

TECHNOLOGY AND THE CHANGING ROLE OF LIBRARIANS AND INFORMATION
SPECIALISTS

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It has already been more than 25 years since the first serious attempts were made to develop computerized library systems. Library applications of modern, electronic technologies are now quite mature and sophisticated. Throughout most of the past quarter century the focus of library systems developers has been the control of the physical artifacts (books, journals, documents) held by conventional libraries. However, in more recent years there has been a significant shift to a concern with systems to manage and disseminate information. For example, modern technologies have transformed library catalogs from simple resource directories to comprehensive information systems and are rapidly redeeming the promise of delivery of the information resources of the world's libraries and information centers directly to the scholar's desk top. This paradigm shift, as we will argue in what follows has profound implications for the practice of librarianship and the delivery of information services. It has at once both the power to displace traditional librarians and information specialists and to magnify their importance and the contribution they can make to scholarship and the information transfer process.

Librarianship as we have known it is rapidly vanishing. Computer, communication and data storage technologies are changing the way we use, operate and manage libraries and information centers. To assume that computerized libraries will be substan-

tially the same as their traditional antecedents is grossly to underestimate the ability of modern technologies to transform the objects of their application. We can deny that significant change is taking place, we can passively let change happen to us or we can anticipate the nature and shape of the impending changes and exploit them to our advantage.

Developing and organizing collections are inevitably giving way to facilitating access to information and information resources regardless where they are located. Physical information resources will inevitably give way to digital data or electronic images. Increasingly, charges for information services will be passed on to end-users, consequently, librarians will need to be aware of the characteristics of the market for information and information services in order best to advise and assist their clients:

Modern information handling technologies, if properly exploited, permit libraries and librarians to become important, active partners in research, education and business activities. But as David Bishop, director of the University of Illinois Libraries, has noted:

"In describing the future of university information systems it would be possible to develop a scenario ... without the library serving in a central role but rather being one among numerous providers of information."¹

He goes on to say that the future for the library that proponents of the use of modern technologies project is one that is also highly sought by other groups. Thus, it is essential that librarians understand clearly the unique contribution they make to activities that involve the use of information, articulate that role clearly, and promote it and themselves. Librarians as passive participants in the information transfer process must give way to proactive specialists who are actively involved in the affairs of their clients.²

Let us consider then how modern technologies have altered the nature of librarianship and library service.

LIBRARIANSHIP AND BIBLIOGRAPHIC CONTROL

In the 1970s computer and communication technologies were primarily used to enhance the productivity of library technical services activities. Shared cataloging was the most important library automation development of that decade. Arguably, its most significant consequence was the changes that resulted in the way technical services departments are organized, staffed and managed. Increasingly, professionals have been replaced by library assistants, or paraprofessionals. This is most apparent in cataloging departments. Most new acquisitions are no longer handled by professional catalogers. They are handled instead by paraprofessionals who search shared cataloging data bases for matching bibliographic records. When cataloging records created by institutions that are assumed to maintain acceptable standards are

found, they are accepted without extensive review or modification, i.e., those records are presupposed to embody acceptable cataloging expertise.

Shared cataloging systems are precursors of systems that will radically alter a great many activities that require the application of expertise that can be expressed in the form of more or less precise rules. Such rules may be encoded and maintained in knowledge data bases and used by systems known as Expert Systems that assist in the performance of tasks that involve the application of the rules contained in the knowledge data base. Online, shared cataloging systems, like Expert Systems, permit the skill and knowledge of experienced catalogers to be captured and stored in the form of standardized bibliographic records that may be retrieved electronically and reused by others who need not possess the abilities of those who created them. More generally stated, such systems permit the process of deskilling of labor, begun with the earliest applications of technology, to be carried to a new level in which skills and knowledge may be separated from the individuals who developed them, and may be separately utilized.

Thus, if we define librarianship as primarily concerned with organizing collections for use and preparing bibliographic access tools, we are proposing a model that cannot long endure.

Some will regret such a development, as it means the loss of an opportunity to practice an intellectually satisfying craft. Others, however, will welcome it because it permits effort and attention to be reallocated to the direct delivery of services to

users. Thus, modern technologies, now as in the past, permit the emphasis in librarianship to be redirected from technical, support activities carried out in splendid isolation to activities directly associated with user services.

LIBRARIANSHIP AND COLLECTION DEVELOPMENT

In the 1980s, the shared cataloging systems of the 1970s and the communication networks that joined libraries to them and to each other enhanced the ability of libraries to coordinate their activities, enter into cooperative programs, and to share resources. As a result, librarians and library users are no longer limited to the resources of their local institutions. The collective resources of numerous other institutions can be readily identified and obtained.

Access to other library collections is no mere convenience. It has become a matter of the most urgent necessity. Because of the amount of information produced and the costs to acquire and organize it, individual institutions are able, with their own resources, to satisfy an ever diminishing fraction of their users' needs.³ As a consequence, it is essential that libraries rely on each other's collections in order to satisfy many of the specialized needs of their users. Remotely accessible, online union catalogs and computerized interlibrary loan systems have become increasingly important tools for librarians. OCLC's interlibrary loan (ILL) is one of its most successful services. Since its introduction in 1979, the number of interlibrary loan transactions

processed by the OCLC ILL system has increased an average of nearly 25%/year -- providing clear evidence of the importance of programs of mutual interdependence among libraries.⁴

Modern technologies have increased the range and variety of information resources available to library users and diminished the importance of individual collections. The diminished importance of collections will heighten the importance of librarians, as it is they who facilitate access to the richness of resources that cooperative programs make possible. If we define librarianship as being primarily concerned with developing and acquiring collections, we are proposing a model that cannot long endure. Librarians will in the future need to be more concerned with facilitating access to materials and information than with the stewardship of collections.

Nonetheless, collection development will continue to be an important activity, but in an altered context. Decisions will need to be made relative to virtual collections that include the physical holdings of numerous libraries. Decision-making will consequently be more complex. Librarians who develop collections will need to distinguish between those items that must be part of locally held collections and those which can safely be part of a larger, virtual collection. Thus, they will need to be more sensitive than ever not just to the information needs of their users but also to the manner in which they use information resources.

LIBRARIES AND ELECTRONIC INFORMATION

Collection development decisions and policies will be further complicated by the enormous growth in the amount of information in computer-readable form and the cost of those information sources. In the past 10 years, the number of new computerized data bases has grown nearly 25%/year; in the most recent 5 years, the number of full text data bases has increased more than 50%/year; and since their introduction in 1986, the number of CD-ROM data bases has grown nearly 60%/year.⁵

CD-ROM publications offer many unique advantages. They are an excellent, cost-efficient medium for storing and distributing large collections of information. A CD-ROM disk, 120 mm in diameter and weighing only a few grams, holds more than 1/2 billion characters -- the information content of 150-200 large reference books, plus indexing of every word of their contents. The information recorded on a CD-ROM can be retrieved, rearranged or incorporated into other documents by computer. CD-ROMs illustrate a very important change affecting libraries, library collections and the delivery of information services. They permit individuals to have access to specialized collections of information sources without having to travel to a traditional library to consult them.

These relatively conventional forms of information are being augmented by a virtual flood of information, or data, generated by high technology systems. For example, the data collected in the

1990 census of the United States are available on CD-ROMs, which can be processed with personal computers and commercially available software such as dBase.

Even works of literature are increasingly computer-accessible. A surprising number of traditional texts have been, or are being, converted to computer-readable form. For example, a project, known as the Gutenberg Project, at the University of Illinois intends to convert 10,000 of the most used books to electronic form by the end of this decade.⁶ Michael Hart, director of the project, reports that more than 1,000 books are in some stage of preparation. In addition, the National Endowment for the Humanities has awarded Rutgers and Princeton Universities grants to develop a plan for a National Center for Machine-Readable Texts in the Humanities.⁷ Dartmouth College has created data bases that contain the fully indexed text of 33 of Shakespeare's plays and all of his sonnets; and another data base, a product of the Dante Project, contains six centuries of commentary on La divina commedia. There are currently more than 300 similar projects in progress in nearly 30 countries.⁸

Journals, the literature of primary interest to researchers, are beginning to appear in electronic form and to be widely consulted.⁹ Electronic journals do not yet command the academic respect that printed journals do, however, this can be expected to change because of the obvious advantages this medium offers. Electronic journals are more timely; are less costly to produce, distribute index, and maintain than are conventional journals; and may be the solution to the problem of rapidly escalating

prices of scholarly journals in print form.¹⁰ A recently initiated joint venture involving the American Association for the Advancement of Science (AAAS) and OCLC may lend to electronic journals the prominence they need to become an important means of scholarly communication. Beginning January 1992, AAAS and OCLC will produce and distribute the first peer-reviewed medical journal, Clinical trials, which is expected to be heavily used by physicians.¹¹

Information handling systems used to support future research efforts as well as the normal operations of many institutions will generate such prodigious quantities of data that the agencies that produce and collect them can archive them, thus, excluding them from conventional collections. For example, in September 1991 NASA began a data collection project, Mission to Planet Earth, that will collect highly detailed information concerning our planet. When fully operational, a group of orbiting earth satellites will transmit to receiving stations on earth tens of thousands of billions of bytes, tens of terabytes of data, each day. It is estimated that the amount of data transmitted and collected each day will exceed the information content of the entire Library of Congress.¹² There will no doubt be other projects that will also collect prodigious amounts of data begun in the near future around the world.

In addition to such highly visible data collection projects, each day thousands of scholars and researchers collect and create new data, which they maintain in personal computer or mainframe data stores. Many researchers share their data and research results,

and carry on dialogs, with colleagues with the aid of electronic networks. An increasing amount of scholarly communication is carried out with the aid of electronic bulletin board services (BBSs). (A BBS is an online system that permits participants to enter opinions, questions, and answers to questions into a central data base, which everyone may interrogate). Often BBS data bases are archived and become important records of the activity conducted on the bulletin boards that created them. The number of BBSs dealing with ever more specialized topics is growing rapidly.

With the exception of CD-ROMs, little of the foregoing information will be held locally, it will be maintained in remote data stores from which it must be retrieved as needed; further reducing the importance of local collections and the role of librarians as custodians of physical information resources, but enhancing the role and importance of librarians or information specialists who assist and advise in locating, accessing and utilizing these information sources.

COLLECTION ACCESS

In the 1980s the emphasis in computerized library systems development shifted from a preoccupation with systems intended to aid librarians with their work to systems for use by the public. Online Public Access Catalogs (OPACs) were the most characteristic development of that decade. OPACs simplify access to library catalogs and permit innovative approaches to their contents, and

more significantly they permit catalog access to be extended and distributed to numerous non-traditional places inside and outside the library.

Many library users, particularly users of academic libraries, have had experience with the ability of computers to retrieve and manage information, thus, they have put increasing pressure on libraries to provide computerized information services.¹³ Online Public Access Catalogs and access to online data bases are responses to these pressures. However, as soon as people are exposed to these new services, they begin to imagine and demand ever more sophisticated and convenient services. An example of this is the growing number of libraries that are loading various non-traditional data into their OPACs, e.g., journal article indexes and abstracts, full text data bases including electronic encyclopedias, locally developed, specialized data bases, etc.¹⁴ Thus, online public access catalogs are progressing from simple directories providing only the information necessary to manage a library's physical holdings to comprehensive information systems.

When libraries implement online catalogs they frequently also permit remote dial access to them. Thus, users are able to interrogate the catalog and to gain access to other associated information sources accessible through these systems from their offices, homes and wherever there is a telephone outlet.

Paradoxically, the availability of an increasing variety of information sources accessible to users at a time and place of their choosing enhances the utility and value of library and in-

formation services for many people, but it also diminishes the importance of the physical library and reduces the contact they have with its staff.

In the past librarians took comfort in the belief that for the foreseeable future existing print collections would continue to be more important than electronic sources in satisfying the information needs of library users. However, recent developments in communication, data storage and display technologies have altered the situation more radically and rapidly than we might have imagined.

LIBRARIES AND COMMUNICATIONS

In the 1990s, the importance of telecommunication for libraries has surpassed that of computing technology. Many universities in the United States have implemented private, high capacity data communication networks that link their various campus computing facilities.^{15,16} Whenever communication networks have been established on university campuses, the library's OPAC is generally one of the first facilities to be included and is usually the most heavily used service on the network.

In addition to campus-wide networks for intra-institutional communication, most major academic institutions in the United States are linked by one or more high capacity national communication

networks. Through these networks, academic institutions and libraries in the United States are also joined with numerous, similar institutions around the world.

Many of the innovative, new information resources accessible through OPACs are available to local users through campus networks and to users of other libraries through the facilities of national and international networks. At present the catalogs and information data bases of more than 200 academic libraries in 8 countries are accessible through an international academic library network known as the Internet.¹⁷

Thus, the personal computers that many people already own can function as workstations bringing an unprecedented richness of information resources to their desktops and tabletops in a form that permits them to be readily analyzed and synthesized into new works. Missing, of course, from this attractive model of the scholar's workbench are the prodigious stocks of materials not in computer-readable form and the graphics and illustrations of documents that are otherwise available in electronic form. However, even this is becoming less of a limitation. Many libraries and commercial document delivery services will supply copies of documents within hours by facsimile transmission. Fax Boards, costing only a few hundred dollars, are generally available for personal computers, making them able to receive and store electronic images of documents. These electronic images can be displayed on video terminals and printed with either laser or dot-matrix printers.

Essentially the same technology that is used to scan documents for facsimile transmission may be used to digitize them for electronic storage and dissemination. In this form, they can be manipulated and incorporated into other documents or converted with character recognition software into computer-readable text for further processing. Thus, even documents not in machine-readable form or which contain complex graphics can be accommodated in electronic information systems by converting them to digital images. There are already many instances in which digital images of documents are created, distributed electronically and stored in computer data bases. For example: The National Agricultural Library (NAL) recently successfully concluded the first phase of a project that demonstrates the viability of using commercially available equipment and software, and data communication networks generally available to academic libraries to satisfy interlibrary loan requests in electronic form with digital images of documents.¹⁸ When NAL creates a digital image of a document to satisfy a request, a copy is retained in a data base to be used to satisfy future requests for the same item. In this way, in the course of time, the most used documents will become available in electronic form.

Although the foregoing are development efforts and services of public institutions, we must expect that private enterprises will also exploit these technologies to create a variety of products and services. For example, University Microfilms International (UMI) markets a system, known as ProQuest, that supplies electronic images of the full contents of currently published jour-

nals on CD-ROM combined with computer-readable abstracts and indexes of the contents of those journals with machine-interpretable references to the appropriate page images.

Ironically, old, rare items may be more readily available in electronic form than new items. A number of programs have begun, or are planned, in which deteriorating documents will be preserved as electronic images rather than on microfilm. For example, since the mid-1980s the National Library of Medicine, the National Agricultural Library and the Library of Congress have studied methods for converting documents to digital form for preservation. In 1984 the National Library of Medicine developed a prototype system for the electronic storage and retrieval of document images.¹⁹ In 1986 the National Agricultural Library began a project to test the feasibility of providing in-depth access to the literature of agriculture while also preserving it from rapid deterioration by using scanning and character recognition technologies.²⁰ In 1989 the Library of Congress initiated a project, known as the American Memory Project, which includes the means to distribute digital images of some of the unique materials in LC's collections.²¹ At present optical disks are used, but there are plans eventually to deliver these data via telecommunications.

A system currently under development for the preservation of deteriorating books and documents promises to have a profound effect on the way books are published, distributed, acquired and assembled into collections. Cornell University is currently testing the Xerox Docutech Production Publisher Copier, a system

that can produce entire books on demand. It has the capability to make electronic images of documents rapidly, to store and retrieve them, and to print high resolution copies of the originals. An entire book can be printed in less than 2 minutes at a cost of less than \$7/book.²² Clearly, such systems, if they become widely used, have remarkable potential to change the nature of publishing, book collections and the relationship between libraries, publishers and library users.

The last impediments to the wide-spread use of electronic imaging technology -- extraordinary data storage and data transmission requirements -- are rapidly falling. Ultra-high capacity magnetic and optical data storage devices are now generally available at moderate prices and, with the increasing use of optical fiber as a transmission medium, communication facilities with the capacity to move prodigious amounts of electronic data quickly are also generally available. Most developed countries have realized that a modern, effective communication infrastructure is essential for national well-being and international competitiveness. An example is legislation, known as the High Performance Computing Act, that was recently passed in the United States. It establishes a communication network with 3 gigabits/second (i.e., 3 billion bits/second) capacity, known as the National Research and Education Network (NREN). At this transmission speed one could transfer in one minute high resolution images of more than 700 large reference books, or the information content of 14,000 such books. In addition, most the telephone companies in most countries are modernizing their physical plants with fiber optic and digital technologies and are studying ways to make a variety

of very high capacity communication services generally available, e.g., Broad Band ISDN. Such facilities will make possible a host of unprecedented information services.

Thus, the technology exists, and is either already in place, or shortly will be, to make possible virtual libraries²³. That is, global, electronic communication and computing networks that make it possible to satisfy a library user's information needs without regard for where he or she, or the resources and the services he or she needs, are located. It seems abundantly clear that the existence of such facilities will profoundly affect the relationships among library collections, librarians, the services provided by libraries and librarians, library users, and the services library users will expect.

LIBRARIANS AS INFORMATION CONSULTANTS

Thus, scholars, researcher, students, and general users of libraries will have available an enormous richness of information sources and services without the need to visit traditional libraries. Many of the information sources they use will not be held by libraries, rather they will be available as online services supplied for a fee by electronic publishers. Users upon seeing the advantages of electronic texts, will prefer them to conventional sources, even if they must pay a fee. Because of decreasing computer hardware, software, online data storage and

communication costs, the cost to offer such services will continue to decrease, thus, creating a market of increasing size and profitability.

Most users, will be overwhelmed by the richness and variety of the resources available to them. They will need a great deal of assistance. Important sources and services will be ill-documented; many of them will be dispersed or duplicated; new sources and services will emerge and cease to exist with little warning; in spite of attempts at standardization, access protocols will differ -- even if protocols are stabilized, individual sources will inevitably possess idiosyncrasies because of the uniqueness of their contents -- access protocols, terms of access and charges will change frequently, etc.. Just as with conventional sources, users working within their own disciplines will continue to be the best judges of which sources are most appropriate for particular purposes, but may need assistance selecting and locating sources in other fields. With the increasing prevalence and importance of fee-based information services, the problem of selecting the most appropriate source will require extensive knowledge of data base contents, services, charging policies, access mechanisms and policies, and alternatives.

In the past, researchers, students and general users needed advice on the authority and comprehensiveness of information resources, however, they didn't need to be overly concerned with how many sources they consulted. They could consult as many as time permitted and they could reach their own conclusions regarding the relative usefulness of sources by comparing them. How-

ever, when the mix of sources includes fee-based services, in addition to the traditional, intellectual questions that information users have always faced, questions of cost-efficiency must also be confronted.

It is ironic that the new information services which will substantially increase users' need for the assistance of information specialists, will at the same time reduce their contact with those individuals. Nor, can we expect that many users will seek assistance even though they need it. Scholars, researchers and many others will not be anxious to admit a lack of ability to deal with high technology systems. For many users, in fact, the connection between information services and traditional libraries will weaken. They will be more likely to seek advice from colleagues or technical specialists than from librarians, or information specialists. Furthermore, the same attributes that make the new electronic sources useful mitigate against the usefulness of assistance. Electronic information sources are useful precisely because they can be summoned and utilized as pragmatic responses to developing situations. Thus, librarians will not be able to wait until clients seek them out. They will need to promote the special service and the assistance they can provide. Those that do, will have the opportunity to make a more significant contribution to the work of their institutions and communities than they have in the past.

Modern technologies have put into the hands of librarians and information specialists the tools they need to be members of research, education or business teams. For example, they can use

the electronic networks and other computerized sources to locate and retrieve the data needed to address particular information needs; they can collect data from disparate sources -- including data from conventional sources if necessary; and combine and reorganize those data into forms most useful for the problems at-hand.

CONCLUSION

Thus, modern information handling technologies are displacing many of the activities we have long associated with librarianship far more quickly than we might have expected. They have brought an unprecedented richness of information to researchers, students and general users, instead of requiring them to go to where the information is. These technologies will diminish the importance of physical collections, and physical libraries as well. As a consequence, there is a danger that they may displace librarians or diminish their importance. On the other hand, information handling technologies are also creating an increased need for the special skills and abilities of information specialists, and will permit them to make important contributions to the effective operation of the organizations that employ them.

However, with the reduced importance of physical libraries, librarians and information specialists will need to be proactive and promote their special services to their user communities. They will need to function more like consulting information engineers than traditional, passive information resource custodians

and dispensers of documents. Those that are successful in this endeavor will enjoy satisfying careers and perhaps earn the status and respect long due, but not achieved by, the library profession; those that choose to cling to the old paradigms of librarianship may find themselves curators of infrequently used, increasingly irrelevant information museums.

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