Chapter I
History of Electronic Resources

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ABSTRACT

This chapter describes the history of the development and use of electronic resources in libraries in the United States. It provides an overview of the major developments in the field with a focus on library catalogs, electronic databases, e-books and e-serials. The chapter is intended to convey the broad sweep of change that has characterized these electronic resources from the 1960's to the early 2000's, as well as a sense of the underlying issues that remain the same. The author hopes that an understanding of the history of the development and use of these resources may lead to a better understanding of the current environment and provide inspiration for the future.

INTRODUCTION

The library profession recognized the potential of computers to make library resources more accessible early in the development of computer technology. Librarians were often enthusiastic and sometimes early adopters of technology. The use of electronic resources in libraries began with the development of the machine-readable cataloging (MARC) format in the mid-1960's, a full 30 years before the introduction of the World Wide Web and its subsequent ubiquity. Bibliographic databases became available at approximately the same time.

Libraries provided access to data sets such as census and survey data as early as the 1970's. During the microcomputer revolution of the 1980's, libraries acquired software and data on diskettes and offered databases on CD-ROM. Databases on CD-ROM began to contain full text. Search interfaces became more straightforward and simpler to use. Online catalogs became more common, and libraries began to offer them through the pre-World Wide Web Internet.

Tim Berners-Lee created the World Wide Web in 1990. The subsequent development of the Mosaic browser in 1992 led to widespread use of the Web beginning in 1993. The graphical interface and the later development of Web search engines such as Yahoo! made resources on the Internet more accessible to average patrons.

Web-based electronic resources were widely available beginning in the mid-1990's. Libraries offered Web-based catalogs, bibliographic and full-text databases, electronic journals, and eventually electronic books through the Web. Patrons no longer had to go to the library to do a significant amount of their research.

This chapter is intended to convey the broad sweep of change that characterized the development of library electronic resources from the 1960's to the early 2000's as well as a sense of the underlying issues that remain the same. An understanding of the development of library catalogs, databases, electronic serials and electronic books may lead to a fuller understanding of the current environment and provide inspiration for the future.

BACKGROUND

The pursuit of electronic resources by libraries was driven by the core values of library science. It is possible to recognize in Ranganathan's five laws of library science the motivation that drove libraries to incorporate electronic resources into services and collections. Paraphrased to better suit electronic resources, the laws read: resources are for use, every person his or her resource, every resource its user, save the time of the user, and the library is a growing organism (Ranganathan, 1963).

Each technological development in library electronic resources during the 20th century was intended to make access to resources more direct, convenient, and timely for the user. The implementation of electronic resources made the library a growing organism as libraries adapted processes and reorganized staff repeatedly to accommodate the changes inherent in the use of constantly changing technology.

ONLINE CATALOGS

Electronic resources began to dramatically change the way patrons accessed library resources in the mid-1960's. The card catalog, a standard fixture in libraries for a century, faced its demise. One of the major developments during the 1960's was machine-readable cataloging (MARC). The MARC format dramatically changed the way library resources were processed and accessed. The library professionals who created MARC recognized the need for automation and a supporting data standard at a critical juncture in the development of technology, and took the necessary steps and risks to develop one. The flexible and expandable MARC format demonstrated the foresight and vision of those who developed it over 40 years ago.

MACHINE-READABLE CATALOGING

In 1964, the Council on Library Resources commissioned a study about capturing cataloging data in machine-readable form. A report called *The Recording of Library of Congress Bibliographic Data in Machine Form* resulted from the study, and was used as the basis for the first Conference on Machine-Readable Catalog Copy in 1965. Participants at the conference determined the requirements for a machine-readable record and discussed how it might be used in libraries. The Library of Congress' Information Systems Office developed and distributed a report based on this meeting titled *A Proposed Format for a Standardized Machine-Readable Catalog Record* (Avram, 1968).

During a second conference held at the Library of Congress, the MARC Pilot Project was conceived. Planning for the project began in February 1966. The MARC I format was created, codes for place of publication, language, and publisher were developed, computer software was designed,

and procedures were developed and documented (Avram, 1968).

In November 1966, the Information Systems Office of the Library of Congress began to distribute magnetic tapes of MARC records to 16 libraries that agreed to participate in the pilot project. The tapes contained English language Library of Congress catalog records that were formatted in MARC I. During the pilot project, the Library of Congress converted 35,000 records (Avram, 1968). Some of the libraries that participated in the pilot project were able to use MARC records to automate some aspects of their library operations. Some of the pilot libraries, however, struggled with a lack of computer programming knowledge as well as a lack of experience with complex bibliographic data (Torkington, 1974). The pilot project officially ended June 30, 1967, but distribution of records continued into 1968 (Avram, 1968).

The Library of Congress decided that the pilot project was an overall success and began to work on the MARC II format in March 1967, while the pilot project was still being carried out. The MARC II format was developed based on feedback from libraries that participated in the pilot project. The Information Sciences and Automation Division of the American Library Association formed a Machine-Readable Cataloging Format Committee to review the MARC II format (Avram, 1968).

MARC II was designed to serve as a communication or exchange medium. The Library of Congress began general distribution of MARC II records in March 1969. Responsibility for creating MARC records was transferred from the Library of Congress' Information Systems Office to a newly created department called the MARC Editorial Office. At first, coverage was limited to American imprints, but this was later expanded to include current English language imprints. By the end of 1972, the MARC database contained more than 300,000 records, and projects to develop MARC systems began in several other countries including Great Britain, France, Italy, West Germany, the Netherlands, and Japan (Torkington, 1974).

The development of the MARC format laid the foundation for libraries to share bibliographic data. Databases and services were subsequently created to support that sharing.

SHARED CATALOGING

The Ohio College Association hired Frederick G. Kilgour in 1967 to establish the Ohio College Library Center (OCLC), which was the world's first computerized library network. In 1971 OCLC introduced a shared cataloging database, now called WorldCat, to support 54 academic libraries in Ohio. This online cataloging system allowed libraries to achieve dramatic cost savings by sharing bibliographic records. One library could create an online bibliographic record and other libraries could use that same record to create cards with local information for their print catalogs. The Alden Library at Ohio University increased the number of books it cataloged by a third and simultaneously reduced its staff by 17 positions in the first year of use. Word of this increase in efficiency spread, and the network quickly expanded to include libraries from all 50 states and around the world (Librarian…educator…historian…entrepreneur, 2006).

ONLINE PUBLIC ACCESS CATALOG (OPAC)

In 1975, Ohio State University Libraries installed computer terminals in its main lobby so that patrons could directly search its library control system without help from a librarian intermediary. The library control system became one of the early online catalogs. The catalog was searchable by author, title, author and title, call number, and Library of Congress subject headings. There was also a computerized shelf list that patrons could

browse (Norden & Lawrence, 1981). Most of the library systems that were available in the 1970's performed a single function, such as circulation, and this information was also made available to library patrons.

Computer-output-microform (COM) catalogs were another alternative to the card catalog that developed as a result of shared online cataloging. Libraries that used these catalogs generally had large collections (over 25,000 volumes, with a growth rate of at least 1,000 titles per year), needed the catalog in at least 20 locations, and were having difficulty managing the logistics of maintaining a card catalog because of the large volume (Boss & Marcum, 1980). COM catalogs enjoyed only a brief period of popularity due to patrons' clear preference for online catalogs over microform.

Online catalogs began to replace existing library card catalogs in significant numbers during the 1980's. A study of users' reactions to four of these systems indicated that the users preferred online catalogs to card catalogs (Moore, 1981). This clear preference led to further development of the online catalog. Online catalogs provided more advantages to patrons than simply improved searching capabilities. These systems were integrated with acquisitions and circulation processing so that added information about on-order, in-process, and up-to-date circulation status information was available to patrons for the first time (Horny, 1982).

By 1989, 50% of all library systems purchased had a patron access catalog that was implemented (Boss, 1989). Many card catalog cabinets were discarded or sold. To ease the transition between card catalogs and online catalogs, online catalogs were designed to mimic the functionality of the card catalog. Text-based catalogs were available remotely using the TELNET protocol, but only relatively sophisticated computer-using library patrons accessed library catalogs this way. That changed significantly with the advent of the World Wide Web.

WEB-BASED CATALOGS

Vendors developed Web-based versions of online public access catalogs to satisfy the demand of librarians, but these catalogs replicated text-based catalogs, which were in turn based on the card catalog. Web-based catalogs, although presented through a graphical interface, relied on Boolean searching, which was "still a retrieval technique designed for trained and experienced users" (Antelman, Lynema, & Pace, 2006, p. 128).

Many libraries added catalog records for Web pages, but it quickly became clear that it would be impossible for librarians to catalog the Web in the way they had traditionally described print resources. Before librarians could fully respond to this new technology, the first Web search engines such as Aliweb, WebCrawler, and Lycos and Web directories such as Yahoo! were created. Libraries became more selective about adding catalog records with links to Web resources and focused more on electronic resources for which the library paid.

Some libraries created catalog records for individual titles in Web-based databases, only to find that database vendors' title lists changed frequently, causing significant cataloging backlogs and inaccurate links that were frustrating to users. Other libraries created html lists of electronic journals and databases rather than catalog records. As databases and electronic journals proliferated, this task became a time-consuming chore. In response to both the need for catalog records and what were often referred to as A-Z lists, vendors emerged that provided services that tracked the individual electronic journals from databases and supplied MARC records for libraries to load into their databases.

In many cases, the library catalog was no longer the main discovery tool for library patrons. The catalog became for many users simply a way to look up call numbers for items they found elsewhere. Despite the fact that researchers in information retrieval developed several experimental

catalogs, such as RLG's Red Light Green, that provided features such as spell checking, subject heading and keyword suggestion, and term weighting, these features were not incorporated into catalogs developed by library vendors (Antelman et al., 2006)

Libraries grappled with ways to incorporate social computing into their Web presence. Podcasts, blogs, and wikis appeared on library Websites. Ratings, social tagging, and reviews were included in library catalogs by vendors. Still, many patrons overlooked the library catalog.

In May 2005, The North Carolina State University (NCSU) Libraries purchased Endeca Technologies' Information Access Platform (IAP) and made a new catalog available using this software in January 2006. The new catalog allowed NCSU to offer its patrons relevance-ranked results, new browsing capabilities, and improved subject access (Antelman et al., 2006). The NCSU catalog caused such a stir in the library world that vendors began to create search platforms with similar capabilities.

Standards development, which started with the MARC format, continued to be critical in the new Web environment. Librarians used XML and developed metadata schemas to describe collections. Metadata schemas and the metadata they carried made it possible for search engines to find and expose these collections to users through digital Web-based libraries. METS (metadata encoding and transmission standard), MODS (metadata object description schema), and EAD (encoded archival description) became familiar to catalogers and archivists. An XML version of MARC was created, along with crosswalks to and from these different schemas, to allow data to be converted from one to another. These new metadata schemas were used to markup online collections of born-digital works as well as digitized photographs, artwork, musical scores, and historical documents.

Many libraries found themselves at the beginning of the 21st century with the unenviable task of maintaining multiple catalogs and systems of information, including Web-based catalogs for traditional sources, A-Z lists of electronic serials and databases, and digital repositories. Patrons found themselves with a sometimes confusing and overwhelming array of resources with no clear path to searching them all.

BIBLIOGRAPHIC DATABASES

While the MARC format was under development at the Library of Congress, the first electronic bibliographic databases were being created on the opposite coast. These databases were originally created to provide access to scientific and government information resources. The first Dialog database software was created under Roger K. Summit's leadership at Lockheed in 1966 (Dialog invented online, 2006). Lockheed and Bunker-Ramo both won funding to develop software that NASA could use to access its database. Lockheed won the contract in 1967 and retained the rights to the Dialog software it created. In 1968, System Development Corporation (SDC), led by Carlos Cuadra, won a contract from the United States Office of Education for research and dissemination of educational information (ERIC). In 1969, SCD created a retrieval program for the National Library of Medicine called ELHILL, which was the precursor to MEDLINE (Bjorner & Ardito, 2003).

Computer-based bibliographic services revolutionized bibliographic research in the 1970s. The ramifications of this revolution continued to impact libraries and electronic resources into the 21st century. In *The Electronic Library: Bibliographic Data Bases, 1978-79*, Christian (1978) attributed the development of these databases in great measure to issues around scholarly communication. These issues included the proliferation of journals and journal articles due to tenure and promotion requirements, increased discipline

specialization, and significant price increases for scholarly journals.

Another driver in the development of these databases was the trend in the publishing industry toward computer-aided production techniques. Techniques such as photocomposition left publishers with a by-product in the form of machine-readable bibliographic data that could be sold to supplement traditional product lines. Finally, the National Science Foundation's Office of Science Information Service (OSIS) was legally charged with fostering and disseminating scientific and technical information through technological transfer. "OSIS funded the foundation of new information services and regional centers to provide data base services on a not-for-profit basis; the conversion to computer-readable form of a number of substantial files of scientific and technical bibliographic data, and a host of other significant innovations" (Christian, 1978, pp. 2-3).

Online information retrieval was a new concept for many libraries, but one that coincided with the core library values of saving the time of the user and providing access to information. Convey (1992) defines information retrieval as "the searching for, and the retrieving of, selected information from the data held on a computer." In the early days of online access to databases, connections were made through leased telephone lines. In 1972, Tymnet set up a commercial telecommunications network, and database providers began offering services via the network (Bjorner & Ardito, 2003).

By 1975, there were already more than 100 machine-readable databases, although less than half of those were available online. Many of them were distributed on magnetic tape and the tapes were searched from a local computer. By the late 1970's, the number of databases had grown to more than 360 and there were at least 40 abstracting and indexing services (Christian, 1978).

These databases were very expensive to use. In the mid 1970's, Lockheed Information Systems and System Development Corporation (SDC) were the two major nationwide vendors of collections of online databases. The average cost of each online search for bibliographic citations was approximately $50.00 per search. By late in the decade Bibliographic Retrieval Services emerged and offered competitive rates for high-volume users. Lockheed and SDC were forced to lower their prices to remain competitive, and prices dropped to an average of $25.00 per search (Christian, 1978).

Because of the high cost per search and the arcane searching protocols that varied from database to database, searches had to be carefully constructed using Boolean logic before the search was conducted. This was not something that could be done by the uninitiated layperson. Jobs were redefined. Reference librarians became gatekeepers to this information and were called online searchers or information brokers.

Some libraries charged their patrons fees for database services. This was a controversial topic at the time and there was much emotional debate about whether it was appropriate, especially in public libraries. The entire library community, partly due to the cost of these resources, did not immediately embrace databases. However, resource sharing in the form of consortial purchasing became more common in this decade and helped make it possible for more libraries to provide access to these databases. Since the content of most of the databases at the time was scientific or technical in nature, most of the libraries that used these databases were academic or special libraries, although a few large public libraries provided access to these databases.

The rate of change in the use of library electronic resources began to increase during the 1980's. Databases were designed for the end user, licensing of electronic resources became common, and the full text of articles began to appear in databases.

CD-ROM DATABASES

Vendors began to distribute electronic databases on compact disc-read only memory (CD-ROM) in the mid 1980's. CD-ROM technology was touted as the "new papyrus" (Roose, 1988). Vendors also designed interfaces for the end user for the first time. The first commercially available CD-ROM product designed specifically for libraries was Library Corporation's BiblioFile. BiblioFile contained Library of Congress MARC cataloging records and was exhibited at the American Library Association's midwinter meeting in January of 1985 (Eaton, MacDonald, & Saule, 1989).

Databases on CD-ROM quickly became popular for several reasons. CD-ROM databases with user-friendly interfaces put online searching into the hands of the end user. Patrons no longer had to request the assistance of a librarian to gain access to these electronic resources, resulting in a service model that was more closely aligned with core library values than mediated searching. Another benefit to CD-ROM databases was that users could search them as much as they wished without concern for per search or per minute charges. Libraries could budget more easily for database use since they did not have to predict the amount of online searching that would be requested.

Optical discs provided high-density storage compared to other media available at the time, such as floppy discs and magnetic tape. They were also more durable and could not be altered or erased (Tenopir, 1986). Library patrons stood in line to use *Magazine Index* through the InfoTrac interface on CD-ROM. The ability to print citations from a computer rather than having to write them down was very convenient for patrons (Roose, 1988). When full-text began to be offered on CD-ROM products in addition to bibliographic citations, these products became even more popular.

While there were advantages to this new media, there were also some disadvantages. It was more costly for libraries to start using CD-ROM databases since they had to invest in a computer and CD-ROM drive for each database they purchased, at least before CD-ROM networking was developed. The annual lease for each database could be quite expensive, especially in the beginning when database producers were trying to establish pricing formulas. Therefore, libraries had to determine whether the CD-ROM database would be more cost-effective or provide more value than online searching of the same database before they could justify purchasing one. After some years, prices became lower as information providers became more comfortable with the medium and perceived the need to increase their subscriber bases.

Some librarians had concerns about investing large sums of money in the computer hardware required to use these databases when with some foresight it was possible to imagine that another medium might soon replace CD-ROM technology (Roose, 1988). CD-ROM databases were not updated as frequently as online databases could be, since the CD-ROMS had to be produced, copied and shipped to the library. Some databases were updated monthly, some quarterly, and others annually.

Along with the introduction of CD-ROM databases, librarians found themselves dealing with a new purchasing model that they were somewhat slow to accept. Vendors frequently offered these CD-ROM database products as annual serials subscriptions, although some were available for outright purchase. The result of purchasing databases on a subscription basis was that instead of buying a resource that could be added to a library's collection indefinitely or paying for an online search on demand, libraries paid significant amounts of money for data that was leased for a limited time (Pooley, 1990).

Librarians were faced with having to interpret complex, legal documents generally referred to as license agreements. These documents specified terms which libraries were required to enforce. These included terms such as whether out-of-date discs had to be returned to the publisher,

the conditions for single- or multiuser access, the conditions under which lost or damaged discs might be replaced, and whether or how much data could be downloaded from the CD-ROM product (Pooley, 1990). Librarians and their institutions identified objectionable clauses in these licenses and worked with publishers to find more favorable alternatives. One of these objectionable clauses required libraries to monitor the number of print copies that could be made or the amount of data that was downloaded. Librarians who worked in state institutions had to be aware of state laws that dictated which state's laws would be used to govern the agreement or where a contract-related lawsuit would be held and then negotiate license agreements to meet those requirements (Nissley, 1990). License agreements continued to be of concern into the early 2000's.

One of the early disadvantages of CD-ROM technology was that libraries had to dedicate a workstation, which generally included a computer, CD-ROM drive, and printer, to each copy of a database. The development of networking hardware and software and CD-ROM servers, colloquially referred to as jukeboxes, gave libraries the ability to offer more than one database at each workstation. Libraries were also able to remove the CD-ROM discs themselves from public areas, which reduced problems with 'missing' discs. However, these networks were difficult to design and install, and could be quite temperamental. The networks generally had to be set up and managed by a network administrator, and often added to the overall cost of these databases to libraries (Flanders, 1990).

ONLINE DATABASES

Online databases were still very much in use in the 1980's. Full-text articles began to be added to online bibliographic databases toward the middle of the decade, which made these databases even more useful. Online searching at this time was generally done via the TELNET protocol and private, for-profit networks, not the Internet.

Some of the disadvantages to using online databases during the late 1980's did not change significantly when these databases became available on the World Wide Web. These disadvantages included the difficulty of identifying and locating relevant sources, the problem of each resource having a different search interface, and the difficulty of moving search results from one system to another for consolidation and analysis (Lynch & Preston, 1990).

WEB-BASED DATABASES

Once the Web became available, online database interfaces were improved to make searching easier. More full text and multimedia became available. However, because most of these resources were subscription based and licensed, libraries were responsible for controlling access to these databases. In addition, these resources were part of the deep Web, along with the library catalog, and it was not possible to discover them with Web search engines. Since most users started looking for information with these search engines, they were not finding these expensive and very useful resources. Librarians responded with expanded library instruction, A-Z lists, searchable databases of databases, and MARC records in the catalog, but this issue continued to be of great concern into the early 2000's.

Early in the development of Web-based databases, access to them was controlled through the use of logins and passwords. It quickly became clear that this was an awkward, if not impossible, way to manage access to Web-based databases. Authentication by IP (Internet protocol address) became the main method used by libraries and database providers to provide resources to computers in the organization, and libraries used proxy servers to authenticate remote users. Library information became easily accessible to patrons

outside the library, which led to a greater demand for full-text resources.

The problem of the appropriate copy of a full-text resource began to be of concern to librarians. Library patrons performed searches and often found only the options to purchase an article from the database provider or request it through interlibrary loan. All too often, the library had the full text of the article available in another electronic resource or in a print collection. Most patrons did not know enough about library resources to anticipate that they might find that resource immediately and at no direct cost to them in another of the library's databases.

Some database providers cooperated with each other to create links from bibliographic records in one database to full-text in another database, but these partnerships were relatively few. When the OpenURL specification became available in 1999, link resolvers were developed to utilize OpenURL to provide the most appropriate copy of a resource to library patrons. Link resolvers used a knowledge base to store information about the library's resources. When a search was performed in a database, another search was conducted in the background against the library's knowledge base. The patron was presented with options for retrieving the resource, fulfilling the core library values of providing the specific resource required by a specific user and saving the time of the user.

Various metasearch or federated search engines were developed in the late 1990's, but none provided truly satisfactory results. This was primarily because each database provider labeled fields differently and search mechanisms behaved differently. Many libraries invested in metasearch engines even though they required improvement because these metasearch engines furthered the core value of saving the time of the user.

In the 2000's, Google and Microsoft helped libraries expose database and electronic journal collections through the use of link resolvers, openURL and services such as Google Scholar and Microsoft LiveAcademic.

ELECTRONIC SERIALS

Internet

Experimental electronic journals were available as early as 1982 through the Electronic Information Exchange System (EIES), which was sponsored by the Division of Information Science and Technology of the National Science Foundation. There were four prototypes of electronic journals available on this system. The four prototypes included a newsletter, a "paper fair" which was a totally unrefereed journal, a peer-reviewed journal where articles were published when they were ready, and an interactive journal that consisted of inquiries, responses, and briefs (Turoff & Hiltz, 1982). Electronic journals continued to be created, mainly in scientific fields, and were made available through ftp and gopher sites, but their proliferation was destined to await the development of the Web.

Some types of serials, such as newletters, were distributed by electronic mail and fax in the 1980's and early 1990's, but this was only practical for shorter serials with limited graphics. The primary method for libraries to access serials electronically during this time was through aggregated databases.

World Wide Web

The Web became the environment where electronic serials flourished. Hitchcock, Carr, and Hall found that there were 115 e-journals in existence in 1995. Within the next three years, the same authors discovered 1,300 electronic journals (Hitchcock et al., as cited in Cole, 2004). Serials publishers were fearful of the potential loss of revenue stream, but benefited from the experience of online database providers and learned to use

subscriptions and licensing terms to make libraries responsible for controlling access to e-journals in the same ways libraries authenticated patrons who used online databases.

Initially, many publishers offered online access free with a print subscription. While many publishers continued to offer this model into the early 2000's, others charged an increased price for print plus online or a somewhat reduced price for print only or online only journals. Some publishers offered special pricing for libraries that purchased large "packages" of journals, often referred to as "The Big Deal." Many smaller libraries found these packages to be completely unaffordable. Some larger libraries decided that "The Big Deal" was unacceptable because the high number of low-usage titles that were often included in them did not seem to justify the overall cost.

Electronic serials were available to libraries in a variety of ways. Some publishers offered their journals through their own sophisticated and proprietary search and retrieval platforms on the Web. Other publishers offered their journals through platforms such as Project MUSE and Highwire Press. Project MUSE began in 1993 with Johns Hopkins University Press titles and later added titles from other nonprofit publishers (General overview, 2007). Highwire Press, a division of Stanford University Libraries, offered over 1,000 electronic versions of high-impact journals in partnership with scholarly societies, university presses and publishers by 2007. Still other publishers offered their journals through subscription vendors or on simple Websites.

The open access movement took shape during this time in response to decades of double-digit price inflation and the early promise of the Web to provide free access to information. This movement advocated making scholarship, especially that which was paid for by public institutions, available freely on the Web. The viability of the economic models to support open access was not proven by the early 21st century. Open access business models in general either charged the author or the author's institution or grantor a fee to publish an article. BioMed Central and the Public Library of Science were examples of early open access publishers.

By 2004, the number of e-journals was estimated at 30,000 titles (Cole, 2004). Such growth clearly demonstrated the popularity of electronic journals. There were some disadvantages to this medium, however, that were not yet resolved. Electronic dissemination in itself did not solve the problem of the rising cost of serials, although the open access movement sought to limit costs or move the costs from libraries to the entities that generated the research. In fact, as publishers invested in hardware and programming to make their journals available on the Web, costs continued to rise. In addition, there were no established workflows between publishers, vendors, and libraries to manage electronic serials, and libraries were ironically forced into manual processes to track acquisition and access provision. Some libraries created databases to better manage these processes, and vendors responded to the efforts of the Digital Library Federation's Electronic Resource Management Initiative by creating products such as electronic resource management (ERM) systems. Still, electronic resource management workflows were very immature when compared with the imperfect, but well-established processes for print serials.

ELECTRONIC BOOKS

Internet

Project Gutenberg was the first electronic book project. It focused on documents and books that were in the public domain. Project Gutenberg began in 1971 at the Materials Research Lab at the University of Illinois. Michael Hart began the e-book project in part to fill up the spare time of computer operators in the lab. The philosophy behind this project was to create texts that were

easy to use and inexpensive to create. Every book was freely available to the public on the Internet, and then on the Web. This was accomplished by using volunteers and by creating the files in "plain vanilla ASCII" (Hart, 1992). Volunteers converted the original ASCII files to other formats such as html and .pdf as there was demand for them.

CD-ROM Books

The first commercial packages of electronic books became available at about the same time as other CD-ROM products. The Library of the Future was one of these products, and it contained about 300 public-domain literary works in ASCII format, and sold for $695.00 in 1991 (Mullin, 2002). As late as 2007, The Library of the Future 4th edition was listed on Amazon.com and contained more than 5,000 titles. Customer reviews were very favorable, and seemed to focus on the amount of information available on one disc as well as the usability of the software, but the item was no longer available. It was still available on eBay at the same time for $32.00. Other popular electronic book collections on CD-ROM included reference works such as the International Dictionary Unabridged on CD-ROM, published by Merriam-Webster Inc. in 2000. It included a thesaurus and illustrations as well as multimedia functions such as audio pronunciations and interactive features such as bookmarks and spelling help.

Despite these early success stories, books did not make the swift transition from print to electronic that was predicted by many in the late 1990's. There seemed to be a variety of reasons for this, but the one most often cited was that reading books on a backlit screen was an unpleasant experience for many people. There was even some confusion about the definition of what an e-book was during this period, as both the reading devices and the text were referred to as e-books.

In addition, there were obvious advantages to electronic serials and databases over their print equivalents, which included the ability to search for and retrieve information more quickly and easily than in print and the ability to do these things from any location. These advantages did not seem to transfer as readily to electronic books, with the notable exception of reference books. While the improved search and retrieval advantages of the electronic format helped users find the books they wanted to read, they usually wanted to read them in print. Most people in the transitional generation between the print world and the electronic world printed items of any real length that they wanted to read. Articles and database records tended to be much shorter and therefore less expensive to print in terms of paper and toner. It was also easier to handle one-sided printouts of 15 pages that could be stapled together than to carry around one-sided unbound printouts of a several-hundred-page book.

There were potential advantages to electronic books, both for publishers and readers. By the 1990's, most books were born digital and had to be transformed into print at a fairly significant cost. In addition, it was often wasteful to print copies in advance. Gall (2005) wrote, "It is estimated that 10 percent of texts printed each year are turned to pulp, although, fortunately, many are recycled. The BBC reported that more than two million former romance novels were used in the construction of a new tollway." Gall also pointed out that the cost of printing caused specialized titles to become out-of-print quickly because fewer copies were printed. So, one potential benefit of electronic books was that publishers would not have to estimate the number of copies of a particular book that would be sold in advance. Some potential advantages to electronic books for readers included the ability to carry several books at once in a small space, a potential benefit to students and travelers, the fact that e-books required little or no space on shelves, and that they could be used with text-to-speech software (Gall, 2005).

The potential advantages to electronic books were undermined in part by the early business

models used to sell them. Most of the early commercial business models for electronic books were focused on sales to individuals, and usually tied customers to a particular e-book reader. E-book readers themselves were expensive, costing from $300 to $700 each, and consumers could only purchase e-books that were available in the proprietary format for that particular reader. Additionally, the files could not be transferred to another reader of the same type, but could only be used on the specific reader to which the file was originally downloaded. So, for example, a family that purchased two readers was not able to buy one e-book and share it between e-book readers. The RocketBook was an early example of this business model.

Publishers selected these business models precisely because it made it very difficult to copy or share an e-book. Most publishers were concerned about losing revenue to file sharing. This in turn made it particularly difficult for libraries to offer e-books to their patrons. Many libraries invested in e-book readers such as the RocketBook, and downloaded several titles to each reader. The problem with that model was that as long as that reader was checked out, none of the e-books on the reader were available for other patrons to read.

There were some publishers, however, namely The National Academy Press, The University of California Press, and Baen Books, who saw e-books as a way to increase print book sales. The National Academy Press, for example, made all of their titles freely available to download and after doing so sold more print copies of those same books than it did before they were available online (Mullin, 2002). Baen Books, which published mostly science fictions books, created the Baen Free Library where it offered authors the option to put copies of their books online. Baen limited authors to one or two books in a series or four or five books overall so that less known authors would have a better chance to be discovered by potential readers (Flint, 2000). This program began in 2000 and was still in existence in early 2007.

NetLibrary joined the e-book market in late 1998 and developed yet another business model that was based on the way libraries check out one copy of a book to one patron. ebrary joined the market at about the same time, and with a similar business model. Libraries and businesses could purchase collections of electronic books that were hosted on the company's server. Patrons associated with the institution could check out electronic books for a period of time. Printing was deliberately set up to be inconvenient, and software controls prevented users from printing more than a few pages at a time. Publishers that worked with these companies insisted on a one book, one patron model rather than a simultaneous user model, once again out of fear of losing the print revenue stream.

There was significant upheaval in the electronic book market during the dot.com bust of the early 21st century, and very few of the original electronic book publishers survived. NetLibrary was rescued by OCLC, which already had an agreement with NetLibrary to archive each customer's collection of e-books. ebrary also continued to operate, but most of the big names in e-books in the late 1990's were gone by 2001.

After 2000, the e-book market gradually began to regenerate. New companies such as Mobipocket, which became a subsidiary of Amazon.com, and OverDrive entered the market with business models that were not hardware specific. OverDrive developed a business model that was library friendly. Libraries purchased specific e-books or digital audiobooks and provided links to these electronic books in their catalogs. Library patrons checked these books out for a period of time, using the OverDrive software, and downloaded them to their computers or MP3 players.

In 2004, Google entered into partnership with major libraries to digitize their print book collections and make them searchable through Google Book Search http://books.google.com/. Titles

that were out of copyright were made available in their entirety. Titles still under copyright displayed bibliographic information and perhaps the table of contents and a few pages of text (Google milestones, 2006).

Sony developed a new e-book reader that it released in 2006. The new Sony Reader used E Ink screen technology, which for the first time did not rely on backlighting and provided a screen resolution similar to print. The new readers supported various file types including .pdf and even Word documents. It also allowed users to listen to MP3 files at the same time they were reading an e-book. The cost was still over $300 for the reader, but the E Ink technology seemed to address one of the major objections to e-books, which was the issue of readability.

While electronic books did not dramatically change the way people read by the early 21st century, they did offer one more way to search for and find information quickly. As a result, these resources were more successful in academic libraries than with the public or public libraries.

FUTURE TRENDS

It seems apparent that library catalogs must evolve quickly if they are to remain an integral piece of the library electronic resources puzzle. Vendors have already begun to respond to innovative efforts such as the NCSU catalog by creating library portals that include federated searching, relevance ranked results, and improved browsing capabilities.

It is almost certain that databases will continue to increase in both number and type of content. Users will continue to demand full-text resources. Federated searching and linking must continue to improve, and libraries will encourage the further development of these tools. Libraries will continue to work to make their resources available where their users can find them through Google and other Web search engines.

Electronic journals will continue to proliferate and it is likely that they will evolve as the Web becomes the primary publication medium. For example, T. Scott Plutchak, speaking at the 2006 North American Serials Interest Group 2006 conference, suggested that the serials container, that is the title, volume and issue number, and publication date, will become less important because publishing on the Web allows individual articles to be published as they are ready. If open access develops into a successful and accepted mode of publishing, more scientific and scholarly information will be freely available to all.

Except for reference works, electronic books will likely only become popular when e-book readers become more similar to print books and when the price of these devices drops significantly. As mentioned earlier, E Ink technology may be the key to that development. Or perhaps the generation that has grown up with the Web will find e-books acceptable as they exist. Then again, it might be that books will have to evolve to better suit the technology.

Until there are adequate means for archiving electronic resources, it would be irresponsible of the library community as a whole to move exclusively to electronic serials and books. The community must come to some consensus about how to archive these resources. In 2005, the National Archives faced the challenge of archiving government documents and awarded a contract to Lockheed Martin to develop a system to preserve documents created by any United States government entity in any format (Reagan, 2006). Perhaps this project will present a solution to this difficult problem that libraries can implement.

CONCLUSION

This brief history of library electronic resources demonstrates that librarians provide access to electronic resources as a way to realize core library values. While certain problems have persisted

throughout the development of these resources, such as the inability to adequately search across a variety of resources, there is hope that these problems will be resolved with time and effort from librarians and vendors. It is certain that whatever new electronic resources or ways of accessing them become available in the future, libraries will enter the fray with both enthusiasm and trepidation, along with the will to provide the best possible resources and services to their patrons.

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