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Information SuperHighway and the Digital Global Library: Realities and Challenges

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關鍵字 (Keywords): 資訊社會 (information society) · 電子圖書館 (electronic library) · 資訊網 (information network) · 資訊
媒體 (information medium)

[Abstract] The fast technological developments in recent years, particularly in the area of telecommunications, multimedia, and digital technologies, have fundamentally changed the way we generate, collect, organize, present, disseminate, share and use information. They have increased sharply our alternatives of fast and effective contemporary roles of all types of libraries.

Throughout history, libraries have transformed store houses of treasures and information resources for centuries to dynamic information centers. Yet, the contemporary roles of these libraries will go far beyond these to the "virtual" domain. Each library has potential to be the dynamic and aggressive information provider of existing multimedia information resources, as well as an effective node of global information network which can provide access to all needed global information.

This paper will extend the concept of "The Digital Global Library" which she has presented in recent years, including her keynote speeches at the 60th Anniversary celebration of the National Central Library of ROC in Taipei, April 1993, and Crimea '94 in Eupatory, Ukraine, May 1994.

In late May 1994, I was asked to give two keynote speeches at Crimea '94 in Eupatory, Ukraine, organized by the Russian National Public Library for Science and Technology and the Ukraine Ministry of Culture. Struck by the theme of that conference, "Libraries and associations in the transient world: New technologies and new forms of cooperation," a subject very close to my heart; caught in the midst of the digital visual information age, and excited in both the great technological potentials and the current development of the global telecommunications networks, I decided to share my thought, at least conceptually, on the "digital global library" as well as its potential for the ultimate global sharing of information resources. A speech on the similar subject was delivered at the National Central Library in April 1993 in Taipei, in celebration of the 60th Anniversary of the Library.

In recent months, with all the emphases and highlights on the coming of the so-called "information superhighway," it seems most timely to elaborate on the topic of "the global library" in light of this "superhighway."

Years ago, futurists like Toffler predicted the coming of a shrinking global village, and today, we are experiencing the true meaning of such a shrinking globe. In recent years, I have made several whirlwind trips around the world, and during the last quarter of 1992, I also made two major consulting trips to 9 countries of the Eastern Europe in a total period of one month. I have been privileged to experience personally this shrinking global village, as well as exposed to the enormously rich information resources of the world. I could not help but to raise a question of very big order, "How can we begin to share these information globally?"

1. An Era of Unprecedented Change

Since the World War II, we have been in an era of unprecedented technological, social and economic changes. These changes have been particularly dramatic in the past decade. Technologically, the advent of microcomputers, optical discs and other mass storage media, worldwide packet networks and communications technology, digital image technology, computer graphic technology, multimedia technologies, compression technology, etc... have dramatically changed the way we live, think, and communicate with each other, and certainly the way we use and view technologies. For example, in the optical technology area, a few years ago, we marveled at the incredible CD-ROM capable of storing 600 MBs of textual information, but now, not only multimedia digital CDs are becoming common place, but the storage capacity has increased multiple folds. For example, IBM announced a few months ago its new layered CD which can store 10 times more information. The fast pace technological developments in these areas, while expected, have surprised many in terms of its widespread scope and inten-

sity.

The new technology buzzwords are everywhere these days, and there is not a single day—regardless whether we listen to the news on radio/TV or read newspapers/magazines at home, or traveling by train or air, or listening to the radio in our car—that we can escape the mention of global village, electronic or digital information superhighway, information age, cyberspace, electronic frontier, etc... In addition, communications satellites, global trade and investment, global technology transfer, and jet travel have prompted dramatic social and economical changes as well. These have pushed the national economies into a more integrated world economy.

2. Universal Information Access

Viewing this situation from the angle of communications, we have passed several "information jumps"—from speech to writing to printing, and now to wire and wireless communications. The last makes effective communications possible on a continental scale, and is taking us toward a global civilization. Take Internet as an example, started in 1969 by the US Defense Department with its humble beginning (the US National Science Foundation took over primary responsibility for managing the network in 1986), once exclusively used by American research scientists and computer specialists for e-mail, group discussion and conduct research—has greatly expanded in the last couple of years and is fast becoming the most effective medium for mass communications. Currently, the Internet is really the SUPRANATIONAL global digital information superhighway—the global communications network, which connects networks of federal, regional, academic, private, and foreign users. It is a network of more than 45,000 networks that form the

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Part of the earlier content was presented at a keynote speech presented at and in the Proceedings of the International Conference on National Libraries Towards the 21st Century, April 20-24, 1993 at the National Central Library, Taipei, Taiwan, ROC; and at Crimea '94: Libraries and Associations in the Transient World: New Technologies and New Forms of Cooperation, in Eupatory, Ukraine, May 23-28, 1994. The Russian Version will appear in the Science and Technical Libraries published by the Russian National Public Library for Science and Technology.

world-wide web. Its membership doubled in 1993 to more than 15 million users and is expanding faster than any one can predict accurately. Most of us are users of Internet and the benefit of this network is undeniable.

As to the wireless communications, expected to be one of the most important technologies of the next decade, it will be as commonplace as wired one within two to three years. With the appropriate hardware platform and proper communications, network and user interface software, packet radio node can serve as part of an "ad hoc" network of other packet radio nodes. Each packet radio system within the network becomes a de facto member of the "ad hoc" network [Mello, 1993]. In most cases, this network is then connected to the larger wired network such as Internet. Wireless communications is driven by two forces--the trend to untether computers from the desktop, and the desire for universal connectivity. Normally, the forces of portability and connectivity are at odds, but wireless communications permits one to have the best of both worlds--freedom from the desktop and connectivity.

Thus, as computing and telecommunications develop and merge, what lies ahead is another jump toward what might be called universal information access. This would mean that anyone, anywhere, could talk, write, confer with, or send both textual and visual information to anyone else in any part of the world. This means that the concept of the digital "Global Library" is not only conceptually sound, but technologically feasible now. With this kind of universal library, we would have access to global information resources which include the collections of the world's great libraries.

3. Where is Information Superhighway Leading Us to?

In a major study of the Information Industry Association in 1989, entitled *The Information Millennium: Alternative Futures*, many major technological changes that may occur during the last decade of this century were identified. Let me list only a few in the following for illustrative purposes:

- Microcomputers (PCs) will have a processing power of 20-40 million instructions per second (MIPS), compared with 1-3 MIPS today.
- 90% of the work now done on mainframes will be done on desktop computers by 2000.
- Optical storage density will increase by a factor of six through data compression and other techniques.
- The phone system will be end-to-end digital, capable of carrying text, data, graphics, pictures, and full-motion video, as well as voice.
- Fiber optics will be the dominant transmission mode for most fixed applications, and fiber transmission into homes will be beginning.

As time passes (only 5 years from that report), it has become clear that some of those predictions have been realized much sooner than expected. As we are truly entering the digital and visual information age [Chen, 1990], and with "information superhighway" is the hottest buzzword, big moneys in the multi-billions are investing by heavy-weight companies to build the digital superhighway for the seemingly exciting interactive future. On May 18, 1994, an interesting feature article appearing in the *Wall Street Journal* [Ziegler, 1994] entitled "Building the Highway: New Obstacles, New Solutions." Ziegler stated that the builders of the information highway have created a media sensation with their plans for wiring America or Europe or other parts of the

world, but to deliver on their promises they will have to meet challenges of unprecedented complexity and size. These include areas related to data compression and storage, the servers, the conduit, the set-top box, the user interface, and the ordering and billing systems. Despite of some of the skepticism on the hype and reality of our interactive future, one thing is sure. With all the money bumping into this effort, we will have a digital superhighway. Yes, the technologies will be soon available to enable us to link all the global information together to form "The Global Library" for multimedia information delivery. But, are we ready to have our information resources available in digital form so that they can be linked together by utilizing the available technologies? All the products and services which attracted BIG investments in billions and millions of dollars are now related to the delivery of popular, game-like, and entertainment type of products. Video-on-demand is in hot pursuit. Companies--big and small--including Microsoft will introduce hardware, software, set-top box, etc... to enable consumers to receive digital video-on-demand programs at home or other locations from multiple channels. It is expected that by the end of this year, likely 100 some channels will be available to deliver this type of multimedia programs, and in one or two years, over 500 channels will be available. If so, is this digital information superhighway, which we are so much looking for, is more suitable to be called digital *entertainment* highway? To prevent this, information professionals like us need to build our own high-speed quality "cars" to ride on this highway. Here, for "high-speed," I mean "digital" or "electronic", and "quality," I mean content-based and knowledge-based, as well as multimedia and not just print based. Have we begun to think about this and to plan to build this? This is the cen-

tral question! If not, how can we work toward that?

4. Shift toward a Learning-Oriented Society: the New Emphases

With all the unprecedented changes, it should not be surprising that there is an increasing demand for better access to needed global information to enable us to have a bigger picture on the world in which we are living in, a better global view on our environment, our history, our cultures, our economy, our science and technology, etc... Thus, information, has become the key to productivity, and there is a shift toward a knowledge-based learning-oriented "creative society." In this type of society, we are witnessing the following change in emphasis:

- Societal values change from "acquiring" to "learning"
- Growing motivation of individuals for knowledge
- More people learn to use information creatively
- More demand for multimedia information
- More demand for global information

It is clear then that a changing society characterized by continuing technological progress, societal and economic changes will definitely pose new challenges to libraries. It demands our libraries to transcend traditional methods of providing information access within the confines of library's physical structures to providing access to services and global information resources to people at home, in school, at work, or any place so desired by them.

5. The Contemporary Role of Libraries

What is the changing role of libraries in this new information age then? In 1986

when I discussed the current day's libraries in the midst of a period of unprecedented change and adjustment, I advocated the need for libraries to shift focus to include the following directions in addition to our basic functions [Chen, 1986]:

- From library-centered to information-centered.
- From the library as an institution to the library as an information provider, and the librarians as a skilled information specialist functioning in an all-related information environments.
- From using new technology for the automation of library functions to utilizing technology for the enhancement of information access and delivery not physically contained within the four walls of the library.
- From library networking for information provision to area networking for all types of information source providers.

Basically, these directions have not changed since then. However, we can further expand accordingly with the following shifts: —

- From information-centered to knowledge-centered
- From information access to selectivity of the most relevant
- From centralized information systems to distributed information systems
- From national networks to a global "network of networks"
- From a focus on libraries being the warehouses of library materials to focus on the "content"
- From technology that supports the library staff to technology that empowers the library user
- From the adaptation of individual technology utilization to technology in-

tegration in libraries.

6. The Need to Form Global Coalition

Up to now, unquestionably, for centuries, all national libraries in the world have been store houses of their countries' treasures and rich information resources, and all major academic/research libraries have attempted to boast for their resources judged by the volume and/or size of their collections. Quality of library and information services have seemed to be closely correlated with the quantity of available print-based information resources. But, the contemporary roles of libraries have to go far beyond those of the store houses. Each library needs to be the dynamic and aggressive information provider of both its country's enormously rich information resources, as well as an effective node of global information network which can provide access to all needed global information. Each contributes effectively toward the eventual realization of "The Global Library", in which national, research/academic, as well as other types of libraries in the world can be linked together as nodes of the worldwide information network. At the 1994 Annual Meeting of the American Library Association (ALA) in Miami Beach, Florida in June 1994, ALA issued its Fact Sheet on Libraries Online. It stated:

"Across the country, school, public and college libraries offer public access to worldwide data networks and serve as information clearinghouses accessible by computer from home, office or dorm room. And libraries are as likely to assist in using this new technology as they are to recommend a good book."

While it is encouraging to know that some American libraries are working toward the "Global Library," yet there is still a very long way to go. In order to assume the contemporary role of library as articulated above, the integration of new information technology becomes essential. Instead of staying on the early stage of technology applications by simply applying new information technology to traditional functions, processes and procedures, such as cataloging, circulation, OPAC, creating conventional databases, etc., the libraries need to use the new, exciting technology as a means of changing and/or expanding what they do, not just how they have done it. The multiple convergence of various types of technologies—with powerful central processing units, versatile and inexpensive micro-processors, very high density storage devices particularly the optical media, facsimile transmission, improved graphics imaging and printing, powerful software development, multimedia applications, wire and wireless communications, etc.—is enabling us to rethink how people gain access to all types and formats of information in non-traditional ways.

In the current environment, in order to adapt successfully to the technological, social and economical changes, there may be a need to change our keyword from "access" to "selectivity". If our multimedia information resources are available in digital format as alluded earlier, then, there are many important and immediate questions which need to be addressed. The most immediate and important ones are:

- How to make our information resources available in digital form so that they will be available for sharing digitally?
- In the big ocean of digital information, the most important thing will not be the access of this big ocean, but will be "how to find and retrieve the most

relevant from this big ocean?"

Answers to these are not easy, and they are great challenges for all information professionals. In addition, what seems critical for adapting to the changes is not so much access to data or information of every sort, but rather a new level of knowledge and wisdom. Clearly, major national and research libraries will be on the front lines of meeting these challenges. Instead of each library worries about its own development, we need to think of utilizing new information technology to have a new form of co-operation in the broadest sense. The need for global coalition building should be great. This will make possible the global linking of multimedia information toward an eventual global digital knowledge base ["Multimedia and The First Emperor of China... ", 1994].

7. The Global Library Scenario

In early 1993, I presented the network connections of "The Global Library" in an over simplified illustration as shown in Figure 1 (Chen, 1993). Take the national libraries as examples, global communications make it possible to connect these libraries from different part of the world together. They become regional "knowledge centers" which can access information from the entire global "network of networks." High-density optical storage in jukeboxes makes a vast increase in global collection size possible. With the availability of a high-speed and broad-band global communications network, cutting-edge technologies such as multimedia and digital imaging, can be linked, so that texts, images, digital videos and voices can be transmitted from one part of the world to the other.

At the same time, however, nationalism becomes a stronger theme: building national collections, serving as an information source for national government, collecting national

history, culture etc. The use of multimedia and Knowledge Navigator enable the delivery of these information as well as information of other countries to citizens' homes, schools, and offices. In this kind of environment, the knowledge world is going from a paper culture to an electronic one, and libraries will be deeply affected. In other words, printed information sources, such as books, journals, and archival materials, will not be enough. Digital information sources become essential.

2. How to Work toward This Global Library?

Currently more and more libraries are starting to create limitless digital bookshelves. For example, as reported in a *Wall Street Journal* article, some law libraries in the US are busy in tearing pages of their books and journals in the stacks and scan them. While it will be decades before libraries become totally electronic, some of these libraries are starting to create limitless digital bookshelves of information sources and thus making good progress toward electronic digital libraries [Bulkeley, 1993]. For example, 'the Columbia University Law Library in New York is creating 'Project Janus', a 'virtual library' that can find and display on one computer screen the full text of any document among millions stored digitally as optic images. The project is the first library application of digital full-text search and retrieval stored images" (America Library Association, 1994).

Once the information sources are available in digital form, they can be accessed, distributed, and transmitted easily in almost "no" time with "no" cost to the end-users over the global information network, such as Internet. Users around the world can also ftp (using the standardized file transfer protocol over Internet) to any specific elec-

tronic archive to obtain needed information and download it. With this kind of convenience, we are witnessing the fast proliferation of electronic journals and publications over the Internet network, (Chen, 1994).

In a bigger national scale, for example, the National Agricultural Library in the US just proclaimed its commitment to "Electronic Library". It has announced that on January 1, 1995, electronic information becomes the preferred medium for library materials in an all-out push to make NAL's services and its collection available in various electronic format worldwide. NAL is making this commitment because of its belief that "the current paper-based information delivery system is inadequate to keep pace with the needs of the modern agriculturist." The NAL *Statement of Commitment* contained in the *Phase 1 Final Report of the Electronic Information Initiative* stated "Increasingly, information is produced in digitized form, and with recent telecommunications innovations and the Internet, the resources available to the computer literate researcher are expanding exponentially... [Consequently] NAL is taking the initiative in a systematic program of managing data in electronic form and establishing strategies for collecting, storing, and distributing U.S. agricultural information in electronic form". (NAL..., 1994) For more detailed information on this development, the readers are referred to this NAL report, (US National Agricultural Library, November 1993). This report can also be obtained electronically by ftp to the NAL.

With a major national library, such as the NAL, starts to take lead in going "digital" in this big way, for sure there will be more and much more to follow.

There have not been sufficient discussion on the possibilities of including high-resolution digital images and videos in real library applications, but this is also forth-

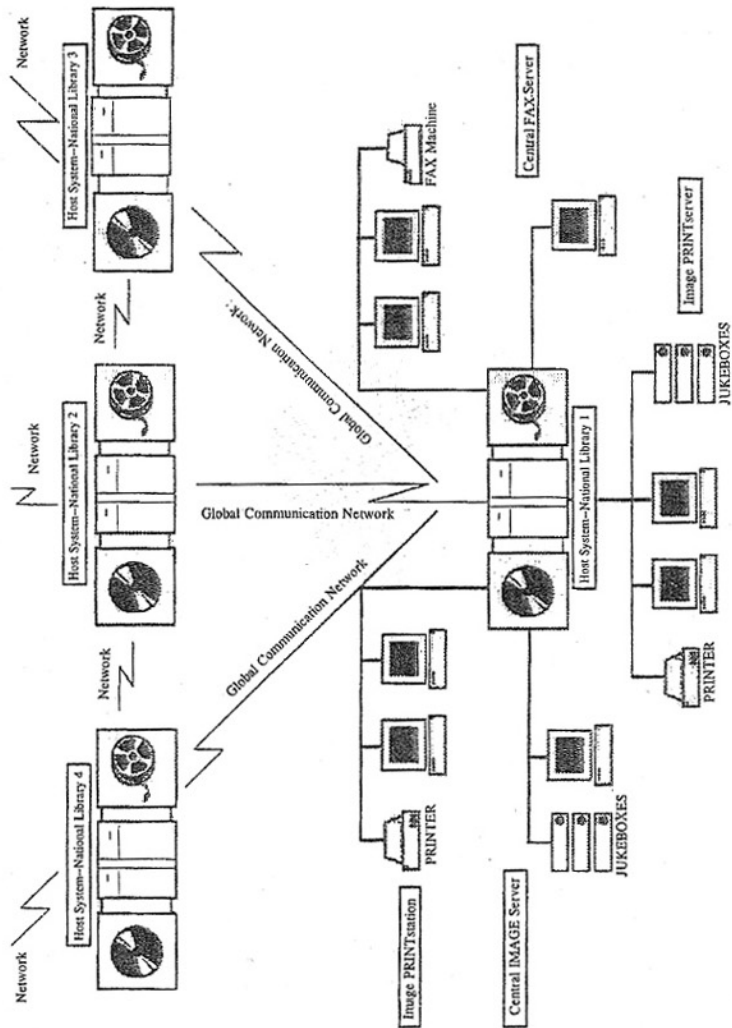


Figure 1. The Global Library - Conceptual Diagram

coming in a matter of time. While there are more technological hurdles to overcome in dealing with digital image and video information for global sharing and transmission, they are not impossible. In fact, high-tech industry players are investing heavily in these developments, and positive technological results can be obtained in a matter of months.

9. Barriers to the Global Library

As expected, there are many barriers to implementing The Global Library. In 1987, when discussing the barriers to international information exchange at the first Pacific Conference on New Information Technology organized by me in Bangkok, Roland Brown, then President of OCLC, stated that despite the numerous obvious benefits, there are also substantial barriers to international library networking and resource sharing and to user access to international bibliographic and other information resources [Brown, 1987]. These include: ...

- * National policies that tightly control, discourage or even prohibit transnational data flows,
- * Lack of interest on the part of information professionals to exchange information-- a lack of vision,
- * Lack of common standards for both manual and machine-readable cataloging, interchange codes, protocols, character sets, etc...
- * Distance and the availability and cost of telecommunications;
- * Lack of foreign exchange to purchase equipment, SW and data acquired from outside the country,
- * Language,
- * Difference library customs,
- * Difficulty in finding supportive local environment.

All these barriers for international cooperation were related to more traditional type of library cooperation, yet they also exist for the electronic Global Library. In addition, there are many more logistical, political, technological, and economical issues as well, which is beyond the scope of this paper. For the technological obstacles, as mentioned earlier, Ziegler(1994) offers a good summary on all related areas including:

- * Data compression, storage
- * Servers
- * The Conduit
- * The set-top box
- * The user interface
- * Ordering and billing systems

10. Information Superhighway: the Good, the Bad, and the Unavoidable

The great potentials of the information superhighway for fast global communications and information sharing need not be further elaborated. All of us are either current or potential users of Internet, thus are well familiar with the "GOODs" of the information superhighway. Yet, nothing is "perfect." As we are in the midst of the evolving digital process, witnessing the planning, the construction, and the eventual offering of this superhighway, we, as library and information professionals, have to be increasingly and seriously concerned on the potential use of this highway of all highways of digital information. Let me elaborate on some of the potential "BADs" of this development:

- * Digital and communications technology experts and even the end users of the current Internet all agree that all types of technological difficulties will be overcome if not already. The real problem will be "content". There are

simply too much "junk" information traveling on the information superhighway now, and more will be introduced. "Conduit" problems can be worked on and solved (Ziegler, 1994), but "content"-related ones are much more complex to be solved easily.

- * "Content"-related problems will related to many difficult areas, such as:

- Too much information in an "information chaos" environment, how to sort them and retrieve them? Do we have "smartware" to do this effectively, easily and quickly?
- How to differentiate the valuable information from the "junk"? Is there an easy way to filter information -- to find the nugget from tons of mud and sands? What are the criteria used?
- Is "information-on-demand" a bad idea? Our answer is likely "no" or "not always". Then, how can information generated from libraries and information centers become the "information-on-demand" type, or, at least, how to compete with the real money-making-"information-on-demand"?
- Will information superhighway eventually become "Entertainment" superhighway, as raised earlier? How can the serious "educational" information compete with the popular "video games"?

It is important to point out that the commonly recognized builders of the information superhighway are the Baby Bells, big cable companies and long-distance concerns (Keller, 1994). Some of them have announced the huge sums--\$33.0 billions for Ameritech, \$20.0 billions for MCI, \$16.0 billions for Pacific Telesis, \$11.0 billions for

Bell Atlantic, \$5.0 billions for Time Warner, \$4.4 billions for SNET, etc... These are indeed huge sums, despite of the fact that they fell short of the earlier estimated commitment of \$107 billions. Because of this consumer-based development, every potential market player is more than eager to grab a market share and to make quick money.

Aside from the conduit, the current money-making "contents" have been mostly "game" and "entertainment" oriented, with computer video game companies such as Nintendo and Sega joining force with Hollywood motion picture makers, such as Paramount, etc... The current "players" are eager to exploit this information superhighway, and advises offered are plentiful in all high-tech weekly journals, such as Guy Kawasaki's column, etc... (Kawasaki, 1994). He said, "AT LAST, I'VE FOUND SOME thing good about the information superhighway (aside from providing computer columnists with topics to write about): it's a wonderful opportunity for Macintosh multimedia mavens to make money off Hollywood. Hollywood's got content, but they need you to make it a digital reality..." Thus, the UNAVOIDABLEs for the information superhighway is the fast production and the massive delivery of more and more multimedia information-on-demand, which including more and more high-tech driven computer games, videos, Hollywood type of entertainment contents, and commercial information. As the industry reports a minimum of \$1-\$2 million dollars investment for a single video game title, and millions and billions of huge sum investment to push for the production of entertainment and on-demand products for the information superhighway, library and information professionals do have every reason to be seriously concerned of the incredible lack of funding support for the development of more serious "educational" applications. In fact, we should

worry not only for the potential gloomy future of the libraries as equal players on this information superhighway which will be jammed with market-driven contents, but also for the entire nation where education has been at risk for sometime!

11. Conclusion

Despite of the potential difficulties, barriers, and challenges mentioned above, one thing is sure that the technologies and the infrastructure are in place now for us to experiment an universal library. For the first time ever, lack of proper technology is no longer an obstacle. But, technology is not the end in itself rather the means to an end. We should not suffer from the loss of direction caused by preoccupation with technology.

Thus, at these crossroads, in addition to speculate on the libraries in the next millennium, what we must do is to make sure we can develop in this seemingly exciting networked environment, a vision for our library's future, and define its role in facing a new frontier. It is important for us to visualize that not only all types of libraries in our country would be connected to the super-network, but also globally all libraries would be part of the network as well. Furthermore, through the global information superhighway, digital information resources of all subjects, types, and formats would be available and accessible to anyone on the earth who wants it. We have a long way to see these "dreams" come true, but we must have these "dreams"!

Caught in the middle of the digital information revolution, between traditional academic conservatism and tantalizing possibilities of the high-tech world, the right vision will chart the right course of our library and information developments, and ensure us that we will fit into this period of

unprecedented, continuous change and adjustment, and not be lost in the shuffling of this new digital visual information age, and be totally swept by the tidal wave of the "EntertainInfo" powerhouses.

Our challenges are indeed great! We have too much to lose by failing to accept and to act on these challenges!

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Biographical Sketch

Ching-Chih Chen, an international consultant on new technology application for information management, is Professor and Associate Dean of the Graduate School of Library and Information Science, Simmons College, Boston. An author and editor of 25 books on information technology and management, the founding Editor-in-Chief of *Microcomputers for Information Management*. An active researcher, she has directed many new information technology projects, including the internationally known interactive multimedia PROJECT EMPEROR-I, a project utilizing the cutting-edge hybrid microcomputer and optical technologies to enhance the public understanding of humanities. The Voyager Company has published an abridged version of *The First Emperor of China* videodisc together with its multimedia software (winner of the prestigious Cindy Award of the Association of Visual Communicators) as well as a digital multimedia CD-ROM for both Mac and Windows platforms (chosen by MacUser as the 1994 world '60 Best CD-ROMs). Dr. Chen has served on the advisory board of many international conferences and high-tech journals including the Electronic Library, and is the Chief Conference Organizer of a series of non-profit International Conference on New Information Technology in Bangkok (1987), Singapore (1988), Guadalajara, Mexico (1990), Budapest (1991), Hong Kong (1992), Puerto Rico (1993), and Alexandria, Virginia (1994). She has received many awards and honors, including the Outstanding Information Science Teacher Award of the American Society for Information Science, the Library Information Technology Association's LITA/Galord Award for Achievement in Library and Information Technology, LITA/Library Hi Tech Award, the Distinguished Service Awards from both APALA and CALA, the Distinguished Alumnus Awards from both the National Taiwan University and University of Michigan. She is also a Fellow of the American Association for the Advancement of Science.