The Changing Role of Librarians: Managing New Technologies in Libraries

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Abstract

Never before have there been so many opportunities for involvement in an information-based society including electronic and multimedia publishing; local, national, and global networking; development of navigational and filtering tools for access to networked and non-electronic sources; and new modes for delivering information and educational programs. The base of recorded information is growing at an accelerating rate, in increasing varieties of formats (texts, numeric, graphic, video, audio, image, electronic, etc.). Furthermore, an increasing array of computing and telecommunications technologies are emerging to create new options and opportunities for the development of information capture, storage, retrieval, and delivery systems/services. These developments point toward increased difficulty for the information user to obtain needed information in the required time-frame, quantity, and level of detail.

The role of information specialists is to facilitate the interactions between the potential information user community and the body of recorded information. The traditional information access and management roles played by the information professions are expanding, particularly in the design and development of new information products and services and of tools to support information seeking and selection, the analysis and synthesis of information content on behalf of users, and information user instruction. The emerging recognition of companies as learning organizations, reinvention of government agencies, new directions for education in universities, colleges, and schools, promise new opportunities for information specialists to reinforce and expand their facilitation of communication and learning processes in their organizations and communities.

1 The Changing Environment

Before we talk about the changing role of librarians, it seems appropriate to talk about the rapidly changing environment in which librarians are expected to operate. Clearly, we are moving from an industrial age to an information age; the trends in this direction have been documented for many years, first by Fritz Machlup and subsequently by Daniel Bell, Marc Porat, and others. Most industrialized nations can document that approximately half their work force is engaged in information-related activities. One needs to be careful about how to interpret these statistics, because what is counted as information-related activity varies quite broadly, but on the whole we are clearly moving in this direction, and information and knowledge workers are increasingly important in our respective economies. Another major change that has had an impact on the way librarians work is the modern computer, and hence the technical push with the growth in the amount and production of technical and other documentation. Computers have been able to help in the processing, storage, and management of information, and their application is increasing even more dramatically at present.

One of the major events that has had a significant effect on the way librarians function and perform was the evolution of semiconductor technology and the development of the microcomputer in the mid-1970s. The change this precipitated is significant. First, fairly high-powered machines became available at relatively low cost, and we have continued to see the increase in power per financial unit (dollars, pounds, marks). But perhaps even more significantly, the microcomputer signaled a basic revolution in the way we as humans perceived computers. Up until that time, we had been dealing largely with mainframe computers and larger minicomputers, which required massive supporting systems, cooling systems, etc. The machines were generally locked away in a machine room, people didn't have much access to them, there were all sorts of concerns about "Big Brother", and basically, the machine was perceived as a large, almost mythical being. But with the advent of the microcomputer, our perceptions changed, because for the first time, computers were smaller than we as humans were. In a sense, a power shift occurred, not a real one but a perceptual one, and for the first time people realized that if they did have problems they could simply unplug the machine, which was something that no one would think of doing with a large mainframe. We began to see from that point onward the popularization of computing: every newspaper, every magazine, everybody talked about computers and what they could do for us, whether or not people were actually using them.

In parallel, there was another major development, the evolution of telecommunications and computer networking, which evolved from dedicated fixed connections to circuit switching, and then more recently to packet switching. Circuit switching has actually been around for quite some time. The United States, for example, saw the evolution of the uses of networks from ARPAnet, which was used heavily by defense installations and research universities, to what we called NSFnet, which linked more universities to those networks, to the Internet, which includes a variety of institutions. In 1990, the concept of the national research and education network evolved, which was supposed to link government agencies, government installations and research labs, and academic and educational institutions, from K-12 through the university systems. More recently, in 1992, the concept of NREN evolved to become the National Information Infrastructure and subsequently the Global Information Infrastructure, which for the first time perceived a major role for the private sector in the development and evolution of the global network.

The power of these two converging technologies of increasingly more sophisticated and powerful computers at very reasonable prices, and the evolution of networks to include both wired and wireless networks, as remote mobile communications increases, offers opportunities that have never before been available. Some of the ideas and thoughts that librarians had in the 1960s and 1970s and even in the early 1980s that were not feasible for implementation in the technology of the day now become much more realistic in terms of today's technologies. The opportunities are there for us to take advantage of the technology.

2 What Does this Mean for Information Professionals?

It seems appropriate, when looking at the future, to consider core competencies or core functions. This is the approach taken by businesses when they consider new directions, or diversifying their customer bases or the services and products they provide. I have recently been looking at the concept of education and training for the library/information discipline, and have identified three core areas. First, as librarians, we deal with recorded knowledge. We tend not to deal with unrecorded information transfer, but we certainly deal with all kinds of recorded information, data, and knowledge bases, regardless of the media and formats in which they are recorded.

We also deal with the world of users. In fact, we represent a discipline that has been truly concerned with the information needs of users. We distinguish ourselves from the communications disciplines by dealing on the whole with individual users or small groups of users, rather than with mass communications, although with the development of networks this focus is changing. The potential for the delivery of information services to mass audiences across the Net is significant.

The third function that we deal with concerns tools and technologies. One of the difficulties that librarians have is that we deal with newly emerging tools and technologies as well as the tools and technologies that have gone before. Because we deal with information that is recorded in a particular format and in a particular medium, we have to have the capability, the tools and technologies, to decode the information that is captured in that form. We must recognize that a new technology rarely replaces prior technologies; it tends to just displace them. One of the great challenges for the information profession is to keep up with new and emerging technologies and also to maintain the knowledge bases to deal with the older technologies.

The role of information professionals is to mediate the interface between users and knowledge resources, using tools and technologies. The purpose of that interface is to provide access to knowledge resources to individuals or groups of users. Basically, we can say that our domain, or our core function, is the mediation of this interface between the users and their needs, and the knowledge resources that exist, and we do that using a variety of tools and technologies. When I say "tools and technologies", I'm not talking specifically about computer technologies. The tools include such things as classification schemes, indexing systems, data structures, directories, metadatabases, and so on. There is a variety of tools and technologies, not just computer-based and telecommunications technologies.

3 What Does "Mediate and Provide Access" Mean?

We use the tools and technologies to create information, and this is an increasing role – we do create information, at the primary, secondary, and tertiary level. We collect information, in various formats and various media, and we organize information into an intellectual context. We also physically organize materials, and package them so that we and others can find them when needed. We store them in a variety of modes; we retrieve them on demand. We analyze, interpret, and synthesize and package the results of that process for varied user communities, and we deliver the information to them. We also have a role in preserving information for future use.

We also are increasingly involved in designing and building tools to provide access; designing and building systems that will help support that process; and building interfaces of various kinds, automated and human, between users and knowledge resources. We also create, design, build, and structure the knowledge resources themselves. Clearly, we perform a number of different functions that contribute to the role of mediating and providing access to information.

4 Definitions in a Digital Environment

What happens to these functions in an increasingly digital environment? In the creation process, we are seeing an explosion in the development of desktop publishing and network applications, and increasing movement towards electronic publishing, although I believe for some time we'll continue to see print-based publishing. Increasingly, we will see more and more electronic publication including publications that are available only in those forms, but we will continue to deal with print-on-paper for some while.

In capturing information, we have a role in conversion. It does seem to me that one of the areas that we have not paid enough attention to is the ability of the technology these days to capture information in one form and to deliver it in a different form. There are real opportunities in taking in textual information and displaying it visually or creating audio versions or creating other forms for presenting information to the user.

In collecting information, we will see significant changes in the way librarians function. Increasingly, we will have to address the question of what is actually acquired to build collections and what is accessed remotely on demand. The concept of a collection will change, as will the concept of a core collection for an organization. Typically, core collections have been defined in terms of subject matter, but in this new digital environment, or increasingly digital environment, we will see a definition based on access time. In other words, if you can access materials that are very relevant to the nature of a particular organization's business, and you can access them within a reasonable turnaround time, then it will not be absolutely necessary to physically house the core collection on site within the organization. This issue of ownership versus access is critical to, and will be different for, each organization. Decisions will be based on a combination of amount of use, turnaround time, ease of access, and cost, and the formulas will have to evolve in time.

The organizing of collections or of information content will continue and will grow in importance as multiple formats and new complex objects evolve, such as those associated with the human genome project. This international project contains significantly deep structure and complexity embedded within the database. Geographic information systems also contain very broad and deep structure and information embedded within that structure.

Information professionals will need to continue to organize both from an intellectual content perspective and a physical package perspective. Even if we are accessing information on the Net, it is necessary to know what resources exist, what they contain, how they are structured, and how to actually physically gain access. We will continue to provide this level of organization for both individual items and, perhaps increasingly, for entire collections, because as more and more information and knowledge is made available through the networks, it will be increasingly important to understand, at multiple levels, what is available. Directories about collections are starting to emerge, but the accompanying item-related information is not there.

We will continue to store information in multiple formats. Some research has been performed on the most appropriate way to organize information in multiple formats. However, the issue of scaling needs to be addressed. This critical issue relates to the capturing and storage of large volumes of information, as well as the retrieval performance for very large databases. Until now there has been no way of testing whether existing retrieval algorithms will work at the level of scale of databases that are being envisioned. Some of the emerging digital library initiatives to build large digital collections should provide the testbeds to evaluate existing algorithms. It could be that some of the existing algorithms will be robust enough to provide efficient and effective retrieval, but we may have to develop new approaches to retrieving information from these huge databases and across heterogeneous collections in a networked environment.

The function of analyzing, interpreting, synthesizing, and packaging information on behalf of users will increase in importance. It is a function that librarians have tended on the whole to shy away from in some environments. If librarians do not agree to take on this function, then others will come in and fill the niche. End-users simply cannot cope with the amounts of information that are currently available in their fields, let alone what is going to be available. Increasingly, we need people who have subject expertise in particular areas and who have the skills of finding and retrieving specific information to analyze the retrieved content and create syntheses for users. This is one of the functions that information brokers and information analysts have performed, and it is perhaps the potentially largest area of growth for our profession. In educating information professionals for the future, we are recruiting people with specific types of subject expertise; at the University of Tennessee, for example, we are focussing very heavily on the scientific and technical environment, on children's and youths services, and on the corporate information environment.

In terms of delivery of information, emerging technologies offer the potential to customize the formats for presentation of information according to the specific needs and preferences of the end-user. There is no reason for all users to have information presented in a uniform manner. We are now seeing the emergence of customized interfaces for groups of users, for example, the Scholars' Workstation. Increasingly these projects are diversifying so that we might see an engineering workstation, an architect's workstation, and so on. It is likely that we will begin to see individually customizable interfaces to electronic information systems so that users can gather and have information presented in their preferred manner. There are many different styles for learning and assimilating information, and we need to optimize systems to our own learning styles. The technology can and should be used to effect that optimization.

Finally, preservation is a function that will continue to be performed. Regardless of the format or the medium in which information is captured, it will need to be preserved for future use. There are significant issues over digitally encoded information. In an environment that facilitates changes in information materials, major issues over the preservation and archiving of those materials will need addressing. Consider as an example an electronic encyclopedia – one that is only available electronically. It might be updated in a continuous fashion, but each entry should have the equivalent of a time series. You wouldn't want to overwrite an entry, because the value of an encyclopedia is not only in its currency but also the historical trail of how things have evolved. So, in this example, time adds an extra dimension to a multi-media document.

5 Functions That Will Increase in Importance in a Digital Environment

The functions that I believe will grow and become more important include creation; increasingly, librarians will become publishers. They will create more and more bibliographies, guides, and syntheses, and higher-level abstractions of information content, directories, and so on, and will increasingly be involved in the creation activity.

Increasingly, we will need to focus on the intellectual organization, both at the individual item level and at the collection level, simply because it is going to be too much to deal directly with the item level across the networks. However, the collection level alone will not discriminate enough to make access and retrieval efficient at the item level.

The analysis, synthesis, and packaging processes are going to increase dramatically. This has been the situation for a considerable period of time and these activities are going to continue to increase as the amount of information and the number of available resources grow.

Interface design, as I have indicated, is going to become increasingly important, and increasingly relevant to the way people access and use digital technologies.

Finally, user education and training have become a very critical part of the environment. We will have to expand what we cover in user education and training. We tend, on the whole, to promote the technology we give users – competencies to use specific systems and resources. But we need also to give users understanding of the range of resources and systems available to them, of the limitations as well as the capabilities of those resources and systems, and, most importantly, of when users should help themselves and when they should seek help from information professionals.

6 Some Popular Myths about Information Access

This leads naturally into a discussion of popular myths being promoted about the way people are going to access information. The first of these is the myth of end-user searching. It's been quite some time now since librarians began training end-users to perform their own searches; I haven't yet seen an organization where the demand for searches by the information professional has decreased. What has actually happened is that the total amount of searching has increased. The amount of end-user searching increases, but end-users, having been trained and having performed some of their own searching, become aware fairly quickly of the complexities of searching, the limitations of some of the resources and of the searching process. They become much more capable of expressing their needs relative to the systems that currently exist, and they realize that keeping up with changes in these systems takes valuable time. So the net result is a more educated user who continues to perform simple searches on his or her own behalf, but then returns to the librarian or information specialist to perform the more complex searches. The effect on librarians has been an increase in workload because the searches they are asked to perform tend to be the more complex ones and the amount of time per search has increased. There will always be a role for the search intermediary. Studies have shown, increasingly, that information professionals consistently search more efficiently and more effectively than end-users do themselves, so those searches which are not straightforward will always tend to be delegated to an intermediary.

The second common myth relates to user-friendly interfaces. Computer companies and system developers consistently imply that computers and computer-related resources are very easy to use. The concern that I have is that the simpler you make the interface for the user, the more complexity is hidden behind the interface. A very good example is the menu-driven online catalog interface, where the user is able to go through a menu, and at one point is able to conduct a search by inputting words. Very often, the user is able to input multiple words. What the user isn't told is that those words are then subjected to the Boolean "and" search; therefore, when the system indicates no hits, the user assumes nothing is there, rather than that the combination of words used simply does not exist in the same record at the same time. This is not to say that we should not develop user-friendly interfaces, but that part of our role is to educate and train users to understand that while the interface may appear very simple they need to have some general understanding of how the interface works, and what is happening to their interactions with the interface, to truly understand the results they get from it. If they are going to perform some of their own searches, then they need to understand the interfaces.

The third myth is a tendency to presume that we are going to move almost exclusively from today's environment into a fully digital future. For example, there is a tendency to think that with the growth of electronic publishing we will see the end of print-based publishing, or that as we move to a digital environment, we are going to see only digital libraries. In considering futures, there is a tendency to set up the world in terms of irreconcilable opposites: all or nothing, black or white. In fact, what tends to happen is that we have a little of everything. I have already indicated that this has happened with technology: new technology does not completely replace prior technology; rather, we have to deal with most technologies that have been used to capture, store, and deliver information. There are very few technologies and very few formats that will cease to exist. Thus, we tend to be left with legacy systems and legacy formats, and have to deal with them. At such a time when conversion costs decrease to a reasonable level we may see more conversion to a uniform format/medium; on the other hand, we will continue to preserve the original formats for historical legacy.

7 Functions That Will Diminish in Importance

Some functions will become less important over time, although I don't think we will see any of the functions of librarians disappear. In fact, I recently developed the theme in talking about the future role of librarians, that the more we see change, the more we see things stay the same; instead we see a change in emphasis. Functions that will perhaps become less important relative to those that will increase in importance include collection building, because increasingly we will be able to have remote access on demand.

Physical proximity to collections, and even to users, is likely to diminish, as we become more able to deliver information electronically to the desktop. This is not to say that the libraries as places will cease to exist, because physical collections will continue to be needed and users will need a place to browse and conduct secondary research. The same users who are demanding increased desktop access and delivery of primary information are, in fact, also indicating that they have an increased need for the physical library.

The function of circulation will also likely diminish. As more and more materials are available electronically, the concept of taking things out of circulation will of course diminish, as physical collections diminish.

8 Information Professional of the Future

Most importantly, the information professional of the future must continue to be user-oriented and maintain a focus on the user and not become distracted by the knowledge resources. Secondly, as a profession we must become much more proactive in delivery of information to the user. Thirdly, we need to be team players. Librarians are increasingly going to participate in and be critical members of user teams. This is related to the need for increased analysis, synthesis, and packaging of information on behalf of users. In fact, I believe that most teams within an organization should have an information professional who is responsible for the information-gathering function of the team. Some organizations are beginning to reorganize library staffs to be able to do that.

9 Barriers

There are a number of barriers to this evolution toward an increasingly digital world. The first and most obvious one is the lack of available digital collections. There are some digital collections, though they tend to be small at present relative to their potential size and scope. The digital library initiatives in the United States (funded through the National Science Foundation) and hopefully similar ones that will follow in other countries are efforts in the right direction. There is a difficulty until a certain critical mass is reached in that we cannot test performance at scale, we cannot test retrieval algorithms, storage devices, delivery mechanisms, and so on. So the digital environment will evolve over time, and we will see an increasing amount of digital information and digital collections available.

I've mentioned the barriers of scalability and performance at scale. Research is needed, and relates, of course, to the first barrier, the lack of digital collections. Fortunately, we are beginning to see movement towards not only individual clusters of research initiatives to build digital collections, but also the networking of those efforts so that a larger virtual digital collection is created for testing.

Another barrier is that while we can talk about the Internet and the growth of networks around the world, there is still a considerable lack of infrastructure at the local level to support the sorts of capacities that are going to be needed in the future. That's like building a huge highway without creating the on- and off-ramps at appropriate widths. If you only have a footpath onto a highway, traffic will back up at that intersection. Similarly, if you don't have a computer that is fast enough, or that has enough internal memory, to cope with the volume and the nature of the information you are delivering, it is like having a bicycle on the highway – you can't maximize the advantage of the highway. Organizations need to think through the types of information they anticipate getting from the networks: increasingly, we will be looking at full-text, complex objects, and multimedia. We need to begin to think about what infrastructure and support will be needed locally to take that off the main highway and deliver it to the end user.

There is also a certain lack of education and awareness about the future role of information professionals. The notion of direct end-user access to digital networked information without need for intermediary support continues to be expressed. However, end users are beginning to exhibit a certain amount of discontent, an awareness that the quality of resources available on the Net is very different and it can be difficult for the end user to spend the time to discern what is of good quality. This is the niche, the role, that I see for the information professional: to be aware of and to maintain and keep up with the resources that are becoming available, and the ongoing quality assessment of those resources.

10 Conclusions

We talk about the Information Superhighway in the United States, and I know you talk about the Infobahn here in Europe. Perhaps I can position the role of the librarian in that metaphor. It seems a little simplistic, but sometimes it is a useful way to explain our role to others.

The roads, with their intersections, overpasses, etc., are built and maintained by the telecommunications companies. They interconnect locations. The vehicles by which you get from one point to another on that highway are built by computer manufacturers and systems developers. Services of various kinds equivalent to gas stations, hotels and motels, etc. are provided by the content providers: publishers, database producers, and increasingly and probably most overwhelmingly by TV and movie production companies, and so on.

We, the librarians and information professionals, provide the road signs, and hopefully more intelligent road signs than those we see now. For example, it would be very nice to know not only that an exit off the highway goes to a particular set of locations, but also that there are specific restaurants and motels, etc. at that exit. It would also be helpful to know if the motels have any rooms available, what they cost, which restaurants there are, what they have on their menus, and so on. I'm talking about getting to a much deeper level of directory and catalog entries, down to the individual data items and data elements.

We also supply the route guides not just the road signs but the maps and the sorts of guides that say how to get from A to B. In other words, if you are a biologist, here are the sorts of resources you might be interested in, and here are some guides to accessing them. We have a role in the design and development of navigational systems that are appropriate to specific groups of users.

But perhaps most importantly, we are responsible for driver's education. We should think very seriously about this role that we have in educating and training end-users. It is going to be most critical for the success of our profession in the digital environment. If we can educate users appropriately, they will recognize when they can drive themselves around the highway, and when we have to drive for them. I indicated that the librarian can search for information both more efficiently and more effectively than the end-users themselves. So in this metaphor, we are like racing car drivers, like the Formula One teams that can zip around this highway, because we know all the twists and turns, all the on- and off-ramps, and can run out and get the information very quickly.

In closing, I would also mention that in addition to documenting that librarians can be more efficient and more effective searchers, research has determined that a single librarian or information professional can save the equivalent amount of time of three, or four, or even five end-users. In other words, librarians are three, or four, or five times more efficient and more effective than end-users are at performing their own information searching activities. This, probably, is the most important point to remember, because it is why librarians will continue to play a role in the newly emerging digital information world.