Libraries and Technology: Forging New Frontiers or Lost in the Wilderness?

Bil Stahl

It is difficult not be be aware of the "information explosion" that confronts libraries. The amount of information being produced is increasing exponentially. A recent estimate put the number of journal articles written just in the area of science and technology at over one million per year![1] This production of information is possible because of advances in information technology. However, the impact of the new information technologies is not limited to increasing the quantity of published materials. More importantly, the new technologies are changing the fundamental nature of information and our abilities to work with it.

Steward Brand, in his book *The Media Lab*,[2] states that our ability to convert information of all types into digital form will rank in importance to civilization with the invention of the movable type printing press. By translating all types of information into a common base of 1s and 0s, pictures, sounds, and text can be merged and manipulated simultaneously. As Ted Nelson speculated would happen,[3] we have become surrounded by an ocean of digital information. A discipline called "information ecology"[4] is emerging which views digital information as making up an "infosphere." It studies the interrelationships of the various types of information in the "infosphere." The capabilities of computers and other technologies that convert information to digital form and manipulate digital information are doubling every three to five years. In addition, the cost per byte of information processing power of these technologies is declining very rapidly. The challenge for libraries is to identify their appropriate niche in the infosphere and to adapt to the rapidly changing environment.

Bil Stahl is Associate Director of the J. Murrey Atkins Library, The University of North Carolina at Charlotte.

It is usually true that new technologies become available before libraries are able to develop the necessary policies and procedures to implement them. Often this lack of policies and procedures has retarded the adoption of technologies in libraries. The purpose of this paper is to attempt to give some insight into what capabilities the new technologies will offer in the next several years and to identify some of the major issues that libraries will need to address because of them.

Current Library Technologies

The application of computer technologies to library operations was seen as a logical step from the early days of computers. Basically, libraries and computers do the same things: store, arrange, and retrieve information. Libraries have been successful in adopting computer technologies. However, during the past thirty years computer technologies have had to "catch up" to the libraries' needs. Libraries needed systems that could provide quick access to large data bases with multiple indexes to records consisting of variable amounts of text. They also needed fast transaction processing times for circulation transactions and global changes to these large data bases. The creation of bibliographic utilities and library consortia required sophisticated telecommunications networks. In recent years, libraries quickly became a market for the high storage capacity optical disk technologies of laser disks and CD ROM.

With the development of high speed telecommunications networks and standards, libraries are now developing the ability to thread through a variety of networks to access a number of different systems and data bases. As telecommunications speeds increase and telecommunications costs decrease, optical disk data bases will be replaced by online services. In the near future many library terminals will not be connected directly to any single system, but rather will be connected to a network which will enable users to

access distant systems as easily as the local system.

In large part, the automation of libraries has consisted of applying technology to what libraries have always done. The changes in libraries brought by technology have been major ones, but they have also been incremental with long lead times. The most significant cognitive change that libraries have had to addreses during this process was the adoption of Boolean logic for searching. Keyword researching capabilities using Boolean operators (AND, OR, NOT) required librarians to create research strategies that were very different from those based on the controlled vocabulary of subject headings.

... the new technologies are changing the fundamental nature of information and our abilities to work with it.

The Future

While there are many enhancements that still need to be developed for library systems as they stand today, usually their development is pending not because the necessary technology does not yet exist, but because of resource limitations or legal and political concerns. We are now coming to the point where libraries will have to "catch up" to the capabilities of information technology. In the past, libraries knew what they wanted the technology to do—make the library more efficient and effective in doing what it traditionally did. Now, the tables are turning. The technology is challenging libraries to review what it is they can and should be doing.

The library clientele is certainly aware that information is all around and is becoming increasingly facile with important technologies. One out of every five Americans in 1984 used a computer either at work or at home.[5] It is estimated that the total market for home computers is eighteen to twenty percent of American households. However, this figure does not include all of the "computer-like" devices that are or likely will be in homes. Currently twenty percent of American homes have Nintendo video games and this number is projected to grow to around sixty to eighty percent.[6] In Japan, people are utilizing Nintendo games to access information via their television networks such as financial market information, shopping, and travel arrangements. Many feel that Nintendo is positioning itself in this country to provide the same services.

High Definition Television (HDTV) also promises to bring extensive computer power into the average household. While the initial attraction of HDTV is picture quality, it achieves this quality by processing images as digital data. Most HDTV units will have an "open architecture" like the standard microcomputer, meaning additional boards such as memory modules or modems can be added to them.[7] It is important to note that CATV companies may become the major players they have long been predicted to become in the information supplier market. Many already have the capacity to support HDTV and digital information transmission. CATV is not regulated by the FCC, and therefore does not have to wait for broadcasting standards to be adopted.

The major market for CD ROMs will not be libraries, but will be the home entertainment market with devices like Nintendo and HDTV.[8] Even the lowly touch-tone telephone will become a major "computer" device. Companies such as Intecom have developed front end interfaces that enable systems, such as online library catalogs, to be queried by simply pressing the pad on a touch tone telephone. The interface offers a series of menus that are voice-synthesized using the system's data.

The information systems that will be available to people in their homes will not simply be a reworking of the failed Qube and other videotext systems that were tried in the mid 1970s. Those were attempts to make everyone use the text-oriented computer systems of the day. The shift in personal computing has been towards the use of graphics. However, computing in the 1990s is envisioned as being not just graphically oriented, but cinematically oriented.[9] There will be a true convergence of entertainment and information technologies. When this happens a person could view a presentation on buying a franchise, retrieve an article from his or her library's copy of the *Wall Street Journal* on the franchise, arrange for a loan from the bank to purchase the franchise, and apply for the appropriate licenses using information from the local government documents depository library just by using the HDTV set. Libraries will either be part of these information systems, or others will fill their role.

Issues

The primary issue libraries will continually have to address is what types of information the library is responsible for providing. Many of the new technologies provide the same access mechanism to traditional library information as to extremely specialized data bases in esoteric

fields. Historically, library collection development practices have been oriented towards standard units of readily identifiable forms of information (e.g., books, prints, and motion pictures). Will the library become responsible for finding and providing access to fragmentary collections of data that exist in myriad data bases throughout the world? If not, what are the parameters that define which of these the library will include in its domain and which it will exclude?

An associated issue to the type of information a library should supply is the level of expertise the library will be responsible for providing in manipulating the information. Is the librarian going to be expected to know only that information exists and how to find it, or will he or she also need to know how to use the information. As information "collections" become more fragmentary, a librarian may need to know how to use it in order to be able to find out about its existence. Librarians will need to be fully information literate. A recent report on the future of libraries states that information literacy, the knowledge of how to find needed information, will become as important to society as the ability to read is today.[10] If the ability to find information and the understanding of how to utilize the information become more closely linked, then libraries may need to develop staff with more in-depth subject expertise than is common today.

Another major issue is that of access to, versus ownership of, materials. Since libraries have traditionally been collectors and owners of materials, standards dealing with measuring the adequacy of a library have used volume counts as a primary measuring device. However, the new technologies are forcing libraries to address the issue of access to information versus actually owning the source of the information. This is certainly not an either/or issue, but one of balancing resources to accommodate the best mix of the two. In academic libraries this issue is directly tied to support for teaching versus support for research. The importance of access will probably always be more important for the latter. The sources of the access will not always be the same as the sources the library now uses for either collections or online services. For example, should the electronic files of the complete works of Shakespeare come out of the library materials funds, even though they are available through Humanet, a scholarly electronic network? While the access versus ownership issue may have been brought to the forefront by technology, the decisions need to be based on much more than the availability of appropriate technologies. Access requires a great dependency on interlibrary cooperation and/or on the information vendors' long term commitment to support their products.

The issue of ownership versus access also applies to the area of equipment. The library will need to invest in telecommunications equipment and capabilities that certainly are not as tangible as the library's minicomputer that people can see and touch. This also means that while the library can offer more, and enhanced, services, it has less direct control over those services because of the dependence upon those who manage the networks.

Basically, libraries and computers do the same things: store, arrange, and retrieve information.

The new information technologies will largely be additions to, rather than replacements for, library collections. Much of the replacement will be phased in at a much slower rate than the development of new technologies. This means that the array of information types and formats in the libraries of the 1990s will be much greater than the libraries of the 1980s. Collections defined by format will be much harder to maintain as new formats combine the aspects of several others. The types of struggles that many libraries have had in handling microforms and media formats will recur with increasing frequency unless libraries can establish flexible systems of organizing their collections.

Bibliographic control will need to become much more complex as libraries and their clientele become fluent in the new information technologies. Standard machine readable records will need to be more robust than the MARC formats of today. Retrieval of information may commonly be done on such attributes as sound, color patterns, and emotional content (e.g., anxiety, serenity). At some point librarians will have to consider when it is time to switch from the current MARC standard bibliographic format to one that is more adaptable to the new technologies.

Libraries will also have to decide whether they should provide bibliographic control for information they have access to but do not own, and what form this bibliographic control will take. What should the library's online catalog contain when a significant portion of the library's resources are used to purchase access privileges rather

than actual materials? Will the catalog become interactive with "hot links" that take the inquiring patron directly to the cited data base?

... the knowledge of how to find needed information will become as important to society as the ability to read is today.

Another key issue is how these new information technologies fit into the library's mission. What is the library's obligation to provide unimpeded access to information to its primary clientele? Will the primary clientele be redefined because of the costs of the new information technologies? New information technologies are expensive. The most likely scenario is that the cost of these technologies will not go down significantly, but rather the capabilities will increase while the costs become more stable. Can the library afford to provide free access to all the information resources for which it has purchased access? If not, what are the trade-offs between the need for state-of-the-art information access versus readily and generally available sources of information? As the number of options for information sources increase, the mission statements of libraries may become much more different from each other than they currently tend to be. With limited resources and varied options to spread those resources over, libraries must become increasingly unique.

Because of the impact of information technologies on the library's resources and the organizational structure of the library, an effective mechanism to determine on which of their increasing numbers the library should focus its attention needs to be developed. This mechanism must allow timely reactions to new opportunities and yet it must keep the library from fragmenting its efforts on too many different technologies at once. It must also prevent staff from having to deal with ever changing technologies to the point where they develop what has been termed "cognitive whiplash."

Libraries usually view part of their mission as gathering information for the future. This has always been a challenge, since it is difficult to determine what information will be important later. As Daniel Boorstin points out, information itself has no value. It is only when information is assimilated and becomes knowledge that it takes on value[11]. Because of its volatile nature, digital information is much more easily lost than non-digital information. There is an Information Darwinism that applies to the information ecology. Information competes for survival in the infosphere. Potentially valuable information can readily go out of existence in the digital realm before its value can ever be discovered. Will libraries view the gathering of digital information for the future as part of their mission? If so, new methods must be developed which will be radically different from current archival operations and will be expensive.

The purchasing and upgrading of equipment will become a much more critical activity for libraries. New capabilities usually require new types of hardware and software. In some cases existing hardware can be upgraded to meet the requirements of the new capabilities. In other cases, it is more cost effective to purchase new equipment than to try to retrofit existing equipment. In any event, computer equipment (especially microcomputer equipment) usually has a useful life of three to seven years. The library will need to develop an ongoing plan to allocate its limited resources between buying new equipment (e.g. new technologies that the library has never had before) and replacing or upgrading existing equipment.

Current library budget planning and allocation practices must be radically changed in order to take advantage of opportunities created by new information technologies. As Jerry Campbell recently argued[12], the traditional library allocations for materials, staff, and operations will no longer be proper. Library budgeting must become a much more creative activity and often library budgets, like the mission statements mentioned above, will not be similar to those of other libraries.

The challenge for libraries is to identify their appropriate niche in the infosphere and to adapt to the rapidly changing environment.

Staffing is an important issue that always needs to be addressed with any change. As the library becomes increasingly dependent on technology, it will add technical staff to implement and maintain this technology. Technical staff will assist staff in assessing the value and feasibility of new technologies as well as setting up and maintaining hardware and software. Because of this

dependency, the library must have the personnel that can make needed changes and repairs, or major components of the library's services and operations could become inoperable for indefinite periods of time. This staffing will likely consist of data processing, networking, and media personnel. Good working relationships with other operations and agencies, such as data processing centers, networks, and media production and support operations will also be vital to keep the library functioning. Likewise, ongoing dialogs about the appropriate roles of each of these agencies in managing the information technologies must be maintained.

A major and ongoing training program for service and operations staff will need to be established to keep staff up-to-date with changes and new capabilities. As the technologies become more diverse and complex, staff may well have to become comfortable with entirely new cognitive concepts as well as simply to learn new skills. Just as many librarians quickly had to come to grips with Boolean searching logic when online bibliographic retrieval systems became widely available, librarians will have to become facile in new ways of thinking to utilize such things as hypertext systems, inference engines, and cinematic data bases.

Adoption of new technologies for accessing and handling information will impact the organizational structure of the library. Position descriptions and the interrelationship between departments will change. As mentioned above, new, specialized positions will be required. The goals of many operations may be fundamentally changed. As an example, circulation, interlibrary loan, and document delivery services may be merged into one operation. As implied in earlier statements,

---

There is an information Darwinism that applies to the information ecology. Information competes for survival in the infosphere.

---

acquisitions, collection development, and cataloging operations will certainly be changed. For reference, bibliographic instruction for an audience in a networked environment of large numbers of information sources would need to be very different from the bibliographic instruction required in a more traditional library. Quick access to large quantities of data that can readily be taken out of context presents different instructional concerns

from the use of a library catalog and indexes which result in the retrieval of physical units of information (e.g., books, articles). Also, libraries will be serving a clientele with a wider range of information literacy than is true today. Librarians will have to be able to work with people who have a highly developed knowledge of information technologies, as well as those who have none.

A new reference position that could be needed is literally an "online reference librarian." The librarian in this position would be stationed at a terminal and available to anyone using a library terminal (or a library network) for interactive communication to answer such questions as how to search a particular system, or which system to use to find specific information. This position would be the new technology equivalent of the telephone reference librarian.

Library facility design for use with new information technologies will raise a series of issues. How are facilities designed to accommodate yet-to-be developed technologies? Who will be using the facility in ten to twenty years? Will the facility ultimately be an electronic hub serving a clientele who rarely, if ever, physically comes to

the library? What type of collections will be housed in the library? In the *Virtual Library*[13], Harvey Wheeler states that we should expand our concept of a library beyond the physical structure and likens the library to a church. While a church is a physical facility, it is also a social institution. While the library may never be without walls, the new information technologies have already enabled the library to go beyond these walls.

Summary

The infosphere is both a wilderness and a new frontier for libraries. Determining which it will be is the major challenge for any library in the coming years. The only constant for libraries in the infosphere is change. Librarians must remain information literate by following technological developments and assessing their potential and their impact. Librarians must look to the literature and experiences of other sectors of society, such as business and entertainment. In an information-based society, all sectors share common concerns with libraries. Librarians must be ready to review critically the fundamental aspects of their trade. To determine and then realize their full potential in the information age, librarians must not be able simply to adapt to change, but must become agents of change.

References

1. Steven Louis and Robert F. Rubeck, "Hypertext Publishing and the Revitalization of Knowledge," *Academic Computing* 3 (May 1989): 20-32.

2. Steward Brand, *The Media Lab* (New York: Viking Penguin Inc., 1987).

3. Ted Nelson, *Computer Library-Dream Machines: You Can and Must Understand Computers Now!* (Redmond, Wash.: Microsoft Press, rev. ed., 1987).

4. Michael Miller, "A Brave New World: Streams of 1s and 0s," *The Wall Street Journal*, (June 23, 1989): 39-41.

5. Joe Schwartz, "The Computer Market," *American Demographics* 10 (September 1988): 39-41.

6. "A New Game in Town: Nintendo, AT&T Deal Would Link Videos with Telephones," *Charlotte Observer*, (June 9, 1989).

7. Leonard R. Yencharis, "HDTV: the Real Questions to be Decided," *Advanced Imaging*, (June 1989): 18-20, 57.

8. Michael Schyster, "CD-ROM as entertainment," *Computers in Libraries* 9 (June 1989): 39.

9. Michale Liebhold, "Personal Computing in the 1990s," Presentation at the Fifth Annual Apple Library Users Group Meeting, Dallas, Tex., June 26, 1989.

10. Patricia Brevik and Ward Shaw, "Libraries Prepare for an Information Age," *Educational Record* 70 (Winter 1989): 13-19.

11. Daniel Boorstin, *Gresham's Law: Knowledge of Information?* (Washington: Library of Congress, 1980).

12. Jerry D. Campbell, "Academic Library Budgets: 'Changing the Sixty-Forty Split,'" *Library Administration and Management* 3 (Spring 1989): 77-79.

13. Harvey Wheeler, *The Virtual Library* (distributed at the 1987 EDUCOM Conference as a diskette of MacWrite files).