processing is more economical for these. She goes on to suggest that in addition to circulation, serials control is a good candidate for local systems, with networks concentrating on "sharing of data."

A study commissioned by the U.S. LIBRARY OF CONGRESS NETWORK DEVELOPMENT OFFICE reports that the advantages of a distributed system include reliability through redundancy in storage and computing and communications efficiency.

MATHEWS also raises some fundamental issues about network design. He says that "there has been a noticeable shift away from older network designs based on functions distributed across a hierarchy of computers with the most powerful computer in the center. Instead, in more and more designs, computational functions are redundantly located through the network, and inter-nodal traffic consists of *data* transactions." As with Martin, he believes that data sharing, not function sharing, is becoming the primary network rationale.

Whether networks evolve as groups of local low-level computers that depend on a central host computer for most of their data and processing or as a group of computers, each with powerful processing and large storage capacity, remains to be seen.

Until recently OCLC did not favor distributed processing, but there are indications that its attitude is changing. KILGOUR speaks of minicomputers operating as "remote communications processors," which may or may not indicate a shift from the present emphasis on functional centralization. James Barrentine, according to the *OCLC Newsletter*, admits that advances in technology have made it clear that in the future the OCLC computerized library network will use distributed processing, not only in Columbus, but in different locations. Whether this means that only distributed systems designed and controlled by OCLC will be supported or whether various local systems will be allowed remains an open question. At present OCLC will only provide local systems with their records on tape. Theoretically these tapes can be used to support local circulation systems, to maintain local online catalogs, to use in producing COM catalogs, and for regional online union catalogs. Direct computer-to-computer transmission of these records to a local computer has not been performed, although there are reports that some libraries

pull their records off the display screen into a microcomputer for incorporation with their catalog, circulation, or acquisitions files.

Although RLG supports the concept of distributed processing, its exact design strategy is not clear. SHAW speaks of "the inevitability of local systems" and states, "as we look at the way technology is evolving . . . our member institutions will be involved in distributed processing."

RLG is developing a more effective way for patrons to access the RLIN central database, but whether it is feasible to use the central database as an alternative to the card catalog is not yet clear.

The positions of WLN and UTLAS are well defined. Both are committed to distributed systems, starting with local circulation systems. According to BOSS (1979a), the DataPhase circulation system designed for the Tacoma Public Library had to be pollable by WLN's host computer, but whether this interconnection has been implemented is not known. The UTLAS minicomputer circulation system interfaces with the master bibliographic file in Toronto, and, according to MARTIN (1978), the plan is for acquisitions and in-process control to be localized, in contrast to WLN, which centralizes these functions.

The utilities are not the only organizations planning to support distributed processing in one form or another. GROSCH (1979) describes commercial systems with minicomputers providing front-end local processing capability to remove some of the load from the host computer. She also points out that intelligent terminals providing communications control are also suitable for some limited data-processing jobs (preparing purchase orders, claims, etc.).

According to BOSS (1979a) some turnkey circulation systems rely on a host computer outside the library for some processing. CL System's circulation systems can also be linked, providing access to the data of other libraries.

Functional integration. The inevitability of distributed systems still leaves open the question of how much should be done on the local computer and how much should be done by central computers. AAGAARD supports the idea that most "processing" of data is done better locally, relying on utilities as sources of data. He points out local systems can be justified if the data that must be stored can be made multifunctional.

Although the principle of functional integration is widely accepted, it is not uncommon for a library to use a bibliographic utility for its cataloging, a turnkey circulation system from one vendor, an acquisitions system that is supplied by a book dealer, and a serial list supported by another set of programs, usually run on a local computer. Such a group of systems, if they articulate at all, do so inefficiently. Because of the difficulties in changing systems after they are once operational, many libraries are locked into these multiple systems and pay a penalty in costs and operating inefficiencies. The challenge, as expressed by MONTAGUE, is to "integrate these parts creatively into one compatible whole which is greater than the sum of the parts."

GROSCH (1979) says that historically most library systems have been "single-application" systems, that application usually defined in light of the library's most pressing need. Developing a single-purpose system is the easiest and quickest way to solve a problem. This is probably why circulation systems have been relatively easy to bring into operation.

Attempts to integrate outputs from different systems are subject to numerous pitfalls, and most efforts are only partially successful. Even when system connections have been devised, the results are not maximally beneficial because of the time lag involved, which results in out-of-date data. As SALTON points out, "the library environment is not closed but evolves dynamically in the sense that new items enter the system at all times while old items may be discarded, and library patrons and personnel continuously effect system changes." Ideally, says Salton, "the status of each library item should be ascertainable at any given time."

Utilities are working on integration but are far from achieving it. There is talk of "downloading" databases over communications lines into local systems, but so far there is little to suggest that it has been accomplished and made operational.

Software principles in general. As the utilities contemplate eventual linkage with a national system on one level and with local systems on another, analysts and programmers at the local, utility, and national levels search for the best mix of centralized and distributed processing and strive to write efficient, affordable software that will not collapse under heavy loads.

WLN appears to have recognized the problem of system overload, and STRONG has stated that it does not intend to provide extensive nationwide service; it expects that its system will be replicated in other regions.

Although OCLC periodically places a moratorium on new users and restricts certain types of searches to low-use hours, it continues to bring up new subsystems and acts as if it sees no limit on the number of users it can serve and the number of functions it can perform. It does seem to have recognized that subject access has to be handled carefully. O'NEILL & ALURI of OCLC point out that a subject approach that works for 100,000 titles could fail with ten million titles, and they state that the subject heading "English Literature" appeared 50,000 times in the OCLC database.

OCLC's system is legendary for its efficiency, probably because of its simple data structures, low-level language, and tight programming. KILGOUR reports that the sharing of processing between mainframe and multiple Tandem database processors is an attempt to preserve that efficiency as the files grow and the transaction load increases.

Designers of some systems, in an attempt to speed up development and to provide flexibility and transferrability, are tending to use higher level languages and to use the new database management systems (DBMSs). Only recently have DBMSs that can handle the complex structures required by bibliographic data been developed. Most require large computers and impose heavy processing loads; however GROSCH (1979) says that there are now DBMSs that will operate on minicomputers.

Under heavy transaction loads, whether or not these systems can cope with data-assembly tasks resulting from complex data structures that require many disk accesses remains to be demonstrated conclusively. WLN, which uses the DBMS called ADABAS, initially had problems with response time, but seems to have "fine tuned" the system so that performance is not unduly degraded. Whether or not DBMSs can be made to operate in a high-use environment, there is no doubt that users pay a premium for the generalization built into them.

RLIN is also concerned with processing efficiency and has embarked on a major redesign effort to provide additional functions and to improve performance, but how this will be accomplished and at what cost is unclear.

Other events have affected our ideas of how to design systems for maximum efficiency. As late as 1975 the cost of storage for a large bibliographic database was important in determining how data were structured and processed and where they were stored. With decreased storage costs, we are reexamining the idea that data redundancy must be eliminated at all costs. Although very large, low-use databases are perhaps best not "duplicated" at multiple sites, if records in files are subject to high use (such as local online catalogs and serials check-in systems), redundancy is now acceptable provided it is system generated and controlled and provided it contributes to overall efficiency. The idea that headings that appeared in authority records should not be repeated in the bibliographic records is being reevaluated. Data-compression techniques, once the subject of much research, are no longer so essential, especially if the decompression processing involved increases the processing load. Short "search codes" of the type used by OCLC can no longer be justified as it becomes possible to provide indexes with more complete data.

Even the pressure to require that all users of a utility agree to a single "version" of a record is being challenged as it becomes feasible for each library to have access to the local modification of the record.

If data storage is no longer the problem it once was, processing efficiency is still important since the number of disk accesses and the amount of memory and central processing unit cycles required can still mean the difference between an affordable and an unaffordable system.

RLIN's elaborate index files illustrate the problem. Although THOMSON & HARTZELL stress that RLIN's structure and organization are optimized for fast and flexible accessing in a heavily loaded online environment, the resulting efficiency of retrieval requires lengthy nightly maintenance to update the inverted tree-structured lists used as indexes.

According to WOODS (1979b) the WLN system is also designed for efficiency in searching, with two-way linkage between authorities records and bibliographic records, which are linked to records in the holdings, working, waiting, in-process, and standing-order files. Whether or not this searching efficiency is compatible with efficient record creation, update, and assembly is not clear.

Network systems, with many users to share the costs, can perhaps afford the heavy processing overhead required to provide efficient, sophisticated information retrieval. Local systems, if they are to be affordable by any except the largest, most affluent libraries, cannot. Under high loads of online transactions, disk accesses must be kept to a minimum; file and index updates must not place a heavy load on computer resources, whether performed dynamically or on a batch basis. Because most research libraries have very large files, file reorganization and reloading must be avoided if possible. Affordable, effective systems are achievable but only if we recognize the uniqueness of the library application and use techniques that provide maximum performance at the least cost. It remains to be seen if some of the commercial vendors that are presently offering library turnkey systems of one

kind or another have done their homework, or if, in trying to turn a profit with minimum investment, they are using techniques that will break down as the number of terminals, users, and records increases.

System Functionality

The functional areas being emphasized in libraries at this time fall into three major categories: 1) catalog access, 2) acquisitions (including serials control), and 3) circulation.

Catalog access. Some large research libraries are seriously considering online catalogs as an alternative to the card catalog. SHAW and other writers in the field agree that libraries are being strangled by card catalogs. GORMAN (1979b), in company with many others, contends that online catalogs are the best way to overcome the drawbacks to the card catalog and that microform catalogs are at best a temporary expedient. Much developmental work remains if an online catalog that is simple enough for direct use by the library patron is to be implemented.

At Ohio State University, SUSAN MILLER reports an online catalog in use by the public in parallel with the card catalog. Although it now contains abbreviated data, it will eventually replace their card catalog.

FURLONG at Northwestern University Library reports on a simplified system to use in accessing the online catalog. It is now being tested by the public, with encouraging results.

BRS (Bibliographic Retrieval Service) is developing and testing online catalogs for Dartmouth College and the Rochester Institute of Technology (*ONLINE REVIEW*). It is attempting to identify the fields needed in a particular display, the fields that should be indexed, how to qualify or limit a search, and what kind of command language is needed.

An important factor in the success of an online catalog is user acceptance—terminals must be easy to use. BOSS (1979b) reports that the Lister Hill Center for Biomedical Communications is developing a system interface that would eliminate the need for the user to know the correct system for entering a query—i.e., where the blanks belong, where the commas go, and so forth.

LC has that portion of its catalog that is in machine-readable form online for direct public access, and ARRET reports that it is used heavily and that user reaction is positive.

A number of commercial circulation systems have either added or plan to add catalog access capabilities. Some libraries plan to use these systems either as substitutes for or adjuncts to card or COM catalogs. BOSS (1979a) reports that the University of Guelph, with a circulation system designed by Geac Computers, Inc., has ten public access terminals, searchable by full or partial author and title keys or call number.

CL Systems, Inc., intends to enhance its LIBS 100 circulation system so that data can be accessed through a number of points, using a touch-screen approach, which should be simple enough for even the most unsophisticated library patron to use.

It also appears that the circulation systems supported by UTLAS and WLN can be used as minimal catalogs, backed up by full records in the central database. KILGOUR has stated that OCLC looks forward to developing local online catalogs, and RLIN is investigating how best to provide catalog access at the local patron level.

Among the many deterrents to the rapid development of online catalogs is the lack of a clear understanding of what an online catalog should be. MARKUSON reflects the opinion of some that the present online retrieval systems offered by the database services are probably a better model than a card catalog.

MALINCONICO & FASANA, on the other hand, point out that the precision of recall that characterizes the information retrieval systems is no substitute for the comprehensiveness of recall that is the strength of the card catalog. This author agrees with them—the local catalog must provide comprehensive recall, and information retrieval is best left to the large utilities and database services. Such local catalogs need not be inferior to the network catalog; rather they would provide a different type of service. If this fact is recognized, then the two systems—local and central—would complement one another.

Although simplicity of searching is essential for the local online catalog, online regional and national catalogs are natural candidates for situations where keyword access is required. RLIN, UTLAS, and WLN have access capabilities that enable ill-defined searches to be satisfied, a capability that should be valuable to reference staffs. The *RLIN NEWSLETTER* reports on studies by Ferguson at Stanford, who found that questions could be answered much more quickly by the RLIN database than by the card catalog, and some questions that could not be answered through the card catalog were answered with the database.

Part of the problem of designing online catalogs is lack of information as to how users perceive and solve their information problems. SHAW ET AL. report research on a "query-analysis system," based on a thesaurus of terms collected from various sources. Users would interact with this thesaurus, and the thesaurus would be modified as the result of this interaction. Although this approach has great long-term potential, it is preliminary and tentative, and its practical application is still some years away.

BREGZIS also has some interesting theoretical ideas as to how "from a seemingly untidy conglomerate of entries... could gradually emerge a different system for information source management closer to the... needs of information users."

Among the less theoretical questions requiring research and testing in conjunction with online catalog access are: 1) in any given library at any time how many terminals are required to minimize queuing; 2) how will the computer perform under varying transaction loads; and 3) what is the best method of training patrons to use the online catalog.

Over and above theory as to what features a good catalog provides is the reality that many libraries must soon close their card catalogs. If libraries elect an online catalog, it must be locally based; the large utilities will not be able to provide direct access to the library patron unless the systems used by

the utilities are drastically reconfigured and unless telecommunications costs drop.

There are indications that some utilities intend to support a limited local catalog that has, as data, a "subset" of the full bibliographic record, downloaded over communication lines from the central system. The assumption is that this subset will serve the needs of most users, and users who need more data can get them from the central database. Research goes on in trying to identify that subset. In the author's opinion, storage costs are now at the point where libraries should seriously consider maintaining the entire record locally, particularly since in a research library so much of the use of a catalog is by staff, who almost invariably want access to the entire record. It would seem that the minimal extra cost of storing the entire record locally would be much less than the extra cost and inconvenience involved in a two-stage look-up.

Over and above decisions as to record content, work goes on to find practical ways to edit displays so that they are intelligible to users. Given the limitations of cathode ray tube (CRT) screens, this is not as simple as it seems, requiring the user often to page back and forth among multiple screens. An area in which experience is also singularly absent is how best to show "holdings" of serials and sets. Perhaps the work of the ANSI Z39 committee charged with developing detailed holdings statements will provide some answers.

Serials present a big stumbling block to the implementation of any form of machine-readable catalog simply because so many libraries do not have their serial holdings in machine-readable form. Even those libraries with machine-readable serials data frequently do not have them in full MARC format and rarely do they include detailed holdings. Many libraries will be faced with major conversion efforts if they decide to include serials in their online catalogs. There is also the problem, described earlier in the section dealing with conversion of data, of what to include and what to eliminate in the online catalog if retrospective conversion is not possible.

Regardless of how well a catalog access system is designed, the subject analysis provided by traditional cataloging is grossly inadequate. LUCKER points out that LC subject headings have a number of strengths: 1) they are relatively universal among academic libraries, 2) they are authoritative, and 3) they are documented. They are weak in that: 1) there is no underlying code or theoretical basis, 2) they are difficult to change, and 3) they are full of inconsistencies.

Ways to enhance subject access continue to interest researchers such as Pauline Atherton, as reported in the *LIBRARY JOURNAL* for August 1979. In the same issue Joe Rosenthal warns against allowing the "historical austerity" that characterized the cataloging of the past to continue into the future. Although he recommends that libraries "not tinker with" LC cataloging, he thinks that pressure should be put on LC to provide better subject access.

PRECIS (Preserved Context Index System) is still being investigated. WEINTRAUB (1979b) points out its advantages and disadvantages and feels that the real problem is that we lack empirical evidence on which to evaluate

it. Regardless of its merits, LC's inability to apply it has more or less doomed it for the near future in the United States, although the UTLAS system provides for its inclusion in their records. Some of the early euphoria about it has subsided, and MALINCONICO & FASANA point out that it is an "indexing system" and as such is not a viable replacement for traditional subject headings. They suggest, however, that "an online classed catalog with a PRECIS index would permit all of the advantages of an alphabetic approach."

One of the problems of the online catalog for subject access, for both local and regional systems, is the processing load that such access requires. The *OCLC NEWSLETTER* quotes James Rush as saying that most existing subject retrieval systems rarely can accommodate more than 100 users simultaneously. For a network system this maximum would be intolerable, and even in a large academic institution, with a user group in the tens of thousands, all of whom are heavily oriented toward use of the library, one wonders what would happen to response time at peak periods, even with optimum system design.

Another stumbling block to effective machine-readable catalogs, whether they are online or COM, is the difficulty of providing consistency in headings and an adequate reference structure. Fortunately the MARC authorities format supplies a tool by which such consistency and references can eventually be provided, but these tools have not yet been applied to a local online catalog.

Although there is a widespread feeling that only an online catalog is an adequate substitute for the card catalog, only a few libraries are actively engaged in planning for it. In the meantime many libraries have adopted COM catalogs. Although the impression is widespread that COM catalogs cost less than online catalogs, this author believes that these cost advantages will gradually decrease and in some situations disappear. Much will depend on the efficiency of the online catalog systems and the cost of the hardware on which they run.

Although the cost of producing a microform catalog, even with many entries, seems small, the cost of maintaining and manipulating the file from which the COM catalog is produced may be high. COM catalogs also require a large initial investment in readers, an investment that is larger for film readers than for fiche. In fact some of the so-called "dumb" computer terminals now cost little more than some of the elaborate film readers. Probably the biggest annoyance is that a COM catalog is never completely up to date. Frequent cumulations are costly, and supplements are unsatisfactory. Nevertheless, those libraries that have adopted COM catalogs seem generally satisfied with them, although the transition is invariably stormy. Many libraries have experienced problems with "dirty data." Vendors also blame libraries for imprecise specifications, and libraries blame vendors for software problems, such as bad sort sequences.

The University of Toronto Library was one of the first large research libraries to substitute a COM catalog for the card catalog, and BLACKBURN reports that it is now widely accepted.

One likely future development is for COM catalogs to be used as backup files to the online catalog. COM catalogs also can be distributed to places that cannot support a terminal, such as small branch libraries. However, in the

author's opinion, they are cost-effective only if they are abbreviated, cumulated infrequently, and are on fiche rather than film.

In summary, it seems that the early hopes for COM catalogs have not materialized, and many research librarians now intend to keep the card catalog going until they can have an online catalog.

Automated acquisitions. Probably the most neglected area of library automation today is acquisitions, despite the fact that in many libraries this function was the first to be automated. Unfortunately, most of these early systems were batch systems and are now obsolete and only marginally effective.

Of the few completely operational online acquisitions systems, only a handful are integrated with the online catalog, and fewer still can handle serials check-in and claiming. HORNY reports that Northwestern's NOTIS has both capabilities, and according to CHRISTOFFERSON, the University of Georgia's MARVEL system is also integrated with cataloging and has a serials check-in capability.

LC's order information system (LOIS) is online, but there is little integration with other library operations, and it does not support serials check-in. WLN's online acquisitions system is integrated with cataloging, but it does not include serials check-in. OCLC has an acquisitions subsystem scheduled for operational testing in 1980. Just how it will interface with their cataloging database and serials check-in system is unclear. RLIN's acquisitions system, used by Stanford operationally, may become the system used in the future.

Although many libraries do not have access to complete online acquisitions systems, a number have been quite ingenious in using local printer-produced displays of OCLC records as purchase orders. Pre-order verification of orders is also facilitated by access to a utility database.

Some book vendors have online or batch book-ordering systems, but all are limited in scope. Most have a design philosophy that encourages the library to order from the vendor that supplies the system. Some interface with cataloging or circulation systems, but one wonders how efficient this interface is.

GRAEF reports on development work to enable users of CLSI to dial up Brodart, Inc.'s automated order system and order books either from Brodart or other vendors, simultaneously creating a circulation system record that is used to print purchase orders and to supply information on the status of an on-order book.

Machine-readable invoice data are also an area of investigation, and the University of Kentucky Library has translated machine-readable invoice data received from F. W. Faxon Co. into the format used by the BATAB system of Baker & Taylor Co.

One development worth watching is a method by which purchase orders can be transmitted directly to vendors. An ANSI Z39 committee is charged with developing a standardized machine-readable format for such orders (GRAEF).

One must applaud the efforts of librarians to piece together systems to support the acquisitions function, but at the same time one wonders if all the time spent in creating ad hoc, stop-gap systems would not have been better spent in developing comprehensive acquisitions systems that would mesh smoothly with cataloging, in-process control, and circulation.

Circulation systems. The past several years have witnessed a veritable explosion of commercially developed turnkey circulation systems, and so much has been written about them that it is only possible to touch some of the high points. One must agree with BARKER that automation of the circulation process is now a necessity, given the size of collections and the increased labor costs. The question, according to Barker, is no longer "whether" to automate but "how."

CL System's CLSI, the first really successful turnkey circulation system, continues as the front runner, but there are strong competitors whose names are beginning to be heard with increasing frequency.

BAHR points out that reduced costs of these systems account for the upsurge of interest in circulation systems, most of which are based on minicomputers and some on microcomputers. MATHEWS points out that circulation is a perfect candidate for a local system since "economies of scale" can be realized in very small systems, and "economies of resource sharing," which are the basic rationale behind networking, are elusive and difficult to find.

Advances in terminal technology have also accelerated the growth of circulation systems. Libraries now can choose between OCR and bar-code readers, and BAHM points out that the Epic data terminals produced by Epic Data Corp. have facilitated conversion for libraries that had batch systems relying on keypunched book cards for circulation.

BOSS (1979a) reports that laser scanners for reading bar-coded labels are now available that are reliable enough to permit patron self-charging. Although self-charging is not new, this labor-saving technique seems to be catching on only now. Direct patron inquiry into the status of books is also beginning to be popular, heralding the obvious next stage—elimination of the card catalog.

Probably the most significant aspect of the growth of circulation systems is that as computers have moved into the library, they have lost their aura of mystery, both for library staff and patrons. As familiarity grows, demand for more services is inevitable.

A System for Systems: The National Network

Just as the utility and local system designers have problems in determining how best to design workable effective systems, designers are now faced with deciding on the configuration of a national network, superimposed on the increasing number of regional and local systems.

The simplest design concept is that of a star network: data would flow from libraries into a utility, which would then route them into a "national" system, where duplicate records would be removed or consolidated, headings checked against a national authorities database, and the records sent back to the utilities, which in turn would feed them to the local systems. Such a simple solution may not be the best one. The cost to LC would be large, and there are dangers involved in overloading a national computer just as regional systems have been overloaded. An alternate configuration being considered would completely "distribute" the database. However one problem with this approach is how to achieve the desired consistency in headings.

Fortunately LC is now beginning seriously to build a national authorities database, derived from multiple sources, which may permit utilities to be linked into a configuration other than a star without undue loss of consistency in headings. Development of such a national system requires development of a standard query language, standard search arguments, and standard message formats. It also requires a major commitment in time and money by the utilities and any individual commercial organizations or libraries that wish to be a part of the national system.

The requirements for a national system are being addressed by CLR's BSDP, which, according to JONES, aims to "specify the manner in which the several bibliographic data bases can be joined into a nationwide inventory of bibliographic records." According to JONES & GWINN, the BSDP has issued a contract to review the problems involved in linking networks and to prepare a request for a proposal that will result in a detailed assessment of the consequences and requirements of various options.

At the theoretical level, KENT is engaged in a study that he expects will create a working model for a national network, which might be star, distributed, or hierarchical.

LC is performing studies on the relationship of communications costs to storage costs, traffic loads on network under different conditions, and the effect on a network of changes in technology and economic factors. Although the design concept being emphasized by the planners appears initially directed to the connection of utilities (with LC being considered as a special kind of utility), use of the proposed message delivery system is not restricted to these utilities. It has the potential, eventually, for use by any organization with a host computer that can receive and transmit data in the required formats and with the proper protocol.

CONCLUSION

Despite occasional expressions of pessimism and despite awareness of the enormity of the tasks ahead, a reading of the literature cannot help but lead to the conclusion that by 1985 online catalogs will be in common use by patrons in many libraries. Manual circulation systems will still be around, but their numbers will be declining rapidly. Best of all, within five years libraries can realistically expect to have access to some type of "national" database, bringing closer the day of universal access to information.

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