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Trends in American Academic Libraries

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Washington University School of Medicine Library has a long history in library automation, going back to the first punched-card-based serials management system—PHILSOM, in 1962. Since those early days, there has been a desire to replace the paper-based collection with a fully on-line electronic information distribution system. Some have even predicted that electronic publishing would supplant paper in the near future.

However, concerns for the demise of paper-based publishing have proven to be premature. Paper publishing has grown exponentially in the last 25years, and this growth shows few signs of abating.

There are several recent technical advances that make the vision of electronic information distribution seen more likely to occur in the near future :

1) Advances in computer technology have dramatically increased the speed and storage capacity of computers, while reducing prices.
2) High speed local area networks(LANs) have allowed users within an institution to communicate rapidly and efficiently.
3) High speed wide area networks, such as the Internet provide high speed, low cost data transmission from institution to institution.
4) As the costs for automated systems have declined rapidly, the costs for manual, non-electronic systems, ranging from paper to utilities and personnel, are all rising rapidly.

The changes outlined in this paper will not happen overnight, however over the next 5-10 years I believe that significant progress will be made toward an all-electronic information distribution system.

I will divide my predictions into several areas, with some overlap in coverage. The general areas are :

1) Computers and Workstations
2) Communication
3) Media and Audiovisual
4) Databases
5) Catalogs
6) Software

I will try to give a broad brush overview of the current state of each area in American academic and medical libraries, followed by my prediction for the future in each area.

1. Computers and Workstations :

Computers are currently used in libraries in four primary ways :

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a) To run the on-line public catalog, circulation, and/or integrated library system for the entire library
   Usually this is either a mainframe computer or a larger minicomputer.
b) To act as terminals to the local OPAC and/or a remote database system, Usually this is some form microcomputer.
c) To act as database search engines for CD -ROM systems.
   Usually this is some form of microcomputer.
d) As a general-purpose computer for patron use. Usually this is some form of microcomputer locked in a media/computer center.

The near future should see a shift from PC-based ad-hoc solutions to more UNIX-based and standards-based systems. This will include unix workstations with X-windows as well PC's running various forms of X-emu lation and/or UNIX. This is necessary future systems will be too large and complex for single-vendor solutions, regardless of the size of the vendor. CD -ROM will prove inadequate for the very large and frequently updated databases, so communication-based solutions will regain prominence.

2. Communication :

Current communication technology is highly fragmented, with many libraries having one or more LAN's, but with majority of database access and patron access being provided via 1200 or 2400 baud dialups or via 9600 buad local connects. Romote access is largely via dialup long distance telephone. Some libraries provide access via LAN and Internet.

The near future should see a large-scale shift to LAN-based systems for local communication, both within the library and one the local campus. This LAN-based system will probably be substantially more complex than a single Ethernet, but will still be, conceptually, a single LAN. This will provide the communication infrastructure that will make document imaging systems practical.

Remote access will be via national and international wide area networks, such as the Internet. These networks will provide the high bandwidth necessary for document image delivery as well as for multi-media applications. These networks will also provide access to vendors.

In the more distant future, very high speed networks using ATM and fast packet technology, and operating at gigabit per-second speeds, will provids remote access to the interactive full-motion video as well as the full range of current applications. Cable TV systems will provide high-speed data networks directly to patrons' homes and offices, so that most of the services currently requiring patrons to visit the library will be accessable remotely.

3. Media and Audiovisual :

This are currently consists mostly of movies, videotapes, slides, records, tapes, and other "physical" media, along with a smattering of patron-use computers with some Computer Aided Instruction(CAI) routines and some videodisks.

The near future will hold a large increase in use of interactive videodisks. Also increasing dramatically will be hypertext-type applications and multi-media.

In the more distant future(3-5 years), audiovisual systems will move away from the current

stand-alone systems model toward more linked systems, where several workstations are linked to each other for class-type projects, and these are also linked to remote computers containing large databases for simulation and multimedia.

4. Databases :

Currently most libraries provide dialup access to some remote databases. Many libraries provide local CD-ROM-based systems for heavily used databases such as MEDLINE or Wilson. Microform or paper remains the primary storage media for full text.

The near future will see a large increase in CD -ROM use, mainly for access to data-indexes. Some full-text access via CD-ROM will be available, as will some document imaging.

In the more distant future(3-5 years), document imaging systems will become more prevalent, containing both the fully-indexed textual material and the digitized images of any charts or photographs. These systems will use both local data storage on optical disk and/or CD -ROM and remote access to large full-text databases via high speed wide area networks(WAN).

5. Catalogs :

Most libraries have now installed their first on-line public catalog (OPAC) system. Many libraries are now considering replacement systems that will correct for deficiencies found in their first OPAC system. Integrated library systems are now widely available, but are still quirky in operation, installation, and patron interface.

Cataloging is usually done via a bibliographic vendor such as OCLC or WLN. The local OPAC and/or integrated library system usually runs on a local mainframe or minicomputer. Access is via local terminals with some dialup or lan access. Union catalogs for remote libraries are usually provided via microform.

The near future will see much more union-list type searching done over networks, with regional OPACs and worldwide search capability.

In the more distant future, the catalog will provide not only the index into the information, but also the information itself. This includes the document images, full motion video, multimedia, and imbedded local comments and enhancements.

6. Software :

Currently, library software is written in a variety of languages including assembly language, C, MUMPS, D-base, BASIC, and many more, Database management systems(Adabase, oracle, etc) are usually selected independently of application language selection. Most software is provided as part of a bundled library system, including hardware, software, support, maintenance, and supplies. Many programming systems(4GL, 5GL, Structured programming, object-orient code, etc) are in use, but most production systems are currently hand-coded. User interfaces are primarily line-by-line or full screen VT-100 type displays, with a smattering of windows-type systems.

The near future will see much more use of programming systems such as 5GL and object-oriented cods, Languages with imbedded database management systems, such as MUMPS(M) will come into increasing use. Soft-

ware will be sold separately, with hardware and operating systems decisions left to the individual libraries. Windows-type systems will become more popular for patron interfaces; however, command-type interfaces will remain popular for library staff functions and for remote access.

Direct database access systems such as SQL and 239.50 will allow a single workstation to query many databases on many systems and combine the results locally.

Software standards will emerge for patron access to public catalogs, as well as for patron searching of remote databases. These standards will cover both the patron interface and a computer-accessable interface into the database.

At Washington University School of Medicine Library, many of these jkchanges are already in the planning and Testing phases. The BACS(bibliographic access and control system) began as an on-line serials system and progressed to an on-line public access catalog/integrated library system. It now acts as an umbrella term for a family of integrated software providing patron and librarian access to the whole gamut of medical information, ranging from BACS-mounted large databases, through local non BACS databases(such as CD-ROM), through remote databases(such as Genbank). BACS provides a framework for disparate resources. BACE is wiritten in the ANSI standard M(formerly MUMPS) language, so code if fully portable to over 100 different hardware/operating system platforms ranging form 8088 through Cray. M compliers and operating environments are available from 20 different vendors including IBM and DEC. This leaves the library essentially unlimited freedom in choice of platforms. M allows for easy modifications of complex systems, while providing high performance. The large vendor base and the ongoing standards process assures that M will incorporate new technology as it becomes available.

In the past, the traditional library was basically a book warehouse. The collection was essentially static, with most of the effort on the part of librarians going toward storage, preservation, and accessability of the collection. Modern computer technology will change this situation dramatically.

If we assume that the "documents" start as electronic "images", such as video or word-processed documents, the costs for an on-line library relative to a conventional library are summarized in Table 1.

Storage requirements for document images are summarized in Table 2.

For the near future, the library will probably not be able to replace the existing collection with electronic media, and so will probable be forced to maintain a dualsystem with more recent material available electronically.

The more distant future will see a debate over whether information should reside with the information originator(probably suitable for large, continually updated databases), an information distributor(perhaps a publisher, academic society, or library), regional distribution centers, the local library, or perhaps with the patron. Each of these solutions has merit for different problems. The eventual solution will probable be some mixture of these, with the mix depending on the ralative costs of local storage verses the costs of telecommunications.

A separate set of issues revolves around copyright/intellectual property. The electronic library could spell the end of copyright as we know it, with essentially unlimited access to documents with no renumeration for the author/

Talbe 1 :

Catagory	Non-Electronic	Electronic remote access	Electronic local storage
Acquisition	Book purchase price Journal purchase price Incoming processing Cataloging	usually negligable	Purchase pirce of distribution media purchase price of storage media(short/ling ter)
Storage	Floor space costs Shelving HVAC Lightning Personnel for periodic collection maintenance	usually negligable	Maintenance of storage Media Floor space for media HAVC, electricity Operations personnel Hardware/software updats
Access	Re-shelving Personnel(circ-related)	telecommunication host access charges	Local telecommunications CUP and storage cycles
Training	Minimal patron help	search techniques training Patron help	Computer-related training
Royalty	Fair use usually included in purchase purchase price	large usually proportional to use	Bundled with database purchase or per-use

Table 2 :

Documents in an electronic library can be stored as text, as bit mapped graphics, or some combination of these. Either format is amenable to substantial compression. Keys and indexes into the data are usually equal in size to the text.

	8-bit bytes per page	Ucompressed $ per page $2/meg
Text	2,500-10,000	$0.0050-0.0200
Bit mapped 300×300dpi	1,000,000	$2.00
Bit mapped 300×300dpi color	25,000	$50.00
Bit mapped 92×203(fax)	200,000	$0.40

Text can often be compressed at a 3 : 1 or greater ratio, depending on content. Simple document images can yield 20 : 1 or greater compression on average.

Initial purchase price for computerized storage of a typical ten page journal article with four diagrams would be approximately $0.10. Ongoing maintenance of computer equipment would be approximately $0.01 per year. Regardless of storage resolution, the document can be delivered directly to the patron via fax or laser printer.

publisher. It could also go completely to the opposite extreme with detailed usage tracking and charge back to the copyright holder. The future probably lies somewhere between these extremes; however, a more liberal policy seems more likely for university-originated data.

Most of the changes described above already exist in bits and pieces throught the American university community. Integrating these pleces into a coherent and costeffective fabric is the challenge of the immediate future in library automation. The BACS system provides a framework for this integration.

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