The Georgetown University Library Information System (LIS):

A Minicomputer-Based Integrated Library System

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ABSTRACT

Georgetown University's Library Information System (LIS), an integrated library system designed and implemented at the Dahlgren Memorial Library, is broadly described from an administrative point of view. LIS' functional components consist of eight "user-friendly" modules: catalog, circulation, serials, bibliographic management (including Mini-MEDLINE), acquisitions, accounting, networking, and computer-assisted instruction. This article touches on emerging library services, user education, and computer information services, which are also changing the role of staff librarians. The computer's networking capability brings the library directly to users through personal or institutional computers at remote sites. The proposed Integrated Medical Center Information System at Georgetown University will include interface with LIS through a network mechanism. LIS is being replicated at other libraries, and a microcomputer version is being tested for use in a hospital setting.

IN DECEMBER 1980, the Dahlgren Memorial Library of the Georgetown University Medical Center in Washington, D.C., acquired a dedicated minicomputer to automate library functions using an integrated systems approach. By the summer of 1981, version 1 of the Library Information System (LIS) was tested; it consisted of such basic functions as cataloging, circulation, and serials. By autumn, LIS became available to users, with on-line access to 95% of the library's holdings (more than 100,000 volumes, consisting of monographs, journals, and audiovisuals). With continued development, by 1982 LIS consisted of eight on-line components: the public catalog, circulation, serials control (which interfaces with PHILSOM III), acquisitions, accounting, networking (messages and interlibrary loans), computer-assisted instruction (CAI), and bibliographic management, including a special feature called "Mini-MEDLINE."

Although the library's progress to this fully automated state may appear spontaneous, it involved a series of logical, semiautomated planning and preliminary steps that aimed at building a data base from the library's bibliographic records in machine-readable form. Therefore, in 1976, when the library implemented OCLC (On-line Computer Library Center) for on-line cataloging of new monographs and conversion of backfiles, the catalog cards as well as the archival tapes were acquired. In 1977, the library joined the PHILSOM II network, a batch-mode serials system developed by the Washington University School of Medicine Library, St. Louis. When the PHILSOM III on-line version became available in 1979, the library transferred its machine-readable serial records to the local PHILSOM III node based at the George Washington University (School of Medicine Library), Washington, D.C. Direct data lines between George Washington and Georgetown allowed on-line access to all serial records.

By late 1979, technological advances in minicomputers made streamlining library operations more economically feasible. The integrated-system approach was gaining wide acceptance and seemed destined to become a reality [1–3]. The library began to explore the most appropriate means to mount an integrated system. By mid-1980, a proposal to acquire a dedicated minicomputer for the library was presented to the library committee and medical center administrators. Justifications were increased demand for information and the library's need to provide more efficient and less labor-intensive services. Approval was based on the proposal's phased approach, the library's ability to assume budgetary responsibility for the system without drawing capital from the scarce resources of the medical center, and its success in the preliminary automation projects. A phased approach allowed the library to afford the project, and to introduce users to system components gradually, as they became available.

SYSTEM HARDWARE

Because the proposal specified system requirements, such as programming language, network-

ing, and storage needs, the hardware needed was easily narrowed to a basic PDP 11/34 minicomputer with a ANS MUMPS operating system. The Plessey Peripheral systems and other supporting equipment (Table 1) met all requirements, were reliable, and were not costly. To launch the system and prepare a computer room cost approximately $141,000. In 1981 and 1982, phased system enhancements and ongoing costs ranged between $15,000 to $20,000 per year. Computer maintenance contracts totaled $14,000 per year.

System Software

LIS software is written in ANS MUMPS, one of only four computer languages designated as a standard language by the American National Standards Institute (ANSI). LIS runs on a MUMPS operating system purchased from Inter-Systems Corporation. Standard MUMPS was selected because it offered the most flexible approach to rapid development of the LIS system and because it was language-compatible with PHILSOM, facilitating interface. In 1981, the librarians and a physician/programmer from the school of medicine designed and programmed LIS. Design included incorporating the previously developed data bases for the catalog and serial records and creating the new components targeted for automation.

The basic philosophy of system design was pragmatic: to create LIS programs for those components with no usable software and to interface with developed systems that already met the library's needs. This approach influenced the decision to stay within the PHILSOM network for serial control, to use the Veterans Administration's File Manager (a data base management system), and to adapt the QUEST programs for CAI software development. Interface with the National Library of Medicine (NLM) *Medical Subject Headings* vocabulary was selected to assure standardization of subject headings for creation of the "user-friendly" catalog and Mini-MEDLINE modules. This strategy allowed the library to mount a system in record time without violating the advice of computer experts of "not to reinvent the wheel."

TABLE 1

LIS System Hardware and Support Equipment

Computer Hardware
1 PDP 11/34 A with 256 kbytes of memory, 2 kbytes of high-speed cache memory
2 Disk drives (254 megabytes each)
5 8-line multiplexers (for 40 terminals)
4 Dial-up modems (two 300-baud, two 1,200-baud)
5 Disk packs
Support Hardware
29 CRT terminals (Lear Siegler ADM5)
Printers
3 LA 120 DECwriters
4 Microline 82As
2 Axion microprinters
1 Alphagraph letter quality printer
Bar code readers
6 Intermec 9300s
1 Intermec 9400
Microfilm cataloging equipment
2 ROM-4 machines (COM catalog)
Other Support Systems
Electronic cabling, wiring, and telecommunication lines
Air conditioning unit, with cooling capacity of 24,000 BTUs
800 square-foot, static-free, carpeted room

Functional Components of LIS

It would be naive to think that there is a perfect system that can meet everyone's needs and preferences: compromises are involved that depend on available technology and decisions on system simplicity or complexity [4]. Even future decisions on incorporation of new technology, refinements stemming from periodic review, and recommendations from users involve compromises.

Technical and functional specifications are involved in design of an integrated system: the former govern file structure and programming, the latter determine how the files system appears to the user. Various approaches can be taken to achieve integration. The Georgetown approach begins at the system level, where data is shared. Individual modules are developed independently, stored in the same computer, mechanically cross-referenced, and accessed by users through a "one source look-up" step. The basic design approach depends on library policies; for example, if journals are not cataloged (as at Georgetown), it is unnecessary to merge these files with the catalog data base of monographs and audiovisuals. However, data still can be interfaced at system level for a product that integrates library holdings.

Initial design of a system also requires that system integrity, security, and man-machine interaction be studied. For system integrity, Georgetown decided to follow accepted national standards

for cataloging (maintain full-MARC record, follow the NLM classification, and incorporate AACR2 rules). Security and data protection are accomplished at the system, terminal, and user code levels. User interaction is kept very simple, but depends on who uses the system—whether a library staff member conducts data input, manipulation, and output, or a library patron is accessing information from the system's data base. The decision to design a highly "user-friendly" system that requires minimal instruction governed the menu and front end programs used by patrons.

Ease of use is the hallmark of the system. Familiar formats are kept to avoid confusing patrons; commands and instructions are made uncomplicated. The system is virtually self-instructional and takes only a few minutes to learn. It is fast and easy to read: it runs at 9,600 baud, and the instantaneous screen displays scroll from the top down.

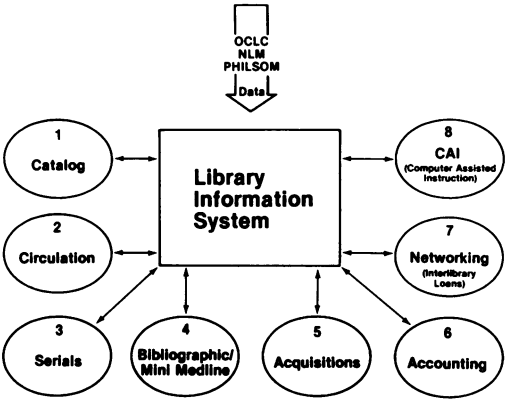

FIG. 1.—Library Information System, consisting of eight functional components.

Existing functional components of LIS are as follow (Figure 1):

1. *The Dahlgren On-line Catalog* (DOC). The catalog record can be displayed at three levels of detail. The first level is the cataloger's comprehensive MARC record, which interfaces with OCLC. To create the cataloging record, OCLC is used, appropriate fields are selected, necessary modifications are made to comply with the NLM MeSH classification system, and the record is then transferred to the library's minicomputer and stored. The second and third levels are available to patrons who use DOC. They consist of both an abbreviated display and a full display that replicates a standard catalog card and contains call number, full bibliographic description, and tracings. In addition, circulation status (whether an item is on the shelf or checked out) and internal location (e.g., reserve room) appears on the terminal screen for the patron's information (Table 2). A "push-of-a-button" approach makes DOC easy to use. Menu-driven access to DOC is achieved through keywords, author, title, and subject. The system simplifies subject access for users.

TABLE 2

DAHLGREN ON-LINE CATALOG (DOC)
TWO DISPLAY LEVELS AVAILABLE TO USERS

Abbreviated Record*

Bellanti, Joseph A.
Immunology II
QW 504 I377 1978 2nd ed

Full Record

QW 504 I377 1978 Immunology II/ edited by Joseph A. Bellanti.—2nd ed.—Philadelphia; W. B. Saunders, 1978. xiii, 813 p.: ill.; 25 cm.
1. Immunity I. Bellanti, Joseph A., 1934– GUMC
II. Gelfand, Michael C., GUMC

Item #	Circulation Status	Volume	Location
31685	shelves	Copy 1	CircDesk
8971	shelves	Copy 2	Reserve

*The abbreviated record is displayed during an initial search of DOC, as in this author search. Items selected by the user are then displayed in full with circulation status.

2. *Circulation.* This includes checkin, checkout, renewals, holds, inquiry, overdues, and fine notices and reports. The basic circulation module consists of patron, item (book or journal), and the bar code files. The item file identifies each item that circulates; the bar code file matches the item and the bibliographic descriptions. Patron records are maintained with special identifying features. The system also maintains internal messages on patrons, gathers management statistics, and assures security. System outputs, such as overdue notices, lists of missing items, and statistics, are generated on a regular basis through the DEC LA120 printer.

3. *Serials Control.* LIS interfaces with PHILSOM III to provide access to the library's serial holdings (Figure 1). The local PHILSOM III file is independently stored in the minicomputer for technical functions, and it shares data with the LIS serials module for the catalog and circulation functions. The LIS programs are written to achieve integration with a "wrap-around" approach. The

library runs all of its technical processing functions that involve bibliographic, inventory (checkin, claims, etc.), and acquisition tasks by using PHILSOM. Fiscal controls are run on LIS. Through the LIS interfaces with the PHILSOM file, DOC provides users with immediate information on journal title holdings and circulation status. The interface with the circulation component allows barcoded items to circulate actively. This approach enabled the library to mount a serials component easily and quickly, to remain within the PHILSOM network, and to contribute to computer-generated union lists of serials with other libraries.

4. *Bibliographic Management and Mini-MEDLINE.* Bibliographic management, an extremely useful component of LIS, allows librarians to generate special bibliographies. Basically, this component saves the data retrieved through a MEDLINE search, and allows editing and reformatting of the data to develop a bibliography arranged to meet a specific need. The library uses this component to compile lists on such topics as faculty publications and dental, nursing, and audiovisual bibliographies. It also includes the "user-cordial" module Mini-MEDLINE that allows patrons to conduct their own bibliographic searches.

Mini-MEDLINE is a very popular self-service search module whose special program routines allow users to execute a bibliographic search from a portion of the MEDLINE data base. Mini-MEDLINE, provided free to Georgetown users, meets immediate patient-care and educational needs of students, young researchers, and residents. Users conduct their searches through simple commands and quickly satisfy their basic needs for information. Nine options are available to the Mini-MEDLINE user (Table 3). The first four allow sets of references to be built through author, title, journal, or subject. Sets can be displayed singly or combined by using the three display options. The last two options allow the user to begin a new search or to stop. The output prints a list of references with basic bibliographic information. The system accepts natural language, which it converts to the appropriate MeSH term to generate the search. The file, updated monthly, contains converted MEDLINE citations of approximately 120 journals since January 1982. These basic journals are available in the library's collection, thereby eliminating the need for interlibrary loans. Mini-MEDLINE is viewed as a valuable educational tool that is designed to help young health professionals become "computer literate" and improve their information-seeking habits.

TABLE 3
MINI-MEDLINE*

Search Options
1. Author
2. Title word
3. Journal
4. Subject
Display Options
5. References from a single set
6. All references from more than one set (boolean "or")
7. Combine references common to two or more sets (boolean "and")
Other Options
8. Delete all sets and begin a new search
9. Quit

*Search options 1 through 4 allow sets to be formulated. Display options 5 through 7 allow users to manipulate sets to retrieve desired references. Other options 8 and 9 allow user to quit or begin again.

5. *Acquisitions.* This component was generated by using the VA File Manager data base management system, a software package in the public domain. It uses the "programmerless" approach to designing a component, with broad categories for record input and retrieval. The LIS acquisitions component was designed by determining principal file requirements and establishing the elements for record maintenance. It satisfies library needs to handle regular and standing orders, vendor files, fiscal records, and to print acquisition order forms. It maintains valuable statistical data and produces special reports for management purposes and collection development. Designed initially by the assistant librarian for resources and technical services, there are plans to expand this component and to integrate it with DOC.

6. *Accounting.* The LIS design complements Georgetown University's accounting system and satisfies the library's need to record all income and expenses. Ledger postings and edit capabilities on purchase orders, encumberances, and payments are entered by transaction and category. Fiscal reports generated monthly provide balance data and current budget status. Reconciliations between the library's records, the university's accounting records, vendor records, and purchasing records are more efficient. Discrepancies previously handled manually are now less frustrating and less time-consuming to resolve. The system runs through

accounting routines and issues final balance sheets on demand.

7. *Networking.* This component allows dial-up access and one-source look-up of the library's online catalog by microcomputers, minicomputers, mainframe computers, and terminals at remote sites. Approximately twenty Washington, D.C., libraries participate in an experimental interlibrary loan network project with Georgetown University. This feature frees libraries from maintaining extensive paper files, eliminates the need to mail interlibrary loans, and gives borrowers immediate information on item availability. Copyright compliance information is incorporated into the file, and the message capability allows the system to respond to user requests about unfilled loans. The electronic mail mechanism also has a word processing program for transmission of documents that, once received, are printed and stored at the Georgetown computer.

8. *Computer-Assisted Instruction.* The component slowest to grow but with the greatest educational potential is CAI. The QUEST programs for CAI development, which also use a programmerless approach, are mounted on the system. This component allows faculty members to develop CAI courses that are stored in the minicomputer and accessed by students via terminals located in the library's audiovisual learning center. A program to design CAI courses that respond to the Georgetown curriculum and student needs is being explored by the computer committee of the school of medicine.

Expanding Library Services: Timesharing and Networking

LIS has extended the role of the library in the medical center by allowing it to offer additional services previously beyond its capabilities. The new services influenced expansion of the system and extended the role of librarians. Librarians, armed with newly acquired technical knowledge, are emerging as likely candidates to provide computer and data base–development information services.

Cited in the AAMC report as achieving stage-one status, the library is rapidly entering stage two (see Crawford et al., p. 324). The library's vital role is already accepted in plans for an internal network or integrated medical center information system [5]. Fortunately, the library's internal and external remote stations and networks can interface easily with the developing integrated medical center information system. The time-sharing features of LIS also enable development of small data bases for in-house use by departments. Several departments have experimented with automation by using the library's computer to establish data bases as pilot projects. Specific units benefiting from this service are the department of family and community medicine, the admissions office of the school of medicine, and the radiation safety office of the medical center. To date, these projects exist as private, independent files. They are accessed through telephone lines; the admissions office project occupies four ports; the radiation safety and community medicine projects use dial-up access. These mutually beneficial endeavors provide free services to offices previously unable to automate and enable the librarians to gain expertise in assisting departments with data base development. Consequently, the library is approached increasingly often by faculty to assist them in automation of departmental information files. Recent involvement with the schools of medicine, dentistry, and nursing to create personal information systems suitable for students will undoubtedly familiarize librarians with curriculum requirements. As these service demands continue to grow, the library will need additional computer resources to respond effectively.

One of the intersecting systems of the medical center network is being spearheaded by the school of medicine. It will link existing computers to share data and exchange information more efficiently. Of primary importance is access and interface with LIS via an intelligent port selector, using two or three ports of the library's computer. The network, in its early stage, will include access to patient information, continuing medical education information, electronic mail, library records (including Mini-MEDLINE), and special data bases.

Education of System Users

The design of LIS focuses on effective human interface and a middle-level approach to self-instruction, with no lines drawn between types of users and sophistication in use of systems. Although human interaction with terminals was given priority, the librarians recognized that users need at least minimal instruction to access the system with some degree of success and self-confidence.

Therefore, a simple, threefold educational approach was selected. It consists of (1) initial acquaintance in large-group orientation sessions for students and faculty; (2) more detailed, hands-on instruction given to individual users at the reference desk when they begin to use DOC and Mini-MEDLINE; and (3) instructional seminars

conducted for special groups, especially for those accessing the system from remote sites, such as the department of medicine and the school of nursing. Local librarians who participate in electronic transmission of interlibrary loans have also attended special workshops sponsored by the library.

Observation of users reveals behavior consistent with the current computer mania. Generally, the system has met with instant popularity. Patrons, students, and faculty are extremely eager to learn it. Once initial commands and instructions are mastered to manipulate a search through DOC or Mini-MEDLINE, users readily concentrate on information displayed on the screen. The terminal displays lend themselves to on-line browsing. Tracings and subject headings are more visible on the screen than on a catalog card, where the tracings are located at the bottom. Users spend more time at the terminals concentrating on which items to select. As a result, they are becoming more aware of the collection and are finding that the library's resources satisfy most of their needs. Occasionally, during peak hours patrons will line up to use DOC or Mini-MEDLINE. The Computer Output Microfilm (COM) catalog, available as backup to DOC, is used only on those rare occasions when the computer is inoperative, and a diminishing number of patrons still use the card catalog. Comments from patrons are very positive and some of their suggestions have been incorporated into LIS.

Role of the Librarians

Involvement in computer operations has had a positive effect on the librarians. They have willingly assumed additional responsibilities by participating actively in design of the system and by teaching users how to access the system. Publicity, training manuals, and working documentation have been prepared by the librarians. In addition, they have become knowledgeable about programming and maintenance of a minicomputer. Moving and connecting terminals, printers, and peripheral equipment is part of their accepted daily routine. Librarians not only teach patrons how to use the terminals, but also conduct all in-house training of technicians, library assistants, and student workers. Besides competently fulfilling their job responsibilities, the librarians are also involved in consulting, teaching seminars on computers, and providing demonstrations to numerous visitors.

Generally, the attitudes of library staff members toward their professional future and work environment have been greatly improved by the presence of the minicomputer in the library. Some skilled persons have learned to manipulate and monitor the system, some with technical talents have become knowledgeable about equipment and wiring, and all have gained expertise in using the system to conduct their work routines more effectively. An interesting change in "mind set" has occurred: no one seems to shy from the computer terminals.

Conclusion: Current Status and Future Plans

The library's plan to make LIS accessible from remote sites after it became operational was rescheduled and accelerated to meet user interest and demand. Immediately after the library finished installing patron terminals throughout the building, a program was quickly initiated to place terminals at remote sites of the medical center. Currently, terminals are at the hospital in the department of medicine and the cardiology division, at the school of nursing, and at the Lombardi Cancer Research Center. Faculty can also dial up LIS through their personal computers. In addition, the network to be installed by the school of medicine will allow terminals scattered throughout the medical center to access the library.

Currently, LIS is undergoing completion of version 2, which involves enhancing and refining the catalog and other components. Future plans for version 3 concentrate on expanding network functions, such as the ability to handle multiple libraries and to extend access to remote users through the intelligent port selector. Additional refinements identified by the librarians will also be incorporated. After the programs are stabilized, some components will be "frozen" and system documentation completed. Efforts are underway to test LIS in a microcomputer environment. If successful, an integrated library system in a hospital setting could become a reality.

Work with such institutions as The University of Texas Health Science Center at San Antonio Library, where LIS is being replicated, will lead to further expansion of the system. Suggestions to develop a reserve room component and other modifications of LIS in 1983 can be credited to the San Antonio project. In addition, research and educational studies planned by San Antonio undoubtedly will provide valuable information about LIS. Future plans also include a potential project with the Samuel J. Wood Library of Cornell University

Medical College to replicate LIS in a network approach that includes four of their affiliated institutions. The Cornell network project will provide useful information about system flexibility and the feasibility of linking a "branch library" approach to LIS. Not only has the system been well received at Georgetown, but its unique contribution is gaining recognition from the medical library community, where the nucleus for a users' group is emerging.

ADDENDUM

At the time this article went to press, Georgetown University decided to develop a serials component of LIS as another option.

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