

Libraries in the New Information Age

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I am truly delighted to have the opportunity to speak at the North Carolina Library Association's Biennial Meeting. When I was asked to give this talk some months ago, it was hinted that I should address a number of information issues, and I was told that the central theme of this year's conference is "Libraries—Spread the News," and the sessional theme of RTSD is "The Impact of Automation and High Tech on Libraries and Their Users." This reminded me of early in the spring of 1980 when we entered a new decade, I was fortunate to be asked to receive the Distinguished Alumnus Award at the University of Michigan's Library School and delivered a convocation

speech for that occasion, entitled "Golden Opportunities in the 80's for Information Professions" (Chen, 1980). The title of that speech clearly suggests that I viewed then and continue to view now the future of the library professions with considerable optimism. In preparing for this talk, I read that speech again the other day, and realized that I did not make too bad a prediction. With your indulgence, I am going to quote a few paragraphs from that speech about the 1980's and new information technologies.

"The 1980's represent a frontier of further development and rapid expansion in electronic and telecommunication technologies. In the area of information sciences, the intelligent terminals, fiber optics technology, direct broadcast satellite transmission, computer-based message systems, large-scale data base storage, video disc technology, high speed printing, and photography offer us all outstanding, ever-expanding opportunities in the coming decade . . ." "Thus, in the 1980's we can expect a dramatic change in the mode of information production, transfer, and delivery. Due to the advent of a low-cost distance-insensitive, wideband satellite network, both local television stations and cable systems may be partially supplemented by direct home-to-satellite broadcasts; home televisions can be used to display text from central online data bases; small, inexpensive-but-powerful computers will provide a means of access to machine-readable data bases at home and at small businesses. Real-time online conversations with consultants, colleagues of the invisible college, and information specialists are well within our technological capabilities.

"There can be a sharp increase of remote library browsing, remote literature searching, and remote interlibrary loans. Real-time hard copy reference and document delivery will also be possible. The 'electronic library' and/or 'teletext library' awaits in the not-too-distant future; sooner than many of us would like to imagine. The rate of technological change created by television and mass media in the past two decades was so stunning that many librarians have been unable to clearly assess the far-reaching effect it has had on the world of their services and opera-



Dr. Ching-chih Chen, Professor and Associate Dean of the Graduate School of Library and Information Science at Simmons College, Boston, delivered this address at the NCLA biennial conference. It was sponsored by the Resources and Technical Services Section.

tions. The pace of change brought on by the telecommunication technology of the 1980's will surely be far greater in the years ahead. Each of us must ponder deeply the role of new technology as a powerful change agent in the information field. We must understand fully the profound and permanent implications of technology in the future role of libraries and information professionals. Our continued relevance and usefulness depend upon it."

These were my predictions in March 1980 and seemed to be rather mind-boggling at that time. Yet only seven years later, in the fall of 1987, not only has everything which I mentioned then become reality, but also we have come of age in such a high-tech world that many of the 1986's and 1987's "firsts" would have been labeled science fiction a mere decade ago. In fact, in all areas of new technology, we fall very short of all predictions. Given what has happened since last week, I wish I could do one-tenth as well in predicting the stock market.

Looking at something more tangible and practical as I traveled internationally many many times in the last few years, I have progressively noticed how the general public's attitude toward the use of high technologies has changed worldwide. Computers were being viewed not as a menace anymore, but as a positive extension of human ingenuity. The general public has become much more computer literate, and, therefore, can use and/or understand computers. "User-friendly" has become less an advertising slogan and more a reality as hardware and software developers and producers rushed to compete with credible products, and more and more professionals and organizations in every field have relied on new technologies to increase productivity, efficiency and effectiveness.

Given the above as a background, I shall try to elaborate on the roles of the library in new information age. As requested by the Conference organizers, I shall deliver it more from the perspective of academic and special libraries and their library users who are deeply involved in knowledge and information technologies development.

Historical Perspective on New Information Technology and Early Library Responses

Looking back, in the 1950's two major revolutions erupted—television and the electronic computer—which have fundamentally altered the communication systems in every part of the world. Furthermore, in the last three decades

high technology has had an irrevocable impact on our libraries and information services. As a result, an information age culminating in the quick disappearance of the traditional "gatekeepers" role of libraries was witnessed. In other words, the information world has begun to shift from print only to multimedia, including imagery.

Since the mid and late 1970's, the dynamic growth and development of the microprocessing and telecommunications industries has had even greater ramifications on library work and services. Developments in these new technological areas have led to major changes in our information society. It seems appropriate to point out that "new technology" is a term which has been used loosely to refer to a wide range of technological innovations mainly in the computing and/or communication areas, each of which is at a different stage of development, implementation, and widespread use. Many of these technological advances reach widespread use in a remarkably short time span. Furthermore, they dynamically adapt to various hybrid technologies which dramatically compound the computing and information processing power for information management applications.

Clearly, in this new information age, synonymously called the "electronic age," we are inundated with an enormously and ever-increasingly vast amount of information. In order to find more efficient and effective ways of using this information, information technology has played an increasingly important and popular role in transforming our information society. Therefore, if we trace the literature on the new information age in recent years, we will find that the developments in electronic and telecommunication technologies are central to all of them, although different definitions may be offered of information age—some scholarly and some empirical. Also dominant is the notion that new information technologies not only permit individual information seekers and users far more "power" than ever before, they have also had fundamental and dramatic impact on all organizations, institutions, and individuals now primarily concerned with the delivery of information services. These clearly include libraries as part of the information universe.

Where are these taking us? What are the effects of these technological developments on library and information professionals? What were library's earlier responses to new information technology? In order to begin to respond to some of these questions, it is helpful to assume an historical perspective and examine what libraries

have done in response to these technological advances. From a very quick and macro review of these developments, three have been commonly identified by librarians as having the greatest impact on the overall effects of automation in libraries:

1. *The Growth of Bibliographic Utilities and Resource Sharing/Networking*

From the early twentieth century to late 1960, growth in resources was one of the major trends in libraries. The watch word was "more"—more money, more books, more staff, more space, and more technology. Yet, "although libraries got more of everything during those years, they still could not keep pace with the growth of new fields of research, new doctoral programs, and increased production of books and journals" (De Gennaro, 1975). Realizing that no library could possibly have everything, with the help of those burgeoning new technologies, librarians quickly had a change in philosophy toward shared resources. Thus, resource sharing and networking have since become popular buzzwords.

Prior to 1970, each library did its own cataloging and there was little possibility of finding out which libraries possessed similar book titles except through the manually prepared union catalogs. With the introduction of machine-readable bibliographic utilities—the first being OCLC in 1968—shared cataloging was born and has since grown rapidly. For example, at this moment, a great majority of American academic and public libraries use at least one of the many available bibliographic utilities to perform their cataloging functions. Take OCLC as an example. It is a five thousand-library network with over twelve million catalogued bibliographic records. Similar growth has occurred in all other utilities, such as RLN, WLN, etc. However, these utilities operate on large scale computers, technically more representative of the 1970's, which are quickly becoming "dinosaurs." Thus, we have seen in recent years the enormous efforts which all these profit-making and nonprofit organizations have made in developing new micro-based products and/or alternatives to keep up with these quickly changing times. Many bibliographic utilities are actively marketing specifically designed micro-based hardware and software that permit libraries to "integrate" automated cataloging, acquisitions, reference, online public catalogs, circulation, inter-library loan, serial control and other functions. In addition, we have begun to see considerable development in the use of CD-ROM technology by these utilities. This is also an area where libraries

may explore their own exciting cooperative CD publishing projects.

2. *The Dynamic Growth of Online Databases*

Online information retrieval systems have been available for quite some time, but their format and content have been changing constantly. We all remember that in the early and mid-1970's, online searching was a big deal. The ability to search online evolved from specialized services with an initially very small number of elite researchers to widespread services available to a large number of end-users (in the case of academic libraries, to a large number of students and faculty.) This was made possible primarily by quickly multiplying online databases, with an estimated growth rate of twenty to thirty per cent per year. In 1979, about four hundred online databases of all kinds, offered via fifty nine online services were identified, yet we have a record total of about thirty two hundred databases available via five hundred online services worldwide. This great proliferation of machine-readable databases and the greater trend in treating information itself as a commodity has had a tremendous effect on library information services. It is anticipated that end-users will do many more searches than their trained intermediaries. The reason for this is the great price reduction, offered by vendors in hopes of cornering the market of those with micros and modems available at home and/or at work. Since 1985, we have seen a great proliferation of CD-ROM products of these online databases (Chen, December 1985). While unquestionably the recent CD-technology has offered exciting potentials for libraries, yet we have seen mainly products of electronic publishing for libraries at this time. When CD-ROMs are mainly used as publishing and storage media, one really doesn't need to make too much out of it. Think about what they can do for us beyond that? For example, how about the possibilities and potentials of libraries' own cooperative CD-publishing?

3. *Online Public Access Catalogs (OPAC)*

The purpose of a library's catalog is to organize its collection in such a way as to permit easy access to the materials the library owns. Yet, maintaining a library catalog is very labor-intensive. Libraries have turned to the more recent developments in OPAC for partial solutions. While OPAC has enabled users to gain quick access to the library's holdings and has given librarians a great deal of operational expediency, it has its problems as well. The OPAC on larger systems has problems such as the initial capital investment, the ongoing cost of maintaining the computer, the

need for backup when the machine is malfunctioning, the cost of retrospective conversion, and the need for and expense of an integrated system. The recent introduction of OPAC on CD-ROM and the micro-based system such as Le Pac introduced by Brodart and the product of the Library Corporation using expert system are only some of the examples.

Recent Technological Developments and Their Effect on Libraries

Given the above-mentioned developments as background, what are the more recent advances and trends? Time does not permit me to elaborate on these by giving a full catalog or directory of new information technology. I shall mention them only briefly and in broad categories:

- As electronic breakthroughs have continued their whirlwind pace in all related areas, the ease of use and increased reliability of system software has been witnessed; application software packages have greater function with more flexibility; end-users have many more alternatives; and hardware improvements have brought more processing power to the users.

- As end-users become more sophisticated and technology more complex, the market demand has prompted the design of fifth generation computers—machines that incorporate artificial intelligence which will allow them to understand natural language, make deductions, draw inferences and solve problems. This is where the shift from information processing to knowledge processing will be seen. There will be an increasing demand for "intelligent" information services by our users in education, research, businesses and industry.

- As the number and variety of electronic databases has increased sharply, so has the speed and mode of the flow of information increased greatly. Communication via text, voice, and image now provides effective solutions to the problems of information flow. Many of these databases can be accessed via networks of remote systems such as Ethernet, Easynet, etc. Obviously the options available for information seekers have increased greatly.

- As the technology progresses dynamically, so does the format of electronic information delivery and distribution change greatly. While traditional printed information entails a fixed format, electronic information can be delivered and distributed via many options, such as videotex, audiotex, digital voice mail, interactive video-audiotex and many, many others.

- There is considerable evidence that the

technologies used in telecommunications will continue to provide multiple alternatives.

- Micro-mainframe and micro-mini-mainframe links have been buzzwords since 1984. Microcomputers are no longer used as single workstations, yet are clearly integrated into the whole system in a workable, cohesive configuration. In the academic setting, for example, we shall see more and more universities experimenting with instructional and operational purposes. For example, Project Athena of MIT involves the use of computer technology in the curriculum. Both IBM and DEC have invested in this project a combined fifty million dollars for the period 1985-88. It is expected that by 1988 a multiple local area network with hundreds of Athena workstations will exist in the educational computational environment at MIT for curriculum development in a very broad sense, which certainly has an important role for libraries. Brown University is another example. Known as a "star wars" university, it is expected within the next ten years that the University will spend over fifty million dollars on wiring together over ten thousand "scholar" workstations. While these workstations will perform all basic "secretarial functions" and "research operations" it will also certainly be easy for faculty and students to access library OPAC and available online data bases via these computer links. This type of development should dramatically change the role of libraries in academic environments. Similarly, in the business and industry settings, the full integration of microcomputers in the common work place is self-evident.

- Storage media technologies have continued their rapid development. Recent strides in storage technology portend lower cost and greater capacity systems for all computers. This has encouraged users to keep more and more data online concurrently for data analysis and other purposes. It has also encouraged new applications such as electronic mail, electronic filing, and other applications. Many library applications requiring large storage capacity are portable now at manageable cost.

- Laser optical storage and retrieval technology, including CD-ROM, hold great promise for libraries for information preservation, management, and electronic publishing. Currently many popular databases, such as COMPENDEX, NTIS, ERIC, *Chemical Abstracts*, MEDLINE, EMBASE (*Excerpta Medicus*), *Dissertation Abstracts*, etc., are available on CD-ROM. Instead of paying for online searches via vendor services, libraries or other database end-users, can actually own a

good portion of the databases now. Obviously, this should have an effect on the library's operations and services related to information retrieval. Furthermore, many key reference tools are also being made available in an electronic format. Here I am not only referring to various reference tools for librarians, such as *Books in Print* and *Ulrich's Periodical Directory*, but also the major subject references to end users, such as Beilstein, *McGraw-Hill Encyclopedia of Science & Technology* etc. Surely, this should undoubtedly have great effects on the mode and operations of reference services in libraries. My recent CD-ROM use survey in American academic and college libraries has revealed some very interesting results in this area (Chen, December 1987).

- The recent development in WORM (Write Once and Read Many) technology provides more opportunities for information processing and management. For less than \$3,000, it is possible to acquire a 5 1/4" optical WORM drive permitting a system user to write about 240-MB data on a WORM disc. Recently, Kodak has announced the availability of its fourteen inch WORM disc with 6-GB storage capacity. When compared with floppy disks, the 10-MB, or even 40-MB hard disks, this technology indeed offers visible and exciting potential for library information management in areas such as archival management, document preservation, etc.

- As we are just getting used to CD-ROM, the messy optical and computer technology market is throwing out all types of acronyms of products, such as erasable discs, CD-V, CD-IV, CD-I (Compact Disc Interactive), DVI (Digital Video Interactive), hypertext, hypermedia, hypercard, etc. While some of these such as CD-I and DVI are still at the prototype development stage, it is too early to foresee the possible effect these will have on information management and service delivery. It is unquestionably substantial when the product is available on the market for meaningful applications.

- In the meantime, optical videodisc technology, by no means passé, has offered great potential for multi-media and multi-formatted information processing and delivery. For example, a double-sided analog videodisc can contain 108,000 frames of visual images (from slides, videotapes and/or films), as well as one-hour dual sound tracks. This opens up great possibilities for librarians for dynamic information provision (Chen, 1985 & July 1987).

- When videodisc technology is interactively used with microcomputers, we can begin to experience the incredible potential of this hybrid

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technology for information retrieval in education and training. In this area one can definitely create a demand for a technology capable of reshaping the field of learning and information retrieval for society. I have had the privilege of directing a major interactive videodisc project, called PROJECT EMPEROR-I, supported by the Humanities Project in Libraries of the United States National Endowment for the Humanities. PROJECT EMPEROR-I is ideal for demonstrating the great potential of interactive videodisc technology for multi-media, multi-formatted, and multi-dimensional information provision and delivery, which epitomizes how new technology has promoted and enhanced information access in a way not possible before. In the recent two or three short years, we have witnessed the development of many exciting interactive videodisc technology—related projects in almost every subject field—art history, archaeology, ecology, geography, science, technology, and medicine. Exciting things are happening in every part of the globe. For example, British BBC's DOMESDAY project has involved over three thousand schools in Great Britain; and in 1986 the Italian government launched a vast multi-year plan for the recovery, classification, and diffusion of the artistic and cultural heritage of Italy, under the slogan "recovering the Italian

gold mine." This program has been funded with five million dollars for only the first three-year phase, which includes the development of various interactive videodisc programs of their museums.

• Murr and Williams in their very recent article, "The Roles of the Future Library" (1987), listed four enabling technologies which will significantly affect the libraries of the future. They are: Artificial intelligence, graphic imaging technologies, optical digital mass storage systems, and digital transmission systems. While some of these have been touched briefly by me, some others, such as electronic imaging technologies and digital transmission systems, have not been. It is important to recognize that technologies are being developed to enable us to capture, enhance, manipulate, and repackage all types of images—pictures, illustrations, charts, paintings, graphics, textual pages, etc.—with high graphic resolution, easy access, and concurrent fast retrieval in a way unattainable before. Take my own PROJECT EMPEROR-I as an example. Through the use of Sun Microsystems' 3-family and the powerful software from the Image Understanding Systems, we have captured several of our "star" images at the resolution of 4K x 4K with 24-bit true color display. Once the image is digitized, the potential for using and manipulating the vast amount of digitized data is indeed unbound.

New and Future Directions for Library and Information Services

Therefore, it is clear that today's libraries and their staff are in the midst of a period of unprecedented change and adjustment. Substantial changes have occurred in every part of library work as automated systems are introduced. Practically every function performed in a library has been altered by advances in electronics, computerization, and telecommunication. Changes have occurred in library management, organization and staffing patterns; job design, classification descriptions and contents; service programs and activities; and the work environment in general.

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What do all these developments mean to us as information professionals, and how is the profession itself changing as a result of the new tech-

nology in the information age? In the last few years, there has been a dramatic change in the mode of information production, transfer and delivery. Clearly, we do not have much control over these technological developments. In order for us to cope with them, we need a fundamental change in library philosophy, education, and practice. Throughout my research and activities, I have stressed the fact that the library is only one of many viable information providers and, most frequently, it has been the most important one. In order to increase the library's relevancy and its role in the present information environment, it must shift focus to include the following directions in addition to its basic functions:

- From library-centered to information centered;
- From collection-centered to access-service oriented;
- From the library as an institution to the library as an information provider, and the librarian as a skilled information specialist functioning in an integrated information environment;
- From using technology for the automation of library functions to utilizing technology for the enhancement of information access not physically contained within the four walls of the library; and to up-grade the general citizen's quality of life. In this way, when serving the business and industry in the emerging information society, a library becomes a vital economic resource, and when serving the academic and public library users, a library becomes a true education resource center;
- From library networking for information provision to area networking for all types of information sources providers. Thus, the library is only one of the many nodes of total information network.

While realizing that librarian's responsibilities lay in preserving records of knowledge, in providing access to information and in knowing that information is intrinsically important; it is their duty as well to broaden their horizons, to expand their working domain, and to experiment with new technological tools which enable them to carry out their responsibilities more effectively and efficiently; and thus add a powerful new electronic dimension to the library's traditional collections and services.

To follow up on the earlier discussions regarding new information technology developments, it is safe to say that in the very near foreseeable future, in fact almost now, many information sources will not be only in their traditional and currently more familiar formats; instead they

will also be in some type of electronic form as witnessed in some of the dual formats of publishing of same major reference tools. In areas of information seeking, the development of a new generation of software, based on artificial intelligence, will allow the assimilation of information in an unstructured way with inference-making capabilities. We will no longer speak of data bases, but of a new type of information source, the knowledge base. Knowledge bases will totally revolutionize our information services. In other words, instead of performing a computer search of a data base by using keywords, the computer will review the information contained and make inferences based on our requests. It will provide a synthesized answer not explicitly visible in any text.

No matter where new technologies have taken us, surely the future of printed sources such as "books" is firmly intact. New technologies have not introduced to us a convenient and flexible product like the "book" as of yet. Thus, new electronic products will coexist with those useful traditional ones and will provide us with additional information which is not obtainable from the one-dimensional printed sources. While it is oversimplification to think that all paper products will disappear totally—to tell the truth, my own home office has never had more paper in it in my life than during the last couple of years. However, it is conceivable that sheer economics will force some types of printed sources out of business.

Knowledge bases will totally revolutionize our information services.

In preparing for this talk, I was pleased to note Murr and Williams' discussion on the roles of the future library (1987). Although they were expressing it "from the perspective of library users, especially researchers and those involved in knowledge and information technologies development—the knowledge workers of the future," I find agreement between their summary and that of mine which has been expressed for sometime. "Library," as a place, will give way to 'library' as a transparent knowledge network providing 'intelligent' services to business and education through both specialized librarians and emerging information technologies. Libraries will rely heavily on computers and peripherals to facilitate electronic document imaging, publishing, telecommunications, and information delivery in addition to

networked collection management and reference services."

Major Issues

As I ran over all the powerful technological tools available to us as information consumers of the vast volume of information, I have made several sweeping remarks which must also have raised many questions and doubts in your minds. The transformation of our society by information technology, for more effective flow and use of information, has brought us problems as well as opportunities. It is our responsibility to recognize the many complex issues involved.

- The need for national and international policies on information and information technology;
- The widening gap between information poor and information rich (for those who can afford the use of new information technologies and those who cannot);
- The value of information;
- The neutrality of information technology;
- Educating and training of information professionals;
- Etc....

While we are on the topics of new information age and new information technology, it is important to note that these technologies, while extremely useful to us, do frustrate us to no end as well. They are like fast moving targets, very difficult to aim at. Some people are so wrapped up in forever chasing the rainbow, they forget that new technology is only a tool. It is not an end. We see too many "jazzy" technological products come and go with little success and impact because they are not problem-oriented. They are "dream" products with little relevance to reality.

Libraries are service organizations. Their primary goal is to increase information access. Thus, whatever the fancy, "mod" technological adaptations—whether they are related to computers, optical technologies, such as videodisc, CD-ROM, CD-I, and DVI, or graphic imaging technologies—if they are the answers, ask "what are the questions?"

Conclusion

So I have illustrated how information technologies have had, and will continue to have, a fundamental impact on the manner in which information can and will be used. While it is easy to witness a realization of these new technologies as time progresses, it is important to keep in mind that the whirlwind pace of new technological

developments has generally greatly outpaced our effort and ability to conceptualize and develop new applications. Similarly, so have appropriate educational programs and curricula for preparing our information professionals for the efficient, full and productive use of these new technologies. Thus, the challenge to educators in restructuring our educational conceptual model, in continuously updating our curriculum, in offering continuing education opportunities and in conducting research, is indeed great. Similarly, it is important to keep in mind as well that the changes in individual responsibilities brought about by the most recent technological innovations are occurring more rapidly than in the past, in fact, often more rapidly than they can readily be absorbed into normal information service programs and routines. Thus, looking back over these thirty to forty years, new technology applications in libraries have indeed been a fast moving target. In fact, they are traveling so swiftly that it has been very frustrating for most of us to take aim, the exceptions being those few who possess vision and understanding.

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It is an understatement to say that we live in an interesting time! For the first time ever, lack of proper technology is no longer an obstacle. The computer power, software, storage capacity, and alternative technologies are all available to provide desired information services. What libraries must do is to make sure they do fit into this period of unprecedented, continuous change and adjustment. While the next decade of librarianship will undoubtedly be a period of great anxiety and flux, it will surely be a decade of great promise for information professionals. In order for us to play a central role in this information-intensive and knowledge-centered society, we have to posi-

tion ourselves to develop appropriate strategies which allow acceptance of the challenges before us. Caught in the middle of the information revolution, between traditional academic conservatism and the tantalizing possibilities of the high-tech world, libraries must determine how they cannot only survive but also thrive on the threshold of a new world; how they can develop a vision for a library's future; and finally, how they can define their role in facing a new frontier before others force their definition upon them. This is a tall order!

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