Volume 4
Number 1

ISSN 0730-9295

Information Technology and Libraries

March 1985

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ITLBDC 4(1) 1–88 (1985); Inf Technol Libr

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Information Technology and Libraries

Information Technology and Libraries is the official publication of the Library and Information Technology Association, a division of the American Library Association, 50 E. Huron St., Chicago, IL 60611; *Executive Director:* Donald P. Hammer. The journal is issued quarterly in March, June, September, and December.

Information Technology and Libraries publishes material related to all aspects of library and information technology. Some specific topics of interest are: Automated Bibliographic Control, AV Techniques, Communications Technology, Cable Systems, Computerized Information Processing, Data Management, Facsimile Applications, File Organization, Legal and Regulatory Matters, Library Networks, Storage and Retrieval Systems, Systems Analysis, and Video Technologies. *ITAL* welcomes unsolicited manuscripts. Submissions should follow the guidelines stated under "Instructions to Authors" on page 88 of the March 1985 issue.

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Information Technology and Libraries is a perquisite of membership in the Library and Information Technology Association. Subscription price, $12.50, is included in membership dues. Nonmembers may subscribe for $25 per year. Single copies, $7.50.

Circulation and Production: American Library Association, 50 E. Huron St., Chicago, IL 60611. Please allow six weeks for change of address.

Abstracted in *Computer & Information Systems, Computing Reviews, Information Science Abstracts, Library & Information Science Abstracts, Referativnyi Zhurnal, Nauchnaya i Tekhnicheskaya Informatsiya, Otdyelnyi Vypusk*, and *Science Abstracts Publications*. Indexed in *Computer Contents, Computer Literature Index, Current Contents, Current Index to Journals in Education, Education, Library Literature, Magazine Index, and NewSearch*. Microfilm copies available to subscribers from University Microfilms, Ann Arbor, Michigan.

Second-class postage paid at Chicago, Illinois, and at additional mailing offices. *Postmaster: Send address changes to* Information Technology and Libraries, *50 E. Huron St., Chicago, IL 60611.*

On Technical Writing and Technical Reading

Janet F. Asteroff

Many members of the university community are beginning to take advantage of mainframe and microcomputer systems for a variety of services such as online library catalogs, electronic mail, word processing, programming, and textual and statistical analysis. One aspect of support is documentation, long the stepchild of computing. To understand the position of printed documentation in computing is to observe the form on several different levels of experience. As print, a manual represents a five-hundred-year-old technology. It exists side-by-side with computing, a technology barely forty years old. The complaint seems to be, however, that in both form and content even this old medium fails the user. Its mere presence not only is not *reassuring, but is often cause for trepidation. But documentation is not as bad as many think. Nor, when one considers the many factors that make a system usable, including hardware and software design as well as user attitudes, should documentation be identified as the only problem.*

INTRODUCTION

Computer documentation is receiving its share of criticism these days. A recent popular magazine article with the subtitle "No Matter What Happens, Do Not Look at the Manual" explained the concept of "wall-stare": after people read a computer manual, they put it down and stare at the wall.[1]

In academia, these wall-starers most often are social science and humanities students and faculty, who in ever-increasing numbers are the newest computer users in the university. They have joined those in the hard sciences who for twenty years were the overwhelming majority of users of university computing facilities. Many members of the university community are beginning to take advantage of mainframe[2] and microcomputer systems for a variety of services such as online library catalogs, electronic mail, word processing, programming, and textual and statistical analysis.

As this heterogeneous community develops, those who administer computing resources are raising anew questions about accessibility, functionality, and support. They recognize that it is difficult for most users, regardless of their discipline, to find their way into computing, and once having done so to make profitable use of the resources, whether in the library or in the computer center.

For all users, training and ongoing support are critical for success. One aspect of support is documentation, long the stepchild of computing. Manuals and other forms of assistance now are receiving more attention as humanists and social scientists, who need different kinds of support than

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those in the hard sciences, become involved with computing. The types of manuals that may have worked for technicians and those in the hard sciences are insufficient for those in the humanities and social sciences, as well as librarians using computers to assist them. For users at all levels and in many capacities, printed documentation is crucial when consultants are not available to provide personal attention.

To understand the position of printed documentation in computing is to observe the form on several different levels of experience. As print, a manual represents a five-hundred-year-old technology. It exists side-by-side with computing, a technology barely forty years old. Although the need for documentation varies with expertise, users at all levels always need some printed instruction to use the computer. This situation, in part a "paradoxical combination . . . of seeming continuity with radical change," is similar to one identified by Elizabeth Eisenstein in *The Printing Press as an Agent of Change*, which describes the incunabula period when, during the shift from script to print in the latter part of the fifteenth century, early printers duplicated scribal manuscripts, but through a totally new mode of production, the printing press.[3] At least for the moment, computing still is learned mainly by reading printed materials, since most users are not fortunate enough to have ongoing personal support and instruction. Trends in online documentation and system design, however, will in the future decrease the reliance on printed forms as the entire experience becomes more completely electronic.

On a more conscious level, whether new users are faced with a terminal connected to an invisible mainframe system or with a microcomputer with a system unit, monitor, and disk drives, only two components of the computing experience initially appear recognizable: the keyboard and the printed documentation. New users soon discover that there are several keys that make a computer keyboard substantially different from a typewriter's, which has not changed much since 1873. This leaves the printed manual as the most familiar technology, in many cases the sole lifeline to a system they have never seen before and which offers an almost totally new environment for thinking and learning. The complaint seems to be, however, that in both form and content even this old medium fails the user. Its mere presence not only is *not* reassuring, but is often cause for trepidation.

DEFINING THE REAL PROBLEMS

Does reading computer manuals really bring about catatonia? Certainly they do provoke a wide range of emotions and, for the most part, criticisms of technical manuals are valid. But documentation is not as bad as many think. Nor, when one considers the many factors that make a system usable, including hardware and software design as well as user attitudes, should documentation be identified as the only problem.

Among the valid criticisms of computer manuals are that they are poorly written and printed; the index is incomplete, esoteric, or nonexistent; the table of contents is too detailed or too sparse; there is no cross-referencing in the text; there are no usage examples or diagrams; they are too elementary or too advanced; and finally, they are condescending in tone. These criticisms are true of many manuals, and significantly hinder those learning how to use a system.

These criticisms are not applicable to all manuals, however. Technical documentation is getting better, in part because of the widespread use of personal computers and, therefore, the vendor's responsibility to make products usable. Many technical writers and editors now are reaching out to their readers with clear prose narratives, good usage examples and diagrams, and more than a little humor.

The most important criticism that can be made about computer manuals is one that users rarely think of. The manual fails to *teach* users how to apply information and concepts to different situations. The best computer manual not only explains what users need to know to perform a specific task, but teaches them how to apply this knowledge in a variety of ways. Such explanations are not always presented in prose, but often through usage examples and diagrams that illustrate a variety of procedures in one situation applicable to many others, e.g., how to create, modify, and save a text file in a typical session, not only how to create a file.[4]

Most manuals fail to teach users for three reasons. First, technical writers often think of themselves rather narrowly as communicators of information, not as teachers of computing in the larger sense. Second, it is always difficult to write effective instructional material without access to potential users, without knowing the audience. To teach only through writing, or with the complete absence of verbal and nonverbal communication, may never really be teaching in its purest sense, but only imparting information. Third, the computer system or software application may be too complex to explain clearly in writing.

To be fair to the art of technical writing and to hard-working users, there are systems even the best writer cannot explain, and the most skilled programmer or analyst cannot understand very well. These hardware- and software-related problems remain obscure because users do not know enough to evaluate system design from a functional or technical point of view. They do not ask of a system "Why does it make me do it this way when the other way is easier?" Poor documentation is not the only failing of computer systems, even if it is the most identifiable one, and it certainly is not the problem if it is good.

Users also share a great deal of responsibility for their success or failure. It is clear that systems are not perfectly designed, manuals are not perfectly written, and users do not take time necessary to learn how to use either well. Even in the best possible circumstances, no technical manual, particularly in computing, can be all things to all people. Some make very profitable use of a manual, while others are confused by it and only use bits and pieces. Generally, if most users applied to learning computers only a fraction of the time they spent learning to use another technology, such as the alphabet, they all would be technical wizards. Like any new and complex technology or tool, learning to use computers requires a great deal of time and patience.

THE DISCERNING READER

Many users are unaware that documentation has always been a significantly weak point in system development and application even for those inside the computer industry at all levels. Poor documentation is not a wrongdoing perpetuated only on new or unsuspecting users. The reasons for this traditional failing could fill a book, but is traceable to a lack of skilled technical writers. Most often documentation was left (and in some cases still is) in the hands of programmers, analysts, and other technicians who did and do not communicate well orally or in writing, particularly to those at a lower level of technical expertise than themselves. More attention to the profession of technical writing, including master's degree programs at such schools as Carnegie-Mellon University and Rensselaer Polytechnic Institute, as well as professional programs leading to certificates in technical writing, is beginning to rectify this situation.

Still, computer documentation follows in a long line of technical literature that was never adequate, including instructions for assembling a child's toy or hooking up the latest stereo component. This comparison does not imply that bad computer documentation is excusable, but only that bad technical literature is not limited to computing.

Further, perhaps we should pay more attention to the amount of bad literature we tolerate with minimal complaint. Of course our lives still go on rather well, even if journals, newspapers, and magazines contain only a few worthwhile articles. This is not the case with computer manuals because of their utilitarian function. And no matter what the content, the form should not be ignored. Ultimately the impact is the same: the literature is poorly written, confusing, and not worth reading. Bad computer manuals have lots of company.

Harper's editor Lewis Lapham, who *does not* contribute to bad literature, speaks directly to these issues in his essay, "On Reading." "On first opening a book," he writes, "I listen for the sound of the human voice. By this device I am absolved from reading much of what is published in a given year."[5] Lapham argues that the institutional codes used by writers in academic, political, and technical fields make these kinds of literature unworthy of his attention, unless they are absolutely necessary for professional reasons. They have no human voice, just the "messages already deteriorating into the half-life of yesterday's news."[6]

Regardless of the genre, the sound of the human voice should be listened for in all *good* writing, and surprisingly it may be heard when least expected. It may never be heard in Heathkit manuals, which do their jobs very well without it, but it can be heard in some computer manuals.

FORM AND CONTENT

When users cannot get their work done, they place the responsibility on someone, or something, other than themselves. It is easiest but least fulfilling to be angry with—or at—a book or manual that does not do its job. In *Orality and Literacy*, media theorist Walter Ong observes that what is stated in a book goes on forever. The writer cannot be refuted, and the book or manual still survives, no matter what the reader thinks about it.[7] Print confers many things, among them permanence and legitimacy, even to thoughts we do not like.

This is why when writers and editors, technical or otherwise, emerge from behind the prose and meet their audience, they sometimes find a fair amount of hostility waiting for them. The reader finally attaches a person to those instructions or ideas that did not work, and the writer is going to hear about it. It is almost as though readers expect that writers and editors start with the worst of intentions. Yet this is rarely the case. Most writers, editors, consultants, programmers, and other technical support staff do their best; sometimes their best is not good enough, in part because users' problems are very individual. Writers and consultants can just as easily meet people who found their work to be helpful, and the gratification is enormous, but those in any service capacity usually hear only the complaints, rarely the praise.

TRENDS IN SYSTEM DESIGN

Ironically, just when printed documentation seems to be getting better, or users have adjusted to its being terrible, there will be less of it. More documentation now exists solely online and not in printed form, and some systems are easy enough to use without reading volumes in print or on the screen.

Online documentation is hardly new, but it is getting more attention by designers and writers. These electronic print[8] documents, including "help messages" and other forms, provide assistance at the terminal, and are not duplicated in print. Context-sensitive help and error messages are particularly important, since they provide assistance geared to the user's current situation, unlike standard messages, which are the same in all situations. (OCLC users will recognize "Message not clear" as an example.) Personal computing software usually has more context-sensitive online documentation than do mainframe applications. For the most part, standard help and error messages appear much more frequently than the context-sensitive type, and this now should be considered a serious design defect.

Recent developments in system design indicate that computers need not be the cryptic machine some specialists would like it to continue to be. This is particularly true of Apple's Macintosh, which because of its icon interface[9] and other design features not only requires less printed documentation than most systems, but uses audio tapes linked to tutorial/guided tour computer disks as an effective alternative to print for getting started with the system.[10] However, most personal computers, and certainly most mainframes, are not designed to be easily understood. While some quite correctly argue that computing is complex and cannot be summarized in a few simple sentences, Apple demonstrates that this need not always be the case, although Macintosh users cannot make full use of the system without reading the manuals. Most manufacturers and designers try but fail to understand where the threshold actually is—

where they must meet their potential users—and so they do not make a system reasonably easy for people to use.

Good system design does not automatically lead to good documentation, nor is the converse true. A good case in point is MCI Mail and Western Union's EasyLink, two popular electronic mail services. MCI's printed documentation is inadequate and confusing, even if it is printed in several colors (which really does make it easier to follow; it's not all for aesthetics). And yet, the MCI mail system is designed in such a way that even a novice user can send and receive messages without making too many mistakes.[11] The EasyLink documentation comes in an expensive binder, complete with good, clear examples and explanations, but the actual system is esoteric and does not follow the thought patterns of rational individuals. You need the documentation to use EasyLink, which is probably (and fortunately) why it is so thorough. It is not always the case that good documentation means an otherwise difficult system, yet this is something to consider when evaluating computer systems.

Even with better system design, it will be some time, if ever, before printed documentation is completely replaced by the supremely easy-to-use computer or alternative forms of assistance. Printed documentation, or books of any kind, will not be totally displaced, at least not until disks or their successors can be read easily and inexpensively on a park bench or at 30,000 feet. Furthermore there is no reason to believe that the perfect system will emerge soon, one that does not even need online documentation. Predictions not too long ago about how computers will create a paperless society now appear frivolous, since current indicators show that the paper industry, unlike most others, is operating at full capacity. The trend, however, seems to be that various kinds of online assistance, including electronic print as well as audio and video technology, will emerge as effective alternatives to printed forms.

CONCLUSION

There is no shopping list of what to look for in documentation, how to separate the good from the bad, easily. Most times this is not clear until it is used. But some features that may indicate a good manual are:

- clear prose narratives
- usage examples and diagrams
- sample sessions
- cross-referencing in the text
- a complete index with logical entries and *see* and *see also* references
- a specific and comprehensive (but not overly detailed) table of contents
- a clearly defined level of instruction
- clear printing and overall spacious design and layout

Computer manuals are books, not scribal manuscripts. Features that differentiated these two media in the early sixteenth century, such as indexes, tables of contents, cross-referencing, and portability, and thus made the former easier to use than the latter, should not disappear in the age of electronic print. Pagination seems safe on all fronts, however.

Three guiding principles should be followed when considering the use or purchase of a computer system:

1. Choose a *total* system, which consists of three components: hardware, software, and documentation.

2. Evaluate the documentation with the features above in mind. Like any book or publication, it has to have qualities that make it worth reading or buying.

3. When using the computer, do not try to read the manual cover to cover in one sitting, which will always produce extreme cases of wall-stare. Technical manuals are not bedtime reading, no matter how well written, how pretty the pictures, or how funny they may be. Like testing the water before swimming, proceed cautiously at first, then dive in, but know when to come up for air. Often it works best to first read for comprehension away from the terminal, and later, at the terminal during actual use. Reading for reference is almost always done as needed while using the system.

The computing experience can be profitable and enlightening, and perhaps even fun. As in all learning, a willingness to think, experiment, and work hard are always the fundamental ingredients for success.

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2. A mainframe system, which may also be a minicomputer, is a large computer that accommodates several users at once through a time-sharing environment.
3. Elizabeth Eisenstein, *The Printing Press as an Agent of Change: Communications and Cultural Transformations in Early Modern Europe* (Cambridge Univ. Pr., 1979, 1980), p.51.
4. Ideas on these points have benefited from electronic mail "discussions" with Purvis Jackson (PMJ@CM-CS-CAD), Writer and Lecturer in Technical Writing, The Robotics Institute and Carnegie Institute of Technology, Carnegie-Mellon University.
5. Lewis H. Lapham, "On Reading," *Harper's* 268:6 (May, 1984).
6. Ibid.
7. Walter Ong, *Orality and Literacy: The Technologizing of the Word* (New York: 1982), p.79.
8. Electronic text/print is text that is displayed on a CRT or TV screen. It is interactive in the sense that users may modify their own textual product, and because the system responds to user commands that are entered in textual symbols. This would include computer systems and videotex applications displayed on TV sets, but not electronic text presented in silent or sound films.
9. The Macintosh interface is primarily composed of icons, or small pictures representing various system components, e.g., a file is represented by a small picture of a file folder, with the name of the file in text on it. Files are deleted by "throwing them away" in the "trash" which is a picture of a trash can.
10. *A Guided Tour of Macintosh.* (Cupertino, Calif.: Apple Computer, 1983).
11. MCI Mail is a completely menu-driven system, which does not accommodate a direct command structure to bypass the menu options. This slows down users who already have some expertise, as well as new users as they gain such expertise. ■■

Applications of Local Area Networks of Microcomputers in Libraries

Virginia M. Levert

The local area network (LAN) of microcomputers is beginning to be applied in library settings, and there is an increasing interest in this technology from librarians. Important features of LANs are reviewed, and several microcomputer LANs are described. Although library installations of microcomputer LANs are fairly new, some conclusions are drawn about the tasks being automated by these systems. Some considerations for libraries contemplating automation with a multiuser microcomputer system are addressed.

INTRODUCTION

Local area networks (LANs) of microcomputers are in use in business and office settings, in the classroom, in industry and laboratories. The number of libraries using microcomputer LANs is still small but is growing. It is clear that the technology is the same whether applied in a business or a library setting, although, of course, the applications supported by the LAN will differ. It is not yet clear, however, where the LAN of microcomputers fits in the overall scheme of library automation.

This article will look at the use of microcomputer LANs in libraries. LAN technology will be briefly discussed, and several vendors' LANs will be described. The results of a survey of ten libraries using or planning to use a LAN of microcomputers are also given. The survey was made to identify some current uses of microcomputer LANs in libraries and to attempt to discover why a microcomputer LAN was chosen rather than some other system. Installations are all so new that it is still difficult to draw conclusions about the advantages or difficulties of these systems. It is hoped, however, that the information presented here will help alert librarians to the availability of this technology and perhaps assist in their choices of an automated system.

LOCAL AREA NETWORKS

A LAN allows communication among computers and peripherals that are located within a limited geographical area. The devices linked by a LAN are physically connected by one of several types of transmission media (wire or cable). While provision is often made for remote connection by modem to other networks or computing facilities, such connections are not necessary to the operation of the LAN. The area covered by a LAN varies; it is usually confined to a single building or one floor or section of the building, although larger LANs can extend up to several miles. The LAN is normally owned by a single organization.

LANs can connect many types of computer equipment: mainframes, minicomputers or microcomputers, or combinations thereof. Computers are linked with each other and with peripherals such as word

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processors, intelligent terminals, printers, disk drives, and integrated-function workstations.[1] Microcomputer LANs are not as powerful as LANs meant for larger machines and longer distances, but since additional power and size are not needed their cost is lower.

LANs can be differentiated in many ways including by topology or geographical layout, transmission medium used, data transmission rate, distance covered and number of nodes supported, access control, error detection and correction protocols, transaction monitoring and control, and interaction (gateways) possibilities with other LANs or with remote computer networks.[2]

The topology of a LAN refers to the spatial arrangement of its nodes and links. The most common topologies are serial and parallel bus, ring, and star. LANs using serial bus topology are among the most common in current use. Bus networks usually consist of one long central cable to which each node is connected directly, or through "cluster box" or multiple station connections. Two cables per station are often used, one to receive and the other to transmit. All transmitters are connected by the bus to a retransmitter that amplifies and broadcasts the signals via the "receive" cable.[3] The advantages of a bus LAN are rapid data transfer over relatively long distances (up to one mile with signal regeneration), ease of expansion without the need for reconfiguration or interruption of the network operation, and "graceful degradation": if a node fails, the network continues to function. A disadvantage is the need for a relatively complex network access protocol since there is no centralized network controller.[4]

The ring topology is a "bus that is closed back on itself."[5] All nodes in the ring are connected to a "common coaxial cable via an active repeater, forming a circular chain ring."[6] The advantages of the ring topology are that it requires no centralized network controller, supports a higher transmission speed than the bus topology, and—since access to the network is deterministic—permits calculation of the maximum access delay. A LAN with a ring topology can cover a greater distance than one with a bus topology because messages can be regenerated by node repeaters. Disadvantages are that, since all nodes are linked to a common cable, installation can be complicated and the entire network must be shut down if a node is added or changed. In addition, unless a bypass scheme is used, the whole network can go down if one node fails. Many ring configurations use redundant paths or a bypassing scheme to avoid this problem.[7]

Another network topology, the star, consists of many terminals or devices connected to a dominant central node. The central node controls network operation, eliminating the need for complex accessing schemes. The disadvantage of this topology is that if the central node fails, the whole system is incapacitated. The star was the first network topology to be developed and is one of the most prevalent types of networks in general, although LANs, including microcomputer LANs, are often designed around the other topologies described.

Transmission media that can be used by LANs include twisted-pair wiring, coaxial cable, and fiber optics. Twisted-pair wiring is the lowest frequency and least expensive link. Transmission rates of 250K to 2M bps (bits per second) are supported. Coaxial cable is of moderate cost but performs well, is readily available, and supports data transmission rates of megabits per second without requiring signal regeneration. Coaxial cable supports both broadband and baseband transmission. The use of fiber optics in microcomputer LANs is probable in the near future. Although it is more expensive, it performs better than other media, providing nearly unlimited bandwidth and very high-speed data transmission (gigabits per second); it is not affected by electromagnetic interference and is small in size and light in weight.[9]

Messages or data are transmitted in packets that also contain information on their source, destination, packet sequencing, and acknowledgement of receipt. There are several different protocols by which these packets are transmitted by the LANs. The most common accessing protocols in use are carrier-sense multiple access with collision detection (CSMA/CD), carrier-sense multiple access with collision avoidance (CSMA/CA), and token passing.[10]

CSMA/CD, also called contention access, was developed by the Xerox Corporation in 1976. It is used in many bus networks, the prototype being Xerox's Ethernet.[11] A network node transmits a message "after listening to the network to make sure it is not busy. Should the network be busy, the node must wait until it is clear before it can begin transmitting."[12] After the message has been transmitted, the node continues to "listen" to the network to "detect any collision with message packets being sent simultaneously by one or more nodes on the network. In the event of a detected collision, all transmitting nodes abort their operations and back off a random amount of time before attempting to retransmit their packets."[13] The random waiting period is influenced by network traffic volume, message length, and the physical length of the network.

Some bus networks, especially if the network is not extensive and will carry a light load, use collision avoidance rather than collision detection. CSMA/CA may be less expensive to implement since collision detection circuitry need not be included in the interface. In this accessing scheme "message collisions get detected by the sending and receiving nodes' circuits. In a common detection technique, the receiving node delivers an acknowledgement signal back to the sender. Should the sender not receive the acknowledgement, it usually retransmits until successful."[14]

Another method of network access, used by many ring- and some bus-topology LANs, is token passing. Token passing is a deterministic accessing scheme since each node is guaranteed access within a set period of time, unlike CSMA where, theoretically at least, waiting times to access the network could be "infinite."[15] The effectiveness of the token-passing scheme is not affected by the length of the network or the data transmission rate. Since access is controlled by a token circulated among all nodes at a constant speed, there is no need for a mechanism of collision detection.

The strengths of the token-passing protocol are that the maximum delay in gaining network access can be calculated; there is no need for a collision detection mechanism, and there is high transmission efficiency.[16] Drawbacks are that more complex hardware is required to support a token-passing network, so equipment may be more expensive than for other accessing schemes, and that if an error does occur in token handling by a node, it can be difficult to locate and correct.[17]

MICROCOMPUTER LOCAL AREA NETWORKS

Among the virtues of the microcomputer are its small size and its orientation toward the individual user. These can also be disadvantages when the microcomputer is not used as a personal computer but as a source of computer power for large, automated applications and those where data must be shared by a number of users. Microcomputers can support more than one user through the connection of "dumb" terminals (terminals without any processing power or data storage capacity of their own). Another way to share computer power, peripherals, and data is, of course, the LAN. LANs are not new to the computing world, since the technology has been developing for about a decade, but their use for linking microcomputers is of fairly recent origin.

Kotelly (1983) notes the rapid growth in the number of what he calls PCNs (personal computer networks), LANs connecting microcomputers only. These are defined as LANs operating at data transmission rates of less than 2.5M bps (megabits per second), with six or fewer microcomputers and peripherals such as hard disk drives and printers. Due to their limited size and complexity they can bypass some of the technical concerns of the higher-cost, higher-performance LANs. Among the LANs he considers to be PCNs are PLAN 4000 (Nestar Systems),[18] Omninet (Corvus Systems), Hinet (Digital Microsystems), PCnet (Orchid Technology), and microcomputer connections to Ethernet (such as 3Com's).[19]

According to Kotelly, vendors of LANs for microcomputers often concentrate on offering low-cost, functional networks, some of which can access the higher-cost, higher-performance LANs (for example, Ethernet). On the other hand, he notes, standardization is lacking. Rather than wait for standards to develop, the market demands (and gets) practical solutions to local area networking needs. Attention to standards is beginning to appear, and some microcomputer LANs incorporate portions of the International Standards Organization (ISO) Open Systems Interconnection (OSI) reference model for the standardization of communication systems.[20] Most microcomputer LANs incorporate only the lowest levels of the OSI reference model (physical and data link layers) in the network hardware. Higher-level protocols have not yet been standardized. Saal (1982) states that due to the "great variety and flux found in high-level protocols, most current office-automation network applications are implemented in software rather than hardware."[21]

The number of microcomputer LANs is rapidly increasing, and some type of networking is available or being developed for most microcomputer equipment. LANs differ on several points, as described previously, and can also be separated into proprietary (developed by vendors for their own equipment) and nonproprietary (developed by one vendor, then adopted for use by other vendors) groups. Following are descriptions of some microcomputer LANs; this group of products is, of course, by no means comprehensive. Proprietary LANs include ARCnet (Datapoint), Hinet (Digital Microsystems), and ShareNet (Novell Data Systems). Nonproprietary LANs include Ethernet (Xerox Corporation), Omninet (Corvus Systems) and PLAN 4000 (Nestar Systems). Since the ARCnet technology has been adopted for use by several other vendors, including Nestar and Tandy, it is considered by some to be a nonproprietary LAN.[22]

ARCnet

Datapoint's ARCnet (ARC stands for attached resources computer) supports a wide range of that manufacturer's equipment. It is a token-passing bus network, but the "electrical connection is made (every 2,000 feet) through a star-like amplifying and isolating device; thus the physical topology resembles a star or tree-like form."[23] Up to 255 nodes may be connected, and stations can be up to four miles apart. The network is fairly powerful and transmits data at 2.5M bps.[24]

Hinet

Hinet is manufactured by Digital Microsystems and links that vendor's equipment. Up to 32 nodes (microcomputers or peripherals) can be linked, and the total length of the network can be up to 1,000 feet. The LAN uses twisted-pair wiring, or flat ribbon cable for shorter distances. Data is transmitted at about 500K bps, making Hinet a relatively low-speed network.

Hinet is somewhat unusual among microcomputer LANs; its topology and network access are not among those discussed previously. Network topology is a multidrop configuration,[25] and network access uses the polling collisions-prevention technique. In a polling accessing scheme, a master station controls all transmissions; no node may transmit until allowed to do so by the network controller. Each node (station) is polled by the network controller every 1/60 second. The master station controls the hard disk drive and access to it, as well as network operation.[26]

ShareNet

ShareNet (Novell Data Systems) has two configurations, Netware/S and Netware/G. According to a Novell representative, Netware/G is a bus network that supports up to 64 IBM PCs and IBM PC XTs. The maximum total length of the Netware/G is 3,000 feet, and data transmission speed is 1.45M bps. Connections can be made to Omninet, Ethernet, and Pronet (Proteon Inc.). Netware/S allows up to 24 IBM PCs or IBM PC-compatible, Victor, and TI microcomputers to be connected in a star topology, in a total network length of up to 4,000 feet. Data is transmitted at 500K bps.

Ethernet

Ethernet, one of the first LANs to appear on the market, was developed at the Xerox PARC (Palo Alto Research Center) in the mid-1970s. Because of its early availability Ethernet achieved a lot of de facto acceptance before standards for LANs were proposed, and it forms the technical basis for one of three standards currently under discussion by the industry. Its "high performance and tight technical specifications" cause it to be somewhat more expensive than other LANs, a drawback—especially when dealing with less expensive systems such as those based on microcomputers.[27] Ethernet is now available for microcomputers; 3Com Corporation, for instance, manufactures Ethernet controller boards for several types of microcomputers including the IBM PC.

Ethernet incorporates the CSMA/CD accessing scheme, has a bus topology, transmits data at 10M bps, supports up to 1,024 stations, and each segment of the Ethernet can be up to 7,600 feet long. The transmission speed of 10M bps is four or more times faster than most networks now available for microcomputers.[28]

Omninet

Corvus Systems' Omninet is a bus network that uses a CSMA/CA accessing scheme. Up to 64 stations can be supported, and there can be up to 1,000 feet between stations—or 4,000 feet, if 1,000-foot segments are connected with repeaters. Twisted-pair wiring is used for connection. Transmission speed is 1M bps. Apple II, Apple III, IBM PC, Apple II with CP/M (and other CP/M-based machines), and the Corvus Concept workstation can be networked; it is claimed that microcomputers of various types can be mixed in any combination on a single Omninet LAN.[29] Each attached microcomputer or workstation has its own interface controller, which performs network management functions, so that a separate network controller is not needed.[30]

PLAN 4000

Nestar Systems' PLAN 4000 (PLAN stands for personal local area network) uses the ARCnet interface hardware, Xerox's Ethernet software protocols, and proprietary software. The use of several well-accepted protocols will allow "the eventual easy interconnection between ARCnet and Ethernet for Nestar products. . . ."[31] PLAN 4000 supports the connection of up to 255 Apple II, Apple III, and IBM PC microcomputers, in any combination. The network is a "logical ring"; access is by token passing, and several different physical topologies are permitted. Any two stations can be up to four miles apart, and data is transmitted at a maximum of 2.5M bps.[32]

USE OF MICROCOMPUTER LOCAL AREA NETWORKS IN LIBRARIES

To identify libraries using or developing an automated system running on a LAN of microcomputers, librarians and information scientists, library automation consultants, and vendors of library software were contacted. Ten libraries were contacted, and the persons in charge of the automated systems were interviewed. Two more libraries using microcomputer LANs were identified in the library literature, resulting in a total of 12 libraries for this survey. It should be noted that all interviews were carried out during the first quarter of 1984, and work in several of the libraries has progressed considerably since that time. Interviews were almost all done by phone; due to the nationwide location of the libraries, it was impossible to visit more than a few.

Of the twelve libraries contacted or appearing in the literature nine had installed, intended to install shortly, or were in the process of developing an automated system running on networked microcomputers. The remaining three were considering a LAN but either had not made a decision to acquire one or had not chosen which system to install. Two of these three had planned the functions to be automated and thought that a LAN was likely to be installed in the future. As can be seen from table 1, all types of libraries are represented in this group, and many different applications are automated by these systems. Following is a brief discussion of these applications.

Each of the four special libraries uses a LAN of microcomputers to support library software integrating acquisitions, online catalog, circulation and serials management. Two were planning to provide access from the microcomputers in the offices of employees of the parent corporation. Three of the four public libraries use, or plan to use, a LAN to support a single function: circulation management.

One academic library is developing a sys-

*Table 1. Use of Microcomputer LANS in Libraries.**

Library	Type of Library	LAN	Use of LAN	Date Operational
A	Special	ShareNet (Novell Data Systems)	Integrated library system	October 1983
B	Special	Hinet (Digital Microsystems)	Integrated library system	June 1983
C	Special	ShareNet (Novell Data Systems)	Integrated library system	Spring 1984
D	Special	ARCnet (Datapoint)	Integrated library system	Installation in progress
E	Academic	Omninet (Corvus Systems)	Information management at branch	Under development
F	Academic	Omninet (Corvus Systems)	Make software available for patron use	Fall 1982
G	Academic	Plan 4000 (Nestar Systems)	Online public access catalog	Under development
H	Public	Omninet (Corvus Systems)	Circulation management	May 1983
I	Public	Omninet (Corvus Systems)	Circulation management	October 1983
J	Public	———	Information management at branches	Under consideration
K	Public	———	Circulation management	Under consideration

*All data as of March 1984

tem to automate several functions such as reserve-room records, acquisitions information, and serials holdings at one campus branch. Their LAN is not intended to support major library processes, several of which are planned for a campuswide system currently under development. A large public library system, similarly, is considering the use of microcomputer LANs to support local information needs at its branches, supplementing centralized systems that automate processes common to the entire system.

Of the remaining two academic libraries, one uses a LAN to make microcomputer software available to patrons. Software is stored on a hard disk and can be called up for patron use from any of the several microcomputers.[33] The other is developing an online public access catalog to be stored on a hard disk drive and accessed by patrons from networked microcomputers.[34]

The types of libraries using LANs are quite varied, as are the applications they support. Although it would seem logical for smaller libraries to use several networked microcomputers rather than a minicomputer or mainframe-based system, fewer than half of the libraries surveyed could really be considered "small." What seems to be more important to the choice of a LAN is the task to be automated. Applications were relatively uncomplicated and involved comparatively small databases. The microcomputer's low cost and ease of use were important to all the libraries, and cost was most often cited as the major reason for the choice of a microcomputer rather than something larger. Other positive aspects mentioned were flexibility, relative ease of replacement in case of failure or malfunction, and the ability to support a variety of computer programs.

Three of the special libraries acquired their automated systems, including hardware, LAN, and integrated library software, from a single vendor: DTI Datatrek

(Encinitas, California). Two of the public libraries also purchased complete packages of hardware, LAN, and software from one vendor, Gaylord Library Systems (Syracuse, New York). In most of these cases the libraries chose the software first, then looked for a microcomputer-based system. Both vendors' software is available in stand-alone and multiuser versions, and the vendors suggested the LAN configuration as best meeting the libraries' needs. Thus it appears that the vendors themselves have played a significant part in the adoption of LAN technology by libraries, as well as in the development of LAN-based systems for library use.

The remaining libraries were all doing system building in-house, acquiring the system components from various sources, not a single vendor. Several were doing software programming as well. Only one had a fully operational system at the time the interview took place.

In general the smaller libraries were able to use prepackaged systems effectively. There was also little staff time or expertise to devote to custom-building a computer system. Staff shortage was almost always cited as a reason (or *the* reason) to automate. The larger libraries, those with less easily defined requirements and those with available staff, have spent considerable time and effort on system design and/or software development. Most of this latter group did not have operational systems, although two expected to have completed installation by the end of 1984. The lengthy period of development could have been required because of the nature of the tasks automated, or because a system developed in-house generally takes longer to plan and implement than one using commercially available programs. In addition, the number of turnkey library systems available for microcomputer LANs is still somewhat limited at present.

The number of libraries using LANs of microcomputers is still relatively small but is considerably larger than the group surveyed. It was impossible to obtain an estimate of the number. Few library applications of LANs are described in the literature, and while vendors marketing LAN-based library systems can pinpoint the number of libraries that have installed their products, many libraries are designing or developing their own systems. However, of the libraries described here, more than half are still in the process of developing or installing a system. Thus there is also a difference between the number of libraries intending to use a microcomputer LAN and those actually doing so.

All of the libraries discussed here are located in the United States, except for one of the academic libraries in London, England.[35] Although this was the only application in the United Kingdom that was found in the literature, it cannot be assumed that there is little activity in the development of microcomputer LANs for library use in that country. A considerable amount of work in this area was found in the U.S., even by an informal survey, yet there is little evidence of it in the literature. It is obvious that the British Library is interested in testing the microcomputer LAN for its applicability in libraries, since it is helping to fund the project noted here.

CONSIDERATIONS IN CHOOSING A LAN

Farr (1983) feels that "LAN technology has real potential in library automation," and notes that "library automation has been closely correlated to data processing trends."[36] Several vendors of library automated systems supply library software that can run on a LAN of microcomputers, including Gaylord Library Systems, DTI Datatrek, CLSI Systems, and Easy Data Systems.

Business data processing methods are certainly applicable in the library setting, but it should be remembered that the purpose and importance of what is being automated may not translate directly from business to library. Hayes and Becker (1974) note that library operations often demand the automation of comparatively larger files than in business operations, with a lower proportion of file activity. The file that is automated is the substance of the library operation whereas in business, files are often of a supportive nature (e.g., bookkeeping, correspondence, inventory; the information in the files is not the "product" as it is in the library). Thus, inevitable changes in basic records, as a result of automation, "affect the character of the library services themselves."[37]

Libraries considering a LAN, or any automated system, should of course carefully study their needs and the products, those presently available and those under development. This is particularly true when implementing a new (at least, in the library setting) and rapidly evolving technology such as the microcomputer LAN. "There is clearly no best single local area network, or architecture, or transmission medium, or access method. The more reasonable question. . . , which can be answered, is: For a given set of user requirements in terms of response time, flexibility, growth, software, protocol conversion, etc., what is the most cost-effective local area network?"[38]

The purpose of a LAN is to link computers and peripherals, allowing multiple users to run individual applications and also to access the network to transfer data and to share programs and peripherals linked to the LAN. From the descriptions of system use it appeared that many of the libraries surveyed were using a LAN to fulfill this purpose. Several more used (or planned to use) microcomputer terminals mainly to access and update data and programs stored on a central hard disk drive.

While there is not yet a wide variety of library software that can be used in a multiuser microcomputer environment, it would seem wise for each library to decide whether a centralized multiuser system is needed (that is, multiple access to a central data store) or if decentralized processing is required. It may be that a large microcomputer linked to a hard disk and accessed by "dumb" terminals would be appropriate in some cases, while networked stand-alone microcomputers would be better in others.

Another capability of a microcomputer LAN is access from microcomputers or terminals located in other areas of the organization. (In the case of a public library, remote access from the home could be considered, requiring a modem connection to the LAN itself.) None of the libraries interviewed had implemented this capability at the time, although several saw it as a future goal and at least one has since installed it. Being able to support access from patrons' own personal computers brings a library one step closer to the vision of the "electronic library of the future," as described by Kaske and Sanders (1981). "The most striking feature may be that the librarian and patron need not see each other for the patron to use the library's service and materials."[39]

Another concern of local networking, and of any automated system, is its ability to provide links to other systems. According to Hardwick and Federbusch (1982), the "next logical step in the functional evolution of local networks is extending their range to include regional and global nodes."[40] Libraries have traditionally tried to share resources, and this could be facilitated by the judicious choice of a local-area network. The concern of linking with other networks is thus even more important to libraries, perhaps, than to businesses where it is often preferred that information stay in-house. The extent to which a library will wish to have their system communicate with other systems should play a part in their choice of a microcomputer LAN.

CONCLUSION

Farr (1983) thinks that the LAN of microcomputers is a logical technology for libraries to adopt, and cites lower cost and greater flexibility as advantages over larger minicomputer-based systems. If the data obtained through this survey are any indication, microcomputer LANs are particularly useful in (1) smaller libraries that want to automate one or more functions and require more power or access from more locations than possible from a single microcomputer, but do not want the cost and complexity of a minicomputer system; and (2) larger libraries that need small computer systems to support local function supplementing a centralized system operated by a main branch or parent organization.

There is no doubt that interest in and use of microcomputer LANs by libraries is growing and will continue to grow. Is the LAN of microcomputers an alternative to the minicomputer? Is it a "natural" step for the library using or desiring microcomputer-based automation? For each library the answer should be a response to present and future needs, with consideration of some of the points touched on previously. It is certain that libraries must choose from an increasing variety of possibilities. While the choice of an automated system may become less clear-cut, the options available are becoming more numerous, providing better opportunities for the installation of a system able to meet and grow with the individual library's needs.

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Automation as a Socio-Organizational Agent of Change: An Evaluative Literature Review

John N. Olsgaard

Through an evaluative review of the literature in the disciplines of management science and social psychology, this study analyzes the causes of difficulties experienced when introducing technological change to an organization and to the organization's employees. The results indicate that the common failures of computer innovation consist of technological, organizational, and behavioral deficiencies. The nature of these deficiencies is delineated, and alternative solutions are explored. Recommendations for further research on the applicability of these findings in the library environment are also examined.

In the last twenty years the growth of computer systems used by libraries has been massive and impressive. Spurred by demand, public and private monetary support, and perhaps a good measure of intraprofession rivalry, most academic libraries in the United States now include the use of the computer in some form. Library organizations were in such a hurry to be included in this transformation that very few contemplated the resulting effect of computer-aided systems on their employees. Allen B. Veaner alludes to this when he states, "Technological change may occur overnight, but social change must *evolve* if continuity and effective utilization of technology are to be assured."[1]

Probably because of the comparative recency of the introduction of computerization to libraries, the literature of library and information science is still concentrated on the technological ramifications of various systems. While some progress has been made into the organizational problems of library automation, little attention has been given to the human concerns of this kind of innovation. In short, as Kathleen M. Heim has pointed out, the literature of library and information science has lagged sadly behind in testing and applying the results of behavioral research that has been conducted in the fields of management science and social psychology.[2]

The purpose of this literature review is to conduct an evaluation of the research performed in other fields concerning the behavioral aspects of the introduction of computer technology, and to examine the applicability of these findings for further study in the library environment. For purposes of this study, the terms *automation* and *technological innovation* refer to computer or computer-based systems; the term *users* refers to library employees rather than a particular service community. The framework used to implement this review will follow Herbert A. Simon's guide to rational decision making, which includes the following activities:

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a. Intelligence activity—determining the nature of the problem.

b. Design activity—examining alternative solutions to the problem.

c. Choice activity—selecting a particular course of action.

d. Review activity—assessing past choices.[3]

INTELLIGENCE ACTIVITY—DETERMINING THE NATURE OF THE PROBLEM

The problem of dealing successfully with technological change is not unique to libraries nor to modern society. One of the hallmarks of the human species has been its ability to cope successfully with the changes produced when the implementation of a new machine or process has altered fundamentally the character of the human environment. What is unique is that in the last two decades the study of the process of change has come under active investigation. The disciplines of management science and social psychology have devoted considerable energy to the study of the process of change, specifically the kinds of change induced by the introduction of computer-based systems. Much of the literature that was originally written about the general aspects of the change process has found new relevance in the more recent phenomenon of technological change. Thus, the exploration of the nature of the problem includes not only an examination of the literature of computer innovation, but also a review of the more general foundations of the effect of any change on organizations and on the individuals employed within those organizations.

The work of Henry C. Lucas, Jr., suggests that the kinds of problems experienced with the introduction of a computer-based information system follow a linear progression.[4] According to this framework, an organization, or the literature of the discipline affected, progresses from problems concerning primarily technological or physical considerations, to the organizational considerations, to the behavioral aspects of computerization. For example, the introduction of a batch-mode computer system will first present mainly technological problems, such as what system will operate most efficiently and what software programs will make the system function most effectively. Once the majority of technological problems are solved the emphasis shifts to organizational problems such as the kind of personnel and the kind of communication system that will be used within the organization to make the computer system produce maximum results. When the organizational problems have been solved the emphasis moves to behavioral or human problems such as how to convince employees to accept and use the computer-based system. As such, the Lucas framework uses a type of inductive approach to problem solving. That is, the emphasis moves from general problems to more specific problems nested within the larger framework.

Kenneth W. Clowes has taken this analysis a step further by suggesting that the Lucas hierarchy of problems is basically correct, but that the progression is cyclical rather than linear in nature.[5] In this framework the same kinds of problems will tend to recur when an additional technological change is introduced. To extend the previous example, the same sorts of problems (i.e., technological, organizational, behavioral) will tend to recur if the computer system shifts from a batch mode to an online time-share mode.

Each of these problem areas presents its own set of concerns and will be considered separately.

Technological Problems

The technological aspect of the introduction of computer-based systems has received primary attention in the literature of library and information science. This literature describes primarily how a particular kind of computer hardware or software system can be applied to a given library process, often in a particular setting. In this area the amount of stress on the library organization or on the library employee is dictated by the degree of technological change introduced. For example, moving from no computer-based system to one based on a cathode-ray tube (CRT) with memory capabilities may well induce much stress; whereas, shifting a given operation from a CRT-type terminal to a CRT with memory capabilities should result in relatively little stress.

There is a difference of opinion in the literature as to whether technological applications will dictate the development of library operations or, conversely, library operations dictate the development of technological applications. If one adheres to the former philosophy then one will agree with the writings of F. Wilfrid Lancaster, which imply that technology will determine the kinds of services that libraries offer.[6,7] If one adheres to the philosophy that library services will move to technological innovation gradually and in ways that improve present services, then the writings of Jesse Shera[8] and Richard DeGennaro[9] will be more agreeable. The difference is one of degree of change and the rapidity with which the change occurs. With the advances being made in the field of computer technology, the problem is not so much whether a technological solution exists, but what form that solution will take and whether the library organization can deal with the subsequent organizational and human problems related to that innovation.

Organizational Problems

It could be considered self-evident that technological innovation within an organization should be well planned and executed. Yet, as several writers in the discipline of management science have asserted, adequate planning remains perhaps the single greatest organizational deficiency when introducing computer-based systems.[10,11,12] In surveys of the banking industry[13] and of a mixture of for-profit industries[14] conducted in the late 1960s, it was determined that many failures in attempted computerization were caused not by system problems but by a lack of prior thought as to how those systems would be utilized. Further research has pointed out that business firms have treated training and managerial preparation for computer technology as a static, one-time concern. However, with advances being made in computer technology almost daily, training and retraining of organizational managers must be recurrent and dynamic. Dynamic training programs must be designed to keep pace with the advances in computer-based systems.[15,16,17]

The second major concern in the area of organizational problems with computer innovation can be labeled with the general heading of leadership. Because most organizations are made up of levels with increasing authority and responsibility, change, particularly technological change, is by necessity directed from above; this is what Everett M. Rogers refers to as the top-down approach to change.[18] This type of leadership requires both the ability to recognize the kind of change that is necessary, and the commitment to see the implementation of that change succeed. Michael Ginzberg, among others, has pointed out that there are inherent difficulties with any kind of change, and managerial commitment to the change process will often bring success to what were initially change failures.[19,20,21,22,23]

The last major concern in the area of the organizational problems related to computer innovation has to do with intraorganizational conflict. Michael Rose observed in 1969 that the introduction of computer systems in organizations tends to divide employees into two groups: the "cosmopolitans," or those who gain organizational power through superior education and general knowledge, who tend to favor innovation; and the "locals," or those who have organizational power via a superior knowledge of how the present system operates, who tend to oppose innovation.[24] This phenomenon of conflict is not a static condition but a cyclical process. It is also not limited to technological change but change in general. The intraorganizational change process, as Goodwin Watson describes it, follows five stages:

1. Early stage—when only a few pioneer thinkers take the change seriously.
2. Second stage—when the movement for change begins to grow, and the forces pro and con become identifiable.
3. Third stage—marked by direct conflict and showdown between groups, as resistance becomes mobilized to crush the change proposal.
4. Fourth stage—supporters of change have won the conflict and are in power.
5. Last stage—the supporters of the change now become those resistant to further change.[25]

The important aspect of the above analysis is that (to use Rose's terminology) the "cosmopolitans" of today are the "locals" of tomorrow. In other words, those who support a present change due to computer innovation may well resist future computer innovation. Although intraorganizational conflict can be seen as primarily an organizational problem, it is also just one of a set of behavioral problems that confronts the administrator.[26]

Behavioral or Human Problems

For the individual employee within the organization, the introduction of computer-based systems can be a stress-producing experience. This stress can be either temporary or ongoing and is caused by the sudden alienation of the employee from his/her environment. This stress can have a cognitive and/or an emotive basis. As Mary L. Schraml,[27] and A. J. Jaffe and Joseph Froomkin[28] have pointed out, the cognitive basis for this resistance to automation is most commonly exhibited in the form of employees fearing either that they will lose their jobs or that their jobs will become less interesting and satisfying. In some cases this fear is justified. When the computer is introduced with the idea that it will reduce the number of employees in the organization, the employee whose job is being affected by the computer system may indeed be at risk. In the case of library employees, the introduction of technological innovation may, as Brian Nielsen has suggested, cause a restructuring or even a loss of professional identity.[29]

The emotive basis for resistance to computer systems can be rather difficult to define in specific terms. It can be based on the fear of physical interaction with the machine as suggested by Lancaster and E. G. Fayen,[30] and by John N. Olsgaard.[31] The problem of dealing physically with the computer has inspired a new application for the field of research commonly known as "ergonomics." Many of the problems and suggested solutions that relate to dealing physically with computer systems are detailed by T. J. Springer.[32] For example, if the employee dislikes using the typewriter portion of a computer system, the organization can utilize touch-screen input devices. Technology has advanced to the point where, in many cases, organizations have the luxury of simply replacing one type of innovation with another that does not generate a negative response.

The second kind of emotive fear has no easy organizational solution. It is the feeling experienced by employees that their self-worth has been devalued when the organization introduces a computer system. This phenomenon has taken on many names. Thomas B. Sheridan refers to it as "phylogenesis" or the fear that the computer is evolving into a more intelligent and useful race of being than are humans.[33] Pamela McCorduck calls it the fear of "The Other," an object that is a good deal like the human species in certain respects, but is mysterious and threatening.[34] Schraml simply states that the computer tends to have a dehumanizing effect on employees.[35] Lewis Mumford's view is typical of this kind of negative reaction to an unfeeling, uncaring machine:

> And it is now plain that only by restoring the human personality to the center of our schemes of thought can mechanization and automation be brought back into the services of life.[36]

Since not all employees have these kinds of cognitive and emotive fears of computer innovation, a natural development in this field of research has been to determine if the organization can predict which employees will experience behavioral problems. The literature is somewhat contradictory in this regard. The most widely accepted analysis has been conducted by Dov Elizur who asserts that resistance to computer systems is inversely related to the degree that the employee is exposed to the system.[37,38] That is, the more the employee works with the computer, the better he/she will feel toward the system. The opposing view is held by social psychologist Robert S. Lee, who suggests that the more one understands the capability of the computer, the more one realizes the possible dangers of automation.[39]

To summarize this section, the characteristics of a process for introducing a computer-based system into an organization successfully can be delineated as follows:

1. The physical system must be of sufficient technological sophistication to do the designed tasks. (technological problem)

2. The change must be well planned, and personnel must be adequately trained.

(organizational problem)

3. The leadership of the library must be committed to the innovation. (organizational problem)

4. The administrator must expect intraorganizational conflict to occur and must devise methods to keep the negative effects of this conflict from endangering the innovation. (organizational and behavioral problem)

5. The administrator must expect certain individual employees to exhibit varying degrees of resistance to the innovation, and must devise methods to neutralize the negative effects of this resistance. (behavioral problem)

The method for ensuring success in the case of the first three of these characteristics is largely self-evident. For instance, if the computer system is not powerful enough to do its intended task, then the organization should get a system that can do the job. In the case of the second and third characteristics the alternatives are few; either the organization plans for the change and is committed to seeing the innovation succeed, or it isn't. It is with the problems that include behavioral components that choices must be made by the administrator.

For the administrator attempting to implement technological change, the essential difference between altering the attitude of a group (as in the fourth characteristic) and that of an individual (as in the fifth characteristic) is not just an increase in numbers, but in the quality of the opposition. In his classic article on social psychology entitled "Groupthink," Irving L. Janis observed that group attitudes, even flagrantly wrong attitudes, can be very difficult to change because each member of the group tends to reinforce all the other members.[40] The problem for the administrator remains to change the attitudes of the individuals within the group, but first the administrator must dissolve the reinforcement aspects of the group. It is in the choice of alternative methods of promoting this change of attitude that real differences in solving the problem can be observed.

DESIGN ACTIVITY—ALTERNATIVE SOLUTIONS TO THE PROBLEM

For the library administrator who is attempting to introduce change in the form of computer innovation, the objective is identical whether the problem is one of intraorganizational group conflict or one of resistance on the part of the individual employee. That objective is to alter the attitude of those who oppose the change to a new and more favorable position. The most widely accepted theory of this kind of activity is Kurt Lewin's "Three-Step Theory" in which the objectives of the library administrator are to:

1. Unfreeze—convincing the individual or group that the present unfavorable attitude is untenable and that a change of position is necessary.

2. Move—shifting the individual's and the group's attitude to the desired level.

3. Refreeze—convincing the individual or group that the new viewpoint should be continued.[41,42]

In this regard, an interesting analogy can be made to the field of advertising. Harper W. Boyd, Jr., and Sidney J. Levy have stated that the purpose of advertising is to "effectively re-enforce that behavior which favors the firm's products and change that behavior which favors the products of competitors."[43] In the case of gaining acceptance of technological innovation, the administrator basically tries to achieve the same result. The administrator attempts to reinforce that behavior which favors the innovation and change that behavior which opposes the innovation.

The question then becomes, What method should the administration use to unfreeze the negative attitude held by the group or the individual? Assuming that elimination of the opposing group or individual from the organization is not a desirable alternative, the literature suggests two mutually exclusive strategies: (1) the Participative Model, and (2) the Nonparticipative Model.

Participative Model

By far the most widely held view is that when the organization faces opposition toward a change, the group or individual should be brought into the change process. Warren G. Bennis states, "Remember that change is most successful when those who are affected are involved in the process."[44] This view is also held by John P. Kotter and

Leonard A. Schlesinger,[45] Peter Davis and Wladimir Sachs,[46] and S. Michael Malinconico.[47]

When the organizational change involves the introduction of computer systems, many researchers enthusiastically support the participation of those opposed to computer innovation in the decision-making process. Typical of these researchers would be Robert W. Holmes who states, "A mediocre system can be eminently successful when supported by user participation, while a model technical system, without such support, can be a dismal failure."[48] The reasoning behind the concept of user involvement has been summarized by Lucas as:

a. Participation can be ego enhancing.

b. Participation can be intrinsically satisfying and challenging.

c. Participation results in more commitment to the change.

d. Participants are more knowledgeable about the innovation.

e. Participants can observe better solutions to change problems.

f. Participation means that the user has retained some control over a system that will affect him/her.[49]

On the psychological level, the last point in Lucas' list is the most important. It assumes that user control over the change process will make him/her feel better about the change. This assumption is supported by the work of Robert J. Gatchel and Janet D. Proctor, in which they theorize that individual control of adverse stimuli (in this example, the introduction of computer systems) will reduce the emotive and physiological opposition to those stimuli.[50]

Daniel Robey and Dana Farrow have refined the participation model by asserting that mere user involvement in the technological change process is not enough; the users must believe that they have true influence in the process.[51] In 1977, Lyle Yorks explored ways to achieve this kind of effective user involvement. Yorks' model is based on an evolving process wherein a portion of this innovation is proposed, changed, and refined in accordance with user involvement.[52]

There is also support for this position in the field of library and information science. As part of a study conducted by Wilson Luquire, it was demonstrated that the attitudes of a particular subpopulation of academic librarians (i.e., professional employees of libraries that are members of the Association of Research Libraries) toward a particular computer-based system (i.e., OCLC) were related to the level of participative management in those libraries.[53,54] This view was also supported in a study of Association of College and Research Libraries personal members by Olsgaard.[55]

Nonparticipative Model

While it is a minority viewpoint, there is a definite indication in the literature of social psychology that nonparticipative management forms can be just as effective as participative forms. The key issue is whether control by employees over adverse stimuli aids those employees in the adjustment process. As Suzanne C. Thompson indicates in her review of the control literature in the field of psychology, there is evidence that employee control may not be desirable.[56] This evidence is summarized below.

James R. Averill suggests that different individuals will react differently to the same aversive stimuli. Prior knowledge and control over the stimuli will reduce stress in some individuals, but in others it will only reinforce the initial stress level experience.[57] R. J. Bulman and Camille B. Wortman take this analysis a step further by hypothesizing that many individuals actually require someone or something to blame when confronted with stress as a result of an aversive change in their environment.[58] This conclusion may suggest that the displeasure with the organization that employees sometimes feel when computer-based systems are introduced and directed by management may actually fill a beneficial psychological role in the process of gradual acceptance by the employees.

CHOICE ACTIVITY— SELECTION OF A PARTICULAR COURSE OF ACTION

The participative and nonparticipative models represent extreme ends of a continuum and each tends to make assumptions concerning the character of the organization's employees. The participative model assumes that all employees are equally motivated toward achieving the organization's objectives, operating most effectively when the participating employees are making decisions involving low levels of stress. Dale E. Zand and Richard E. Sorensen have stated that the goal of the administrator using the participative model is to unfreeze, move, and refreeze the attitude of employees concerning computer-based innovation by building up their confidence in their own ability to adjust to the change.[59]

The nonparticipative model assumes that all employees wish to be led by management, with management being responsible for decision making. The nonparticipative model tends to operate most effectively when employees are experiencing high levels of stress. Herbert C. Kelman and Donald P. Warwick have pointed out that the goal of the administrator using the nonparticipative model is essentially a tearing-down process, whereby the administrator seeks to unfreeze, move, and refreeze the employee's negative attitude by challenging or undermining the psychological supports for that attitude.[60]

Which model should be adopted by the administrator whose library is undergoing technological innovation? Much of the answer to the question depends on the outlook of the administrator and the capabilities of his/her employees. Lynn R. Anderson and Fred E. Fiedler have determined that, if performance is the only criterion of importance, then either form will work equally well.[61]

REVIEW ACTIVITY— ASSESSING PAST CHOICES

In the past fifteen years researchers such as Eleanor Montague and Allen B. Veaner, among others, have explored the administrative potential and the organizational impact of automation in a library environment.[62,63,64,65] While much has been written, there remains little empirical evidence in the literature of library and information science, management science, or social psychology that any particular management model will be effective in guaranteeing the success of the introduction of computer-based systems into a nonprofit organization. Although the relative merits of the participative model have been discussed in the library literature, there is only preliminary evidence that this model necessarily will be effective when the library organization is subjected to great change in the form of the introduction of automation.

CONCLUSION

This study delineated five sources of problems when technological change in the form of computer innovation is introduced in an organizational setting. These problems are

Technological

1. Failure to provide hardware and software that has the technological capability of performing the designed tasks.

Organizational

2. Failure to adequately plan for the technological change so that the computer system will perform as designed.
3. Failure of management to be fully committed to the change.

Behavioral or Human

4. Failure to design measures to deal with intraorganizational group conflicts resulting from the technological innovation.
5. Failure to design measures to deal with resistance to the change exhibited by individual employees.

Further, this study examined the results of research conducted in the disciplines of management science and social psychology that might provide the basis for a solution to these problems and a framework for future investigations tailored to the library environment.

Whether the introduction of technological innovation to libraries will bring about great change as Lancaster suggests or gradual change as DeGennaro asserts, it will in all cases change the structure of the library organization. How we, as a profession, react to that change will determine the ease and success of that process. Paul Wasserman has suggested that the library and information science profession has historically been slow to respond to changes in its organizational environment.[66] What we cannot do is fail to react to the technological changes that have occurred and will continue to occur in our organizations.

In the case of library automation, the profession has been fortunate that other disciplines have taken the lead in examining the effect of technological change on the organization and its employees. The advice that these disciplines can give us should be considered as time-saving suggestions; the solutions we must find on our own.

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The RLIN Command Analysis System: Measuring Use and Performance of an Online System

Walt Crawford

The RLIN Command Analysis System digests large quantities of raw data on RLIN use and performance into smaller quantities of information. Since the analysis system was first designed, in December 1981, it has been refined and extended to produce more varied and useful graphs and reports. Lessons learned should be useful for those studying performance of online public access catalogs or other online bibliographic systems. This paper describes the origin, development, and current state of the Command Analysis System, shows some recent results of the system, and mentions some pragmatic issues of analyzing use and performance of an online system.

INTRODUCTION

There are many ways to measure the performance of an online system. A well-designed system will support them all. One way is selective logging, which generates a flood of raw data about system use and performance. That flood of raw data must be turned into useful information.

The RLIN Command Analysis System is an evolving set of tools to provide information on the actual use of RLIN as an online system, and on system response. The Command Analysis System was first developed in December 1981. Since then, it has been modified and refined to provide better and more readable information. This paper describes the raw data, the original design of the Command Analysis System, and how it has been refined and modified.

The Command Analysis System has evolved through experimentation and evaluation. In that process, we have formed some pragmatic conclusions on the usefulness of various measures for the RLIN environment. Some of these conclusions apply to online public access catalogs. Thoughts and conclusions on measuring an online system are scattered throughout the paper.

First, some definitions.

The Research Libraries Group, Inc. (RLG) is a consortium of universities and independent research institutions involved in a number of cooperative programs.

The Research Libraries Information Network (RLIN) is the computer hardware, software, and database supporting the ventures of RLG. RLIN is the second largest bibliographic service in North America, with over fifteen million bibliographic and authority records and over six hundred installed terminals.

RLIN II commonly refers to the Integrated Technical Processing System (ITPS): the online component of RLIN, providing acquisitions, cataloging, and search capabilities for the bibliographic files supported on RLIN.

MEASURING RLIN

Three different sets of analysis software

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measure RLIN from three different perspectives: computer load and availability, system output, and system use and response.

Computer Load and Availability

Stanford University is the host institution for RLG. Stanford's Information Technology Services (ITS) provides contracted services for RLIN, including a range of graphs for RLG under the general name of Capacity/Performance Evaluation (CPE). Daily sets of graphs show (by quarter-hour slots throughout the service day) number of terminals logged on, CPU usage, memory usage, and other aspects of system load. RLG maintains its own logs to assess overall availability.[1]

System Output

RLIN II is a system for storing, maintaining, and retrieving bibliographic, holdings, and acquisitions data. It has measurable output: new and modified records, transaction tapes, and a wide variety of printed products.[2]

System output is measured and reported in two primary ways. The first is a daily summary of records added or updated in each format. The second is a set of reports generated weekly and monthly by RLG's Management Information/Fiscal Accounting system, which also prepares invoices for members and users.

System Use and Response

RLIN II includes a logging facility. When this facility is in use for a terminal session, each command entered causes a record to be written to a logging file. The record is written after the command has been completed and includes the following elements:

1. A session identifier;
2. The library identifier from which the command was issued;
3. The date and time, down to the nearest second;
4. The text of the command itself;
5. CPU (computer) time required to process the command;
6. Input/output (I/O) operations required to process the command;
7. Response time, that is, actual time required to process the command (from receipt of the command by ITPS to transmission of the response, not including communication delays on either side).

Figure 1 shows a small portion of one day's log.

COMMAND LOGGING IN RLIN II: ORIGINS AND EARLY ANALYSIS

RLIN II began as the RLIN Acquisitions System in 1981. The system was wholly new, developed in a newly supported programming language (IBM Pascal/VS). Once the acquisitions system was in production, applications staff moved on to integrate cataloging into the system. The fully integrated RLIN II (ITPS) went into production in October 1982.

The developers of RLIN II recognized the need for selective logging.[3] Logging allows programmers to backtrack from a system flaw to the events leading up to the problem. Logging can also show the resources required for various commands, allowing the developers to tune the system where efficiency is most needed.

Command logging was, initially, a tool for the system developers. As with any major new system, there were flaws in the system after it entered production; additionally, the developers needed to see how actual use of the system would differ from testing in terms of resource usage.

THE COMMAND ANALYSIS SYSTEM: INITIAL DESIGN

We were generating a lot of data, which could be organized a lot of ways. What did we want to get from it? First, the developers needed a formatted listing, by session, in chronological order within each session: in other words, an end-to-end command log for each individual session. Even with only one thousand logged commands in a day, useful conclusions about overall system performance could not be drawn, and there was no way to compare one day with another. Statistical summaries were needed. Such summaries could be done by a number of useful (or interesting) arrangements, for instance by command, by library, or by time of day.

A set of twelve numbers for each sub-

Time	Response	CPU Time	I/O	Command
104015	0.6527	0.049062	12	FIN TP DOCUMENTO CELAM#
104026	0.4764	0.103688	7	MUL
104040	0.8883	0.121342	5	+
104328	0.6229	0.086918	0	BCRE
104544	1.2300	0.102284	8	BUNIT
104609	0.3580	0.072852	0	BMAT
104654	1.1358	0.074906	10	ENT
104732	1.3407	0.107042	9	FIN CP CANADIAN SOCIETY FOR THE STUDY OF RELIGION
104753	1.0921	0.058188	1	FUL 2
104921	0.5549	0.054860	0	BDER
104939	3.1979	0.108030	0	BBIB
105019	5.8420	0.140478	8	B+
105116	0.6303	0.116038	0	BMAT
105117	1.4781	0.064454	10	ENT
105120	1.1966	0.026728	0	SET FUN ACQ MAI
105243	0.4424	0.061932	3	BUPD ITE
105247	3.4984	0.055510	5	ENT
105256	0.8335	0.036348	4	FIN CP CANADIAN RELIGIOUS CONFERENCE
105311	1.5524	0.140478	8	MUL
105325	0.3091	0.026494	0	SET FUN ACQ
105325	0.8204	0.090818	5	+
105456	0.4651	0.082940	0	BCRE
105622	0.4726	0.082342	0	BUNIT
105657	0.4319	0.054314	0	BMAT
105723	1.0333	0.070954	10	ENT
105733	0.5768	0.044486	8	FIN TP QUADERNI ASAL#
105753	0.8530	0.111228	6	MUL
105810	0.4371	0.052208	1	FUL 2
105826	0.4321	0.099944	5	MUL 7
105946	0.5215	0.086034	0	BCRE
110007	0.4495	0.096148	7	BUNIT
110033	0.7788	0.072722	4	BUNIT
110212	0.2630	0.063752	5	BMAT
110213	1.0581	0.073008	14	ENT
110214	0.7711	0.023686	0	SET FUN ACQ MAI
110335	2.2167	0.078546	3	BUPD ITE
110336	0.8829	0.052078	4	ENT
110336	0.5010	0.026182	0	SET FUN ACQ
110343	1.6164	0.050908	12	FIN TP ARCHBISHOP IAKOVOS LIBRARY OF ECCLESIASTICAL#
110404	0.7641	0.118716	7	MUL
110419	1.6344	0.102752	6	+
110430	0.5228	0.074672	4	+
110453	0.2952	0.050856	2	FUL 2
110454	0.5640	0.011648	0	SET INP SER
110549	0.4370	0.140192	0	BTRA CRE *
110742	1.1835	0.109824	4	BUNIT
110806	0.4924	0.055640	0	BMAT
110807	1.0493	0.058370	10	ENT

Fig. 1. Portion of Detail Log for July 9, 1984.

group (command, library, ten-minute time interval, or day) was established. Those twelve numbers continue as one phase of the current system. As they appear on summary listings, the twelve original numbers are:

1. Count: actual number of commands included.

2–6. Numbers based on CPU time (reported in milliseconds):

2. Total: total CPU time used for this group.

3. Minimum: least time used for any command in the group.

4. Maximum: most time used for any command in the group.

5. Average: total divided by count.

6. Standard deviation: "the square root of the average of the squares of the deviations from the mean."[4]

7–9. Numbers based on I/O count:

maximum, average, and Standard deviation.

10–12. Numbers based on response time (elapsed time from receipt of command to completion of command, reported in milliseconds):

maximum, average, and standard deviation.

Figure 2 shows a portion of an early summary report. Some comments on the choice of numbers may be in order.

The count for a group of commands is fundamental, particularly when looking at summaries by command or by time. Number of commands in a ten-minute period is a

Seq: Command, Time		820617		CPU Time			I/O Count			Response Time		Page 1	
Command	Count	Total	Min.	Max.	Ave.	SD	Max.	Ave.	SD	Max.	Ave.	SD	Command
	2	0.041	0.019	0.022	0.020	0.006	0	0.0	0.0	0.5	0.4	0.2	
+	17	2.383	0.024	0.186	0.140	0.049	6	3.7	1.9	9.5	4.3	2.8	+
+ B	7	0.689	0.049	0.164	0.098	0.048	6	2.1	2.9	2.1	1.5	0.5	+ B
+B	5	0.297	0.025	0.116	0.059	0.045	5	1.2	2.2	4.5	2.2	2.0	+B
-B	1	0.021	0.021	0.021	0.021	0.000	0	0.0	0.0	0.4	0.4	0.0	-B
AND PN	1	0.014	0.014	0.014	0.014	0.000	0	0.0	0.0	0.3	0.3	0.0	AND PN
AND TP	7	0.394	0.036	0.083	0.056	0.018	11	7.6	2.9	5.9	3.1	2.0	AND TP
AND TW	16	3.506	0.038	0.905	0.219	0.248	130	28.9	36.8	18.1	5.2	4.6	AND TW
AUT	20	4.959	0.235	0.266	0.247	0.024	24	23.6	0.5	23.8	10.1	5.0	AUT
BIB	5	0.274	0.051	0.059	0.054	0.010	0	0.0	0.0	5.2	2.2	1.8	BIB
BIBB	14	2.121	0.118	0.187	0.151	0.021	9	2.5	3.3	14.4	4.6	3.8	BIBB
CAL	1	0.008	0.008	0.008	0.008	0.000	0	0.0	0.0	1.3	1.3	0.0	CAL
CAN	8	0.259	0.014	0.066	0.032	0.018	5	1.4	2.0	8.2	2.4	2.7	CAN
CREB	76	9.270	0.090	0.341	0.121	0.031	13	0.2	2.1	14.3	3.3	2.5	CREB
CREB*	23	3.473	0.125	0.174	0.151	0.013	0	0.0	0.0	12.6	3.4	3.0	CREB*
DER	3	0.047	0.013	0.018	0.015	0.006	0	0.0	0.0	0.3	0.2	0.1	DER
DERB	217	13.793	0.045	0.111	0.063	0.014	0	0.0	0.0	9.1	2.2	2.0	DERB
DIS	130	8.183	0.024	0.116	0.062	0.016	6	3.4	1.7	14.4	3.4	2.3	DIS
ENT	375	51.059	0.027	0.212	0.136	0.029	26	18.4	5.1	52.7	5.7	4.4	ENT
ENTB	7	0.531	0.042	0.132	0.075	0.033	7	2.6	3.3	1.8	1.0	0.6	ENTB
FIN AD	1	10.660	10.660	10.660	10.660	0.000	863	863.0	0.0	71.4	71.4	0.0	FIN AD
FIN CN	3	0.116	0.029	0.045	0.038	0.012	0	0.0	0.0	2.4	1.9	0.5	FIN CN
FIN IB	1	0.023	0.023	0.023	0.023	0.000	0	0.0	0.0	1.9	1.9	0.0	FIN IB
FIN ID	44	3.987	0.023	0.331	0.090	0.055	26	5.8	4.4	11.8	4.5	3.1	FIN ID
FIN IS	131	11.643	0.029	0.358	0.088	0.075	28	6.4	5.9	19.6	4.4	3.5	FIN IS
FIN LC	204	18.749	0.021	0.380	0.091	0.052	24	5.9	3.5	45.3	3.9	3.9	FIN LC
FIN PE	5	0.441	0.060	0.104	0.088	0.018	12	6.8	3.1	3.9	2.6	1.2	FIN PE
FIN PN	73	11.853	0.037	1.121	0.162	0.159	163	13.8	20.0	36.7	4.9	4.9	FIN PN
FIN TP	46	6.126	0.031	0.409	0.133	0.117	71	14.5	16.2	10.1	4.5	2.7	FIN TP

Fig. 2. Command Analysis Summary, Original Form

good indicator of system activity. Counts for various search commands show how RLIN II's searching power is being used.

CPU times show the operation of the software, generally without regard to the number of people using the system simultaneously. Total CPU time is very useful for comparing system impact of various commands. For instance, we recently used command summaries to look at searching and search-related displays in terms of system load, finding that they use just over 60 percent of CPU resources.

Minimum CPU time tends to be the overhead of syntax analysis and of logging itself. If specific commands show a minimum higher than this overhead (about 4 milliseconds), the programmer/analyst may be alerted to a potential problem.

Maximum CPU time can also serve to alert staff to potential problems. Except for certain searches and local-site printing, commands should have very low maxima if the system is behaving in a stable, well-controlled manner.

Average CPU time should be useful to study the actual load of a given command and the efficiency of the system. The number is only useful if it is meaningful; as a test of its likely usefulness, standard deviation is also reported (see below).

I/O counts show the other aspect of system load which is directly related to individual commands. For some commands, any number greater than 0 shows system problems; for others, the actual numbers show how well the database mechanisms are working. When Command Analysis was first implemented, the Online Group did not feel that total I/O needed reporting. Maximum I/O is useful partly because it is predictable (except for searches). Average I/O (if meaningful) is one measure of the effects of improved system design and was one measure, in August 1983, of the effects of a vastly enlarged database.

Response times measure performance from the user's perspective: how long is the user "waiting for the cursor"? Response time can't be predicted from CPU time, because it is heavily dependent on the number of terminals in use. "Total response time" would be a difficult concept to deal with, and early logs showed clearly that minimum response time (like minimum I/O) was not a useful number (being 0.1 seconds or less).

Maximum response time, like maximum CPU time, has an upper limit: the system will generate an error if a command takes more than 25 CPU seconds, and can terminate a terminal session if there is no activity in more than 45 minutes. Fortunately, the maximum response time for a full day is rarely anywhere near 2,700 seconds (45 minutes); as noted in an *ITAL* technical communication on search response,[5] the worst response time is usually 6 minutes or less.

The response times shown in command analysis reports are not those experienced by users. The command analysis system works from system logs, which don't start timing until a command enters the computer and stop timing when the response leaves the computer. Communications overhead—logging, transmission delays and retransmissions, and the like, on both sides of the transaction—adds 1 to 3 seconds to this time.

Average response time is the single number most in demand for a system such as RLIN. It might be assumed that average response time is a good way of comparing different commands and of showing how the system was performing during various periods.

THE TROUBLE WITH AVERAGES

Everyone loves an average—or so it seems. When you want to find out how quickly an online system responds, you probably ask the vendor, "what's the average response time?" This may not be such a good question. Of all statistical measures, the average is by far the most commonly used and quite probably the most commonly abused. It's heavily used because it is easy to state, easy to calculate, and apparently easy to understand.

Averages can misstate the case in positive and negative ways. On July 9, 1984, RLIN II showed an average response time of 1.46 seconds, but 73.8 percent of all commands were completed in less than 1 second. RLIN II had excellent "average response" on July 9, but the "typical response" was even better: the median was 0.75 seconds or less.

Does that mean that RLIN II responded to an "average search" in 0.75 seconds, or even in 1.46 seconds? Not at all; different commands place different loads on the system. The "average search response" was 2.58 seconds, even though 83.5 percent of all searches took less than 2 seconds and almost 58 percent took less than a single second. (This excludes record number searches. Seventy percent of those searches took less than 1 second; 90 percent took less than 2 seconds.)

Even within searching, "average response" might be misleading. On July 9, 93 percent of LCCN searches and 89 percent of title phrase searches took less than 2 seconds, but 11 percent of title word searches (rarely done by themselves) took 20 seconds or longer. There's no such thing as an "average search" on a system with complex searching; as a result, there's no such thing as "average search response."

Casual inspection of early logs suggested that averages would be suspect for some aspects of RLIN. At the same time, some averages would be quite meaningful. The standard deviation was included to give a quick fix on the usefulness of averages.

Looking at figure 2, the standard deviation suggests that 0.136 CPU seconds was a meaningful average for ENT on June 17, 1982. A standard deviation of 0.029 means that over 90 percent of ENTs would take between 0.078 and 0.195 CPU seconds. The largest and smallest times logged are within three standard deviations.

On the other hand, response time could be expected to vary considerably for an ENT. In June 1982, when figure 2 was generated, RLIN II included only Acquisitions. Users of RLIN II were a small minority on a heavily loaded machine and suffered erratic response as a result. The average was 5.7 seconds, but the standard deviation was 4.4. Based on later experience, it is fair to assume that most ENTs took much less than 5.7 seconds but that a significant percentage took much more, yielding a high average.

The standard deviation served two major functions in early reports. It warned us against taking "averages" too seriously—some commands show standard deviations several times the size of the average. It also showed whether or not the underlying software was behaving consistently. Except for searches, most commands should take relatively similar CPU times and I/O counts; the standard deviation should be relatively low, and the averages should be relatively meaningful.

For any online system with a wide range of capabilities, the average response time should not be reported without some qualifying figure. Standard deviation is one such figure and is one that can be calculated in a single pass of reported data, without advance knowledge of that data's distribution.

CHANGES IN COMMAND LOGGING: 1982

Early use of Command Analysis reports was aimed at making the system work, and making it work consistently and well. The continuing high standard deviations for response time made it clear that "average response time" was not very useful in terms of user-perceived system performance. The low standard deviations for CPU and I/O on most commands made it clear that the system itself was well designed and stable.

With Acquisitions in place and work beginning on Cataloging, the developers were using the Command Analysis System results and finding them clumsy. The time-of-day summary gave a good picture of system performance, but the command summary was too long for easy interpretation. On a typical day, over two hundred different commands and command variations might be recorded. (*FINd* alone involves more than twenty valid indexes, as well as occasional miskeyed index names.) While the command summaries boiled down the raw data, they were still too bulky to be interpreted easily.

Commands fall into groups. Eight command groups were established: *AUT*, beginning a session; *BUI*, commands done while actually creating or maintaining a record; *DIS*, commands issued to display search results; *FIN ID*, known-record searches; *PRO*, commands issued to produce certain products; *SEQ*, special search commands requiring sequential processing (such as finding all saved records); *SEA*, search commands other than *FIN ID* and *SEQ;* and *OTH*, a miscellaneous set of commands including session termination, changing files, changing functions, setting values, and erroneous commands.

The Command Analysis system was extended to set group names and produce a new report based on groups. This single-page report provides the desired quick summary of system performance and has proved useful for many purposes since its inception, making Command Analysis a much more robust tool.

As development of ITPS proceeded, it became clear that logging would continue to serve a variety of purposes, including telling our members and users more about the system. The overhead of logging seems to be about 4 percent: logging takes less than 4 milliseconds, and the average for all commands is about 90 milliseconds. This is too much overhead for the entire system, and would interfere with use of the system at peak loads. Infrequent logging would not yield sufficient information, particularly on less-used commands (including some of the most resource-intensive).

We settled on a 10 percent sample as being small enough to be largely irrelevant in terms of system load (less than 1/2 of 1 percent) but large enough to give us a reliable sample for most commands. The sample is created by an algorithm applied when a session is begun. It is not a "random" technique but one which induces no known biasing into the sample.[6]

CHANGES IN COMMAND ANALYSIS: 1982

Very high standard deviations suggested that the average response time was not a useful figure. We decided to experiment with other figures while looking for better ways to present the information.

The great virtue of an average is that you don't need to know anything about the data before you process it, and you can always process it in a single pass. You just keep reading figures, adding them up, and counting them; when you reach a breakpoint, you divide the total by the count.

Most other measures require either a double-pass analysis system or some basic assumptions about the nature of the data. If, for instance, you wish to know how many seconds were required for completion of 90 percent of commands, you have to do one of two things: either find out how many commands there were, and sort the commands in order by response time; or establish a set of "buckets" or counters based on gradations of response time.

The first technique, typically used by packaged statistical analysis systems, can be costly when dealing with very large quantities of data anlyzed in several ways. The second is much less costly, but may prove meaningless if the "buckets" are badly chosen.

Response Limits

Response limits show the response time for various percentiles of commands. We chose five percentile limits, and tried to establish a set of response-time counters that would be valid and useful and that could be graphed.

The first percentile limit is the median, or the 50th percentile limit. If the "median response" is 2 seconds, one of every two commands is completed in 2 seconds or less (conversely, one of every two commands requires 2 seconds or more to complete). The second limit is the 75th percentile: only one of four commands takes longer than this limit. The third is the 90th percentile. The fourth is the 95th percentile: at this point, only one out of twenty commands takes longer. Finally, the 99th percentile is measured.

Figure 3 is the resulting Command Group report for July 9, 1984. Looking at searching, we find an average response time of 2.6 seconds, but a median of 1 second and a 75th percentile of 1.5 seconds. Most of the time, a search was completed in 1.5 seconds or less. On the other hand, the 95th percentile was 5.75 seconds, and the 99th was 43 seconds: a few searches were very slow. A snap judgement might be that RLIN searching was excellent on July 9, but that difficult searches could take a long time.

To calculate percentile limits in a single pass, you must have a series of counters, one for each "possible" response time. This means limiting the number of possibilities. We had already decided that it would be

Command Groups		840709		CPU Time			I/O Count			Response Time		Page 1	
Group	Count	Total	Min.	Max.	Ave.	SD	Max.	Ave.	SD	Max.	Ave.	SD	Group
AUT	318	42.003	0.098	0.206	0.132	0.021	25	17.1	2.3	51.1	10.2	6.6	AUT
		Response Limits: 50%: 8.50s. 75%: 13.25s. 90%: 19.00s. 95%: 24.00s. 99%: 30.00s.											
BUI	5499	430.499	0.008	0.182	0.078	0.026	30	4.4	4.9	17.2	0.8	1.1	BUI
		Response Limits: 50%: 0.50s. 75%: 1.00s. 90%: 2.00s. 95%: 2.75s. 99%: 5.75s.											
DIS	6489	393.136	0.007	0.247	0.060	0.038	15	2.7	2.8	15.0	0.6	0.7	DIS
		Response Limits: 50%: 0.50s. 75%: 1.00s. 90%: 1.25s. 95%: 1.75s. 99%: 3.25s.											
FIN ID	1193	54.538	0.008	0.202	0.045	0.025	27	6.8	2.8	13.1	1.0	1.0	FIN ID
		Response Limits: 50%: 0.75s. 75%: 1.25s. 90%: 2.00s. 95%: 2.75s. 99%: 5.75s.											
OTH	1698	75.217	0.004	5.372	0.044	0.187	15	0.8	2.2	518.8	2.3	18.5	OTH
		Response Limits: 50%: 0.50s. 75%: 0.75s. 90%: 5.25s. 95%: 9.00s. 99%: 23.00s.											
PRO	29	0.993	0.023	0.067	0.034	0.009	2	1.1	0.3	1.5	0.5	0.3	PRO
		Response Limits: 50%: 0.50s. 75%: 0.75s. 90%: 1.00s. 95%: 1.25s. 99%: 1.50s.											
SEA	4871	939.635	0.008	20.194	0.192	0.810	2373	25.8	113.9	378.1	2.6	11.9	SEA
		Response Limits: 50%: 1.00s. 75%: 1.50s. 90%: 3.00s. 95%: 5.75s. 99%: 43.00s.											
SEQ	2	0.251	0.088	0.163	0.125	0.055	23	13.0	14.1	0.8	0.6	0.3	SEQ
		Response Limits: 50%: 0.50s. 75%: 1.00s. 90%: 1.00s. 95%: 1.00s. 99%: 1.00s.											
TOTAL	20099	1936.272	0.004	20.194	0.096	0.407	2373	9.1	57.0	518.8	1.5	8.2	TOTAL

Fig. 3. Command Group Report for July 9, 1984, Old Form.

useful to graph overall system response on a daily basis, to see how far it veered from a bell-shaped curve (and in what way); thus, it made some sense to have as many counters as there were points on the graph.

We also considered the pragmatic limits of response-time measurement. Very small response increments can be important for text editing or line-at-a-time message building. RLIN II is designed so that full screens of data are keyed at the terminal and transmitted at once; other aspects of the design mean that the difference between 0.20-second response and 0.5-second response would be lost in transmission delay. Given transmission lag (which is somewhat variable) and the nature of RLIN II processing, it appears that quarter-second increments are the smallest increments of any use at all.

The incremental effect of slow response changes as response gets worse. The difference between 1-second and 2-second response is probably more noticeable than the difference between 20-second and 24-second response: at a certain point, "slow is slow." This pragmatic difference between good response and bad response allowed us to split the counters into two categories. Counters were established for quarter-second intervals from 0.25 to 15 seconds and for one-second intervals from 16 to 60 seconds. In all cases, response times are rounded up: thus, a 0.26 second response is recorded as 0.50, and a 15.01-second response is recorded as 16 seconds. Finally, we asserted that any response over 60 seconds could be lumped as "terrible response," with no further gradations required.

Daily Graphs, First Attempt: Response Distribution

Some people can look at a page of figures and extract a picture from the figures. Most people faced with such a page are somewhat overwhelmed. A graph usually displays less information in a much clearer form. Figure 3, the simplest of the reports, includes 148 figures (not including labels). We realized that something simpler and more graphic was needed.

The first graphic presentation is shown in Figure 4. This graph gives the response time-percentiles for October 11, 1982. The line below the graph name gives the date, the overall percentile limits, the number of logged commands, and the number of logged commands taking more than 60 seconds.

The body of the graph shows percentages vertically and times horizontally. Each column represents either a quarter-second or a full second (seconds are shown at the top and bottom of the graph). The asterisk is used to show what percentage of all logged commands were completed within that particular time slot. Thus, an asterisk at the intersection of 2 percent and 2 seconds means that 2 percent of logged commands took between 1.76 seconds and 2 seconds to complete. (The row of asterisks preceding the 1-second point means that over 10 percent of logged commands fell into each of the first four quarter-second slots: since the median is at 0.75 seconds, it is clear that the percentages were well over 10 percent.)

To place individual marks in perspective, a vertical line of characters appears at the median and the other four percentile limits, and the percentage of commands taking 15 seconds or less is shown.

This graph proved our suspicion that response bore no relation to a traditional bell-shaped curve. A very high percentage of commands takes less than one second to execute, followed by a steep slope that trails off all the way to the right. The shape of the curve was relatively consistent while it was used, though the slope did vary to some extent.

The graph was only used internally and was replaced with a much different graph after a few months. It served to demonstrate that percentile limits were good information and that average response time was not a very useful measurement for RLIN.

Monthly Graphs, First Attempt: Response Time Limits

Figure 5 shows one of the first graphs produced for use by RLG members and RLIN users: a graph of response-time limits for each day of October 1982. This graph takes the daily response percentiles and generates one bar for each day on which logging takes place. The bar is made up of four characters: 'm' for median, '7' for 75th

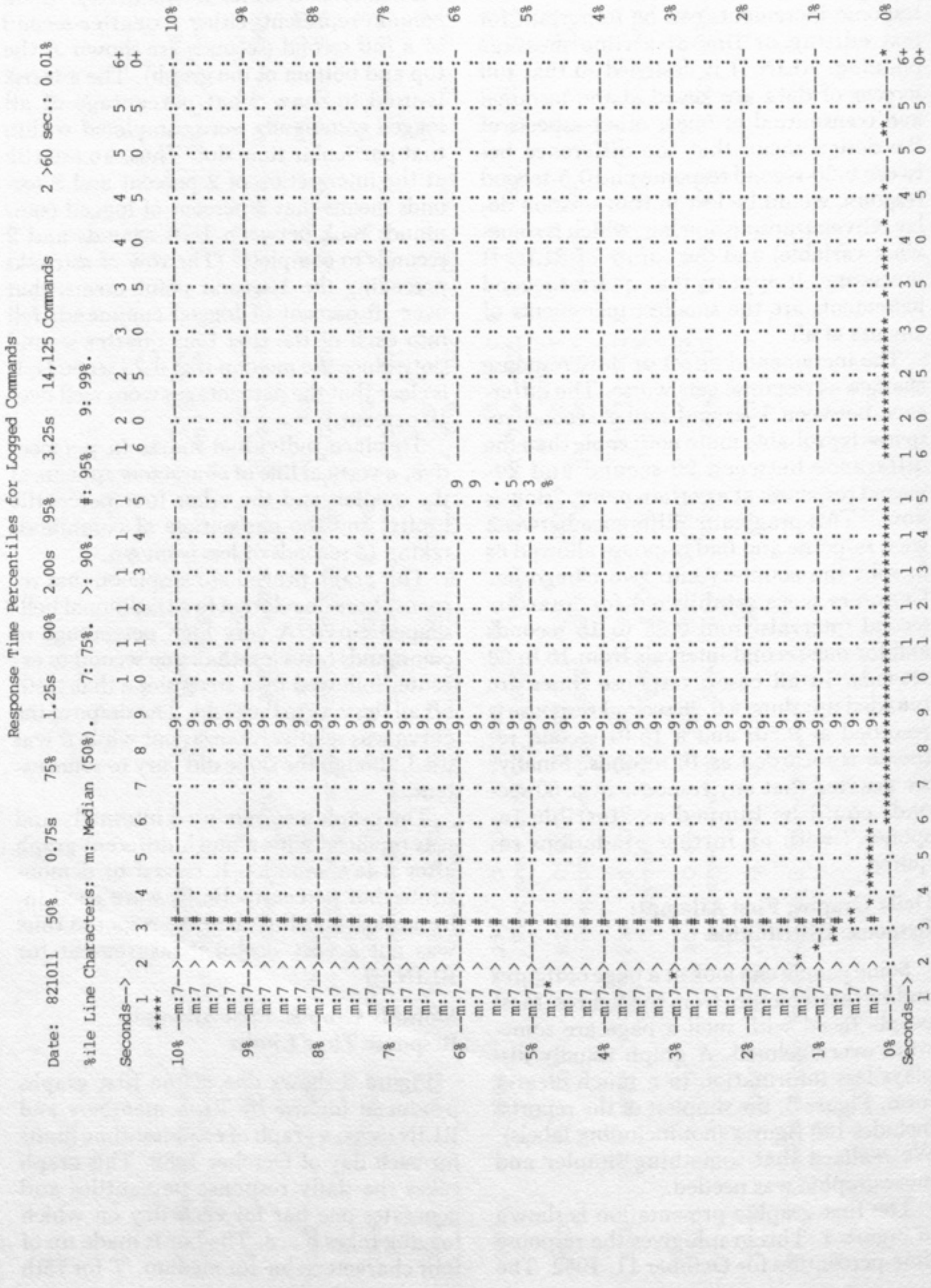

Fig. 4. Daily Response, Original Graph.

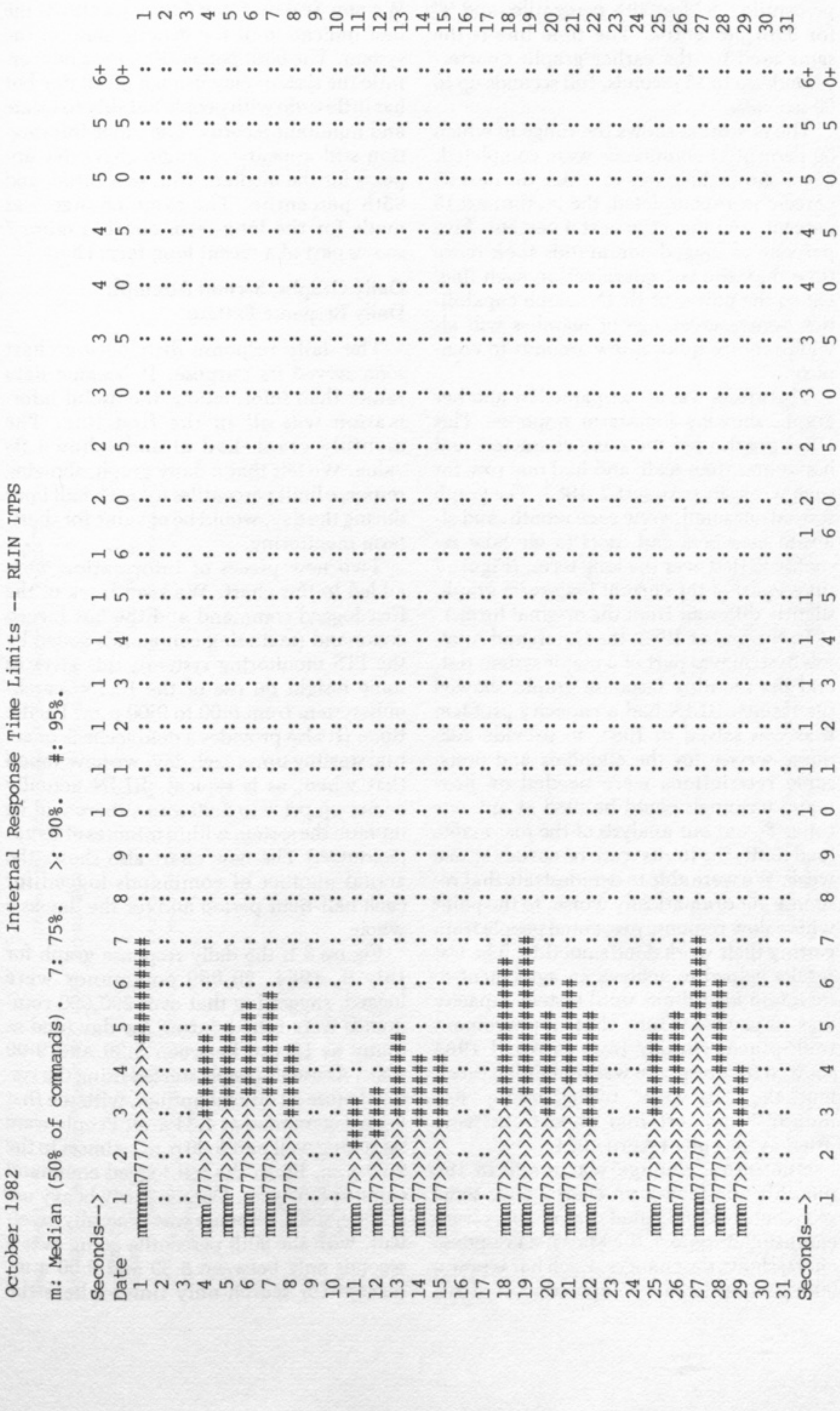

Fig. 5. Monthly Response Graph, Original Form.

percentile, '>' for 90th percentile, and '#' for 95th percentile. The time line is the same used for the earlier graph: quarter-seconds up to 15 seconds, full seconds up to 60 seconds.

The *m* section shows the range in which 50 percent of commands were completed. The 7 shows the range in which the next 25 percent were completed; the >, the next 15 percent, and the # the next 5 percent. Five percent of logged commands took more time than the last character on each line. Given the power of RLIN search capabilities, some percentage of searches will always require quite a few seconds to complete.

This graph was accompanied by another graph, showing long-term response. This other graph used the same characters and horizontal time scale and had one row for each week since August 2, 1982. The graph started out small, grew each month, and allowed members and users to see how response varied over the long term. (Figure 7 shows part of the current long-term graph, slightly different from the original form.)

In November 1982, the Command Analysis System was part of a major system test, and the monthly response graphs showed the results. RLIN had a capacity problem that was solved in 1984: to provide adequate service for the members and users, some restrictions were needed on how many terminals could be used at any one time. To test our analysis of the reasonable load limit, the limits were removed for one week. We were able to demonstrate that response got dramatically worse, to the point where slow response prevented people from getting their work done smoothly. The test results helped to achieve an agreement to maintain load limits until system capacity was improved. Once that improvement took place, similar tests in April 1984 showed that response was remaining excellent: the "test week" turned into a "test month," and terminal allocations were lifted at the end of April 1984.

One minor change was made in the monthly and long-term charts, after some recipients had indicated that the bars were confusing. Figure 6, the May 1984 response chart, shows the changes. Each bar is now a 90th percentile bar, composed of > signs. We now feel that the 90th percentile is the best indication of the general state of the system. The 95th percentile shows how erratic the system may be on a given day but has little to do with people's ability to locate and maintain records. The other information still appears: a single character appears for the median, 75th percentile, and 95th percentile. The same change was made for the long-term chart: Figure 7 shows part of a recent long-term chart.

Daily Graphs, Second Attempt: Daily Response Pattern

The daily response distribution chart soon served its purpose. It became data rather than information; the useful information was all in the first line. The monthly graph had already shown its value. We felt that a daily graph, showing response limit percentiles for each half hour during the day, would be of value for short-term monitoring.

Two new pieces of information were added to this chart. We keep track of the first logged command and the last logged command (excluding commands issued by the ITS monitoring system); this gives us some insight on use of the RLIN search-only system from 6:00 to 9:00 p.m. Pacific time. (It also provides a doublecheck of actual starting times each day; we have found that when, as is typical, RLIN actually comes up prior to 5:00 a.m., there will be users on the system within minutes of its appearance.) The new chart also shows the actual number of commands logged for each half-hour period and for the day as a whole.

Figure 8 is the daily response graph for July 9, 1984. 20,099 commands were logged, suggesting that over 200,000 commands were issued during the day (and as many as 13,110 between 8:30 and 9:00 a.m.) As usual, people started using the system before its official uptime, with the first logged command at 4:34 a.m. People were searching well past 6:00 p.m., almost to the 9:00 p.m. limit: the last logged command came at 8:57 p.m. Despite fairly heavy use of the system, response was generally excellent, with the 90th percentile going over 4 seconds only between 8:30 and 9:00 a.m. (except for search-only times where the

```
May 1984                  Internal Response Time Limits -- RLIN ITPS

Nine out of ten commands were completed in the time shown.

Seconds-->                              1  1  1  1  1  1  1  2   2   3   3   4   4   5   5   6+
Date  1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6  0   5   0   5   0   5   0   5   0+
  1  >>>>m>>>>>>>>>>>>>>7>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>  :   :  :#   :   :   :   :   :   1
  2  >>m>>>>>7>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>  :  :  :  :  :  #:   :   :   :   :   :   :   :   2
  3  >m>7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   3
  4  >>m>7>>>>  :  : #:  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   4
  5   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   5
  6   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   6
  7  >m>7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   7
  8  >>m7>>>>>  :  : #:  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   8
  9  >>m7>>>>>  :  : #:  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :   9
 10  >m>7>>>:  : #:  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  10
 11  >m>7>>>:  : #:  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  11
 12   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  12
 13   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  13
 14  >>m7>>>:  #  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  14
 15  >>m>7>>>>  :  :#  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  15
 16  >>m7>>>>  :  #  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  16
 17  >m>7>>>:  #  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  17
 18   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  18
 19   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  19
 20   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  20
 21  >m>7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  21
 22  >m>7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  22
 23  >>m7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  23
 24   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  24
 25  >m7>>>  : #:  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  25
 26   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  26
 27   :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  27
 28  >m>>  :  :#  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  28
 29  >m>7>>>:  :#  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  29
 30  >>m7>>>>>  :  :#  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  30
 31  >m>7>>  : #:  :  :  :  :  :  :  :  :  :  :  :  :  :  :   :   :   :   :   :   :   :   :  31
Seconds-->                              1  1  1  1  1  1  1  2   2   3   3   4   4   5   5   6+
      1  2  3  4  5  6  7  8  9  0  1  2  3  4  5  6  0   5   0   5   0   5   0   5   0+

Other completion percentages are shown by single characters: m = Median (half of commands).
                7 = 75% of commands (three out of four).      # = 95% (nineteen out of twenty).
```

Fig. 6. Monthly Response Graph, Current Form.

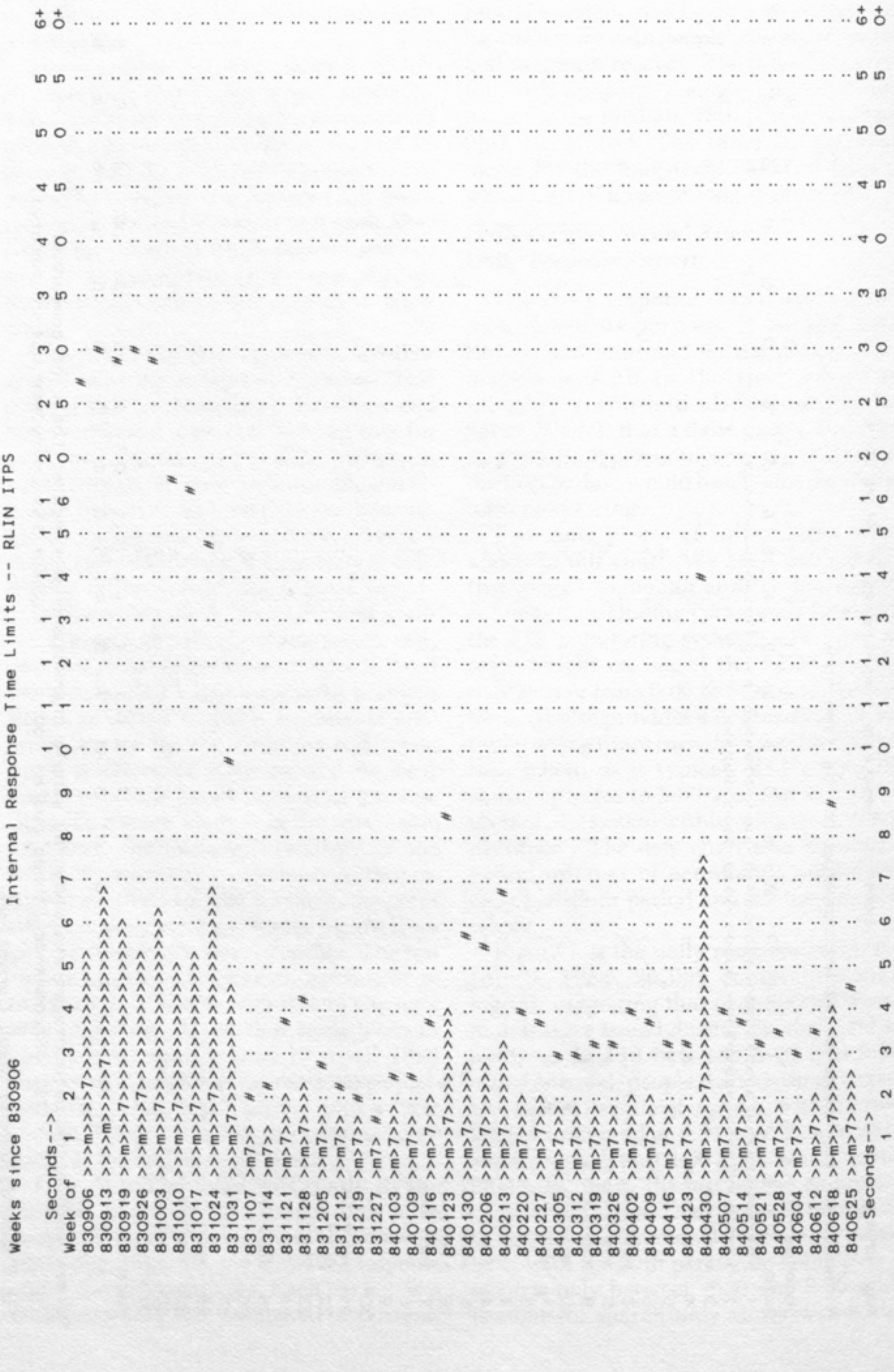

Fig. 7. Long-term Response Graph for RLIN II (partial).

```
                         Response Time for 90% of Logged Commands in ITPS

Date:840709   50%:  0.75s. 75%:  1.25s. 90%:  2.25s. 95%:  4.00s.    20,099 Commands.      37 > 60 sec.: 0.18%

First: 04:34:04  Last: 20:57:04

Seconds-->                                   1   1   1   1   1   1  1  2    2    3    3    4    4    5    5
           1   2   3   4   5   6   7   8   9   0   1   2   3   4   5  6  0    5    0    5    0    5    0    5   Number
DAY:    >>m>7>>>>  :   #   :   :   :   :   :   :   :   :   :   :   :  9  :    :    :    :    :    :    :    :   20,099
  Time     :   :   :   :   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :
  4:00     :   :   :   :   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :        0
  4:30  >m7>>  :   :   :   :   #   :   :   :   :   :   :   :  9:   :  :  :    :    :    :    :    :    :    :      133
  5:00  >m7> # :   :   :   :   :   :   :   :   :  9:   :   :   :   :  :  :    :    :    :    :    :    :    :      427
  5:30  >m7> # :   :   :   :   :   :  9:   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      723
  6:00  >m>7>  #   :   :   :   :   :   :   :   :  9:   :   :   :   :  :  :    :    :    :    :    :    :    :      921
  6:30  >m>7>  :#  :   :   :   :   :   :   :   :   :   :   :   :   :  :  :  9 :    :    :    :    :    :    :      723
  7:00  >m>7>> #   :   :   :   :   :   :   :   :  9:   :   :   :   :  :  :    :    :    :    :    :    :    :      747
  7:30  >>m>7>>>>  :  #:   :   :   :   :   :   :   :   :   :   :   :  :9 :    :    :    :    :    :    :    :      888
  8:00  >>m>7>>>>> :   :   #   :   :   :   :   :   :   :   :   :   :  :  :    :  9 :    :    :    :    :    :    1,060
  8:30  >>>m>>7>>>>>>>>>>  :   :   #   :   :   :   :   :   :   :   :  :  : 9  :    :    :    :    :    :    :    1,311
  9:00  >>>m>7>>>>>:   :  #:   :   :   :   :   :   :   :   :   :   :  :  :    9    :    :    :    :    :    :    1,090
  9:30  >>m>7>>>>  : # :   :   :   :   :   :   :   :   :   9   :   :  :  :    :    :    :    :    :    :    :    1,006
 10:00  >>m>7>>>>> :   :   #   :   :   :   :   :   :   :   :   :   :  :  9    :    :    :    :    :    :    :      836
 10:30  >>>m>7>>>> :  #:   :   :   :   :   :   :   :   :   9   :   :  :  :    :    :    :    :    :    :    :      873
 11:00  >>>m>7>>>>>>>  :   :   #   :   :   :   :   :   :   :   :   :  :  9    :    :    :    :    :    :    :    1,091
 11:30  >>>m>>7>>>>>>  :   :   : # :   :   :   :   :   :   :   :   :  :9 :    :    :    :    :    :    :    :      792
 12:00  >>m>7>>>>  :   :  #:   :   :   :   :   :   :   :   :   :   :  :9 :    :    :    :    :    :    :    :      536
 12:30  >>m>7>>>>  :  #:   :   :   :   :   :  9:   :   :   :   :   :  :  :    :    :    :    :    :    :    :      935
  1:00  >>m>7>>>>  : # :   :   :   :   :   :   :   :   :  9:   :   :  :  :    :    :    :    :    :    :    :      701
  1:30  >>m>>7>>>>>:   :   #   :   :   :   :   :   :   :   :   :   :  :  : 9  :    :    :    :    :    :    :      827
  2:00  >>m7>>>:   :  #:   :   :   :   :   :   :   :   :   :   :   9: :  :    :    :    :    :    :    :    :      972
  2:30  >m7>>  #   :   :   :   :   :   9   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      629
  3:00  >m7> # :   :   :   :   :   :   :   :   :   :   :   :   :  9:  :  :    :    :    :    :    :    :    :      685
  3:30  >m7>  #:   :   :   :   :   :  9:   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      493
  4:00  >m7>#  :   :   :   :   9   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      340
  4:30  >m>>  #:   :   :   :   :   :   :  9:   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      469
  5:00  >m7>  #:   :   :   :   :   :   :   :   :   :   9   :   :   :  :  :    :    :    :    :    :    :    :      305
  5:30  >m>:#  :   :  9:   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      268
  6:00  >m7>>>>>>>>>>>>>>  :   :   :   :  #:   :   :   :   :   :   :  9  :    :    :    :    :    :    :    :       48
  6:30  >m7>>>>>>> :   : # :   :   :  9:   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :       24
  7:00  >m>>7>>>>>>>>>>>>>>>>>:   :   :   :  #:   :   :   :   :   :  :  :    :9   :    :    :    :    :    :       37
  7:30  >m7>#  :   :   :   :   9   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :      107
  8:00  >m7>>>>>>  :   :   :   #   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :       72
  8:30  >m #9  :   :   :   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :       30
  9:00     :   :   :   :   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :        0
  9:30     :   :   :   :   :   :   :   :   :   :   :   :   :   :   :  :  :    :    :    :    :    :    :    :        0
Seconds-->                                   1   1   1   1   1   1  1  2    2    3    3    4    4    5    5
           1   2   3   4   5   6   7   8   9   0   1   2   3   4   5  6  0    5    0    5    0    5    0    5

Nine out of ten commands were completed within the time shown by the bar.  Other limits are shown by characters:
  m = Median (50% of commands.)   7 = 75%.    # = 95%.    9 = 99% of logged commands.
```

Fig. 8. Current Daily Response Graph.

small number of logged commands makes percentiles almost meaningless). Our experience has been that response is only perceived as sluggish if the 90th percentile stays over 6 seconds for at least two consecutive half-hours.

CHANGES IN COMMAND ANALYSIS: 1983

By the end of 1982, the Command Analysis System was providing useful reports for internal system use and for the members and users. While the daily response graphs seemed generally sound, we still thought there might be better ways to look at the data. One different way, which may or may not be better, is interval percentages.

Interval Percentages: The Figures

Interval percentages represent the cumulative percentage of commands falling under a certain limit, either of response time, CPU time, or I/O count. While response percentiles show how long it took to respond to 90 percent of commands, interval percentages show what percentage of commands was completed within 3 seconds. The latter figure may be the most meaningful one in terms of real system performance as perceived by users.

All that is needed are the right questions: what limits are appropriate? The first cut divided response into eight categories (the most that would fit on the page). The first two categories are "immediate" response: less than 0.5 seconds and less than 1 second. The second two are "crisp" response: less than 2 seconds, less than 3 seconds. The next two, less than 5 and less than 10, represent "mediocre" response. The last two, less than 20 and less than 60 seconds, represent "poor to bad" response. CPU requirements were split along similar lines (though the subjective labels would differ); I/O requirements were split along arbitrary lines.

Figure 9 is the new Command Group report for July 9, 1984. This report has even more figures than the old version (figure 3): up to three hundred or more for the page. Fortunately, the figures are grouped in a manner that allows a reader to scan them selectively. The first figure for each group is the command count. Under that is the total CPU time, and under that is the total I/O count. The second column gives averages for response time, CPU time, and I/O. The third column shows the maximum response time, CPU time, and I/O count as before. The final eight columns contain cumulative percentages for various intervals. The top line for each group replaces the previous response-limit figures and shows response-time distribution. The second and third line show CPU usage and I/O count.

Figure 10 is another page from the July 9 summaries. It includes all the major *FINd* commands and gives considerable detail as to the use and response of various RLIN searching techniques. Some labels on this figure are easy to misinterpret. *FIN PN* consists largely of *FIN PN . . AND TW . .* combined author/title searches; some other *FIN . .* labels may represent multi-index searches. Additionally, most search responses include display of one or more records (display is automatic if the search returns fewer than seven records).

The report format shown in figures 9 and 10 suffers from having a great many figures, but gives a great deal of key information in a relatively compact space. The first three columns are generally useful; the other columns are primarily designed for those who can gain information from a page full of numbers.

In looking at, and working with, the numbers, we noted that the second and fourth response columns (1 second and 3 seconds) were "good" intervals for most commands and that they could be translated to realistic descriptions: immediate response and crisp response. This suggested the possibility of further graphic reports.

Monthly Graphs, Additional Version: Interval Percentages

We felt that members and users would appreciate the 3-second and 1-second percentages. We also wanted to illustrate the difference in response for different classes of commands. At the same time, we wanted to keep the user report to a single sheet of paper, printed both sides: if it was more than one sheet, handling would become a significant expense.

The Xerox 9700 laser printer used for most RLG printed output has a wide range of formatting capabilities. One of these al-

Group	#/Total	Average	Maximum	Percentage of responses		Command Groups		840709			Page 1
AUT	318	10.15	51.0	<0.5: 0.0%	<1: 1.5%	<2: 6.9%	<3: 9.1%	<5:16.6%	<10:60.3%	<20:91.8%	<60:All
CPU Time	42.0	0.132	0.206	<.05: 0.0%	<0.1: 0.3%	<0.2:99.3%	<0.3:All				
I/O	5422	17.05	25	None: 0.0%	<5: 0.0%	<10: 0.0%	<15:15.4%	<25:98.7%	<50:All		
BUI	5499	0.82	17.2	<0.5:50.7%	<1:77.7%	<2:92.0%	<3:96.1%	<5:98.7%	<10:99.7%	<20:All	
CPU Time	430.4	0.078	0.182	<.05:12.8%	<0.1:77.5%	<0.2:All					
I/O	23969	4.35	30	None:46.1%	<5:55.2%	<10:85.8%	<15:96.2%	<25:99.8%	<50:All		
DIS	6489	0.61	14.9	<0.5:55.8%	<1:84.7%	<2:97.0%	<3:98.8%	<5:99.7%	<10:99.9%	<20:All	
CPU Time	393.1	0.060	0.247	<.05:51.9%	<0.1:79.3%	<0.2:99.9%	<0.3:All				
I/O	17562	2.70	15	None:36.1%	<5:66.1%	<10:99.4%	<15:99.9%	<25:All			
FIN ID	1193	0.99	13.0	<0.5:28.4%	<1:70.4%	<2:90.8%	<3:95.8%	<5:98.8%	<10:99.9%	<20:All	
CPU Time	54.5	0.045	0.202	<.05:66.3%	<0.1:95.8%	<0.2:99.9%	<0.3:All				
I/O	8144	6.82	27	None: 2.9%	<5:13.3%	<10:92.9%	<15:98.9%	<25:99.6%	<50:All		
OTH	1698	2.28	518.8	<0.5:70.2%	<1:81.3%	<2:85.3%	<3:86.5%	<5:89.9%	<10:96.0%	<20:98.6%	<60:99.8%
CPU Time	75.2	0.044	5.372	<.05:82.2%	<0.1:88.2%	<0.2:98.7%	<0.3:99.5%	<0.5:99.8%	<1:99.8%	<2:99.8%	<5:99.8%
I/O	1436	0.84	15	None:83.8%	<5:89.8%	<10:98.9%	<15:99.9%	<25:All			
PRO	29	0.50	1.4	<0.5:65.5%	<1:93.1%	<2:All					
CPU Time	0.9	0.034	0.066	<.05:96.5%	<0.1:All						
I/O	32	1.10	2	None: 0.0%	<5:All						
SEA	4871	2.58	378.0	<0.5:20.2%	<1:57.9%	<2:83.5%	<3:90.3%	<5:94.2%	<10:96.8%	<20:98.0%	<60:99.3%
CPU Time	939.6	0.192	20.194	<.05:37.4%	<0.1:71.5%	<0.2:90.5%	<0.3:93.9%	<0.5:95.5%	<1:97.2%	<2:98.1%	<5:99.2%
I/O	125852	25.83	2373	None: 1.8%	<5:14.0%	<10:59.1%	<15:80.8%	<25:88.9%	<50:94.9%	<100:97.0%	<300:98.4%
Others	2	0.61	0.8	<0.5:50.0%	<1:All						
CPU Time	0.2	0.125	0.163	<.05: 0.0%	<0.1:50.0%	<0.2:All					
I/O	26	13.00	23	None: 0.0%	<5:50.0%	<10:50.0%	<15:50.0%	<25:All			
TOTAL	20099	1.46	518.8	<0.5:44.5%	<1:73.8%	<2:89.6%	<3:93.4%	<5:95.9%	<10:98.2%	<20:99.2%	<60:99.8%
CPU Time	1936.2	0.096	20.194	<.05:40.3%	<0.1:77.4%	<0.2:97.5%	<0.3:98.5%	<0.5:98.9%	<1:99.3%	<2:99.5%	<5:99.8%
I/O	182443	9.07	2373	None:32.0%	<5:48.4%	<10:83.9%	<15:92.9%	<25:97.2%	<50:98.7%	<100:99.2%	<300:99.6%

Fig. 9. Command Group, July 9, 1984.

Command	#/Total	Average	Maximum	Percentage of responses		Seq: Command		840709		Page 3
ENT	1505	1.44	17.2	<0.5:12.9%	<1:50.8%	<2:80.9%	<3:90.4%	<5:97.3%	<10:99.6%	<20:All
CPU Time	103.5	0.068	0.149	<.05: 4.9%	<0.1:96.8%	<0.2:All				
I/O	15398	10.23	30	None: 0.6%	<5: 1.9%	<10:52.5%	<15:88.1%	<25:99.6%	<50:All	
FIN CA	24	1.24	6.6	<0.5:37.5%	<1:66.6%	<2:87.5%	<3:91.6%	<5:91.6%	<10:All	
CPU Time	1.3	0.056	0.248	<.05:66.6%	<0.1:87.5%	<0.2:95.8%	<0.3:All			
I/O	160	6.66	25	None: 0.0%	<5:29.1%	<10:83.3%	<15:95.8%	<25:95.8%	<50:All	
FIN CP	136	1.54	32.1	<0.5:22.0%	<1:66.1%	<2:89.7%	<3:93.3%	<5:95.5%	<10:97.7%	<20:98.5%	<60:All
CPU Time	13.8	0.102	2.400	<.05:58.8%	<0.1:82.3%	<0.2:93.3%	<0.3:95.5%	<0.5:97.7%	<1:98.5%	<2:99.2%	<5:All
I/O	2040	15.00	292	None: 0.7%	<5:14.7%	<10:72.7%	<15:87.5%	<25:91.1%	<50:96.3%	<100:97.7%	<300:All
FIN CW	50	4.13	79.7	<0.5:15.9%	<1:53.9%	<2:77.9%	<3:83.9%	<5:85.9%	<10:93.9%	<20:93.9%	<60:97.9%
CPU Time	22.4	0.449	9.783	<.05:55.9%	<0.1:73.9%	<0.2:79.9%	<0.3:83.9%	<0.5:89.9%	<1:91.9%	<2:93.9%	<5:97.9%
I/O	2961	59.22	1439	None: 0.0%	<5:31.9%	<10:65.9%	<15:71.9%	<25:79.9%	<50:89.9%	<100:93.9%	<300:93.9%
FIN ID	1158	0.99	13.0	<0.5:28.5%	<1:70.2%	<2:90.8%	<3:95.8%	<5:98.7%	<10:99.9%	<20:All
CPU Time	52.4	0.045	0.202	<.05:67.5%	<0.1:95.9%	<0.2:99.9%	<0.3:All			
I/O	7881	6.80	27	None: 2.8%	<5:13.4%	<10:93.0%	<15:98.9%	<25:99.6%	<50:All	
FIN IS	270	0.83	6.3	<0.5:26.6%	<1:75.9%	<2:95.9%	<3:99.2%	<5:99.6%	<10:All	
CPU Time	16.7	0.061	0.203	<.05:37.4%	<0.1:88.1%	<0.2:99.6%	<0.3:All			
I/O	1690	6.25	26	None: 1.1%	<5:32.2%	<10:84.4%	<15:98.1%	<25:98.8%	<50:All	
FIN LC	305	0.93	5.7	<0.5:22.2%	<1:70.4%	<2:93.1%	<3:97.7%	<5:99.6%	<10:All	
CPU Time	22.7	0.074	0.241	<.05:18.3%	<0.1:84.9%	<0.2:99.0%	<0.3:All			
I/O	2151	7.05	40	None: 1.6%	<5:14.7%	<10:82.2%	<15:95.4%	<25:99.0%	<50:All	
FIN PE	103	2.37	66.3	<0.5:15.5%	<1:52.4%	<2:76.6%	<3:88.3%	<5:94.1%	<10:97.0%	<20:97.0%	<60:99.0%
CPU Time	23.3	0.226	8.434	<.05:36.8%	<0.1:60.1%	<0.2:85.4%	<0.3:91.2%	<0.5:95.1%	<1:98.0%	<2:98.0%	<5:99.0%
I/O	3270	31.74	1136	None: 2.9%	<5:15.5%	<10:48.5%	<15:61.1%	<25:80.5%	<50:93.2%	<100:96.1%	<300:98.0%
FIN PN	976	2.06	65.8	<0.5:20.7%	<1:51.9%	<2:79.4%	<3:88.8%	<5:93.8%	<10:97.0%	<20:98.6%	<60:99.8%
CPU Time	144.2	0.147	6.847	<.05:32.3%	<0.1:60.6%	<0.2:87.6%	<0.3:92.8%	<0.5:95.5%	<1:98.0%	<2:99.2%	<5:99.8%
I/O	19087	19.55	1283	None: 0.6%	<5:20.1%	<10:48.5%	<15:70.0%	<25:85.1%	<50:94.5%	<100:97.7%	<300:99.4%
FIN SP	96	3.08	73.5	<0.5:16.6%	<1:45.8%	<2:79.1%	<3:90.6%	<5:94.7%	<10:95.8%	<20:95.8%	<60:98.9%
CPU Time	20.9	0.217	5.391	<.05:54.1%	<0.1:73.9%	<0.2:93.7%	<0.3:94.7%	<0.5:94.7%	<1:95.8%	<2:95.8%	<5:98.9%
I/O	3879	40.40	1750	None: 1.0%	<5:23.9%	<10:66.6%	<15:83.3%	<25:90.6%	<50:94.7%	<100:95.8%	<300:96.8%
FIN TP	2050	1.38	102.7	<0.5:18.0%	<1:60.8%	<2:89.1%	<3:94.8%	<5:97.9%	<10:98.8%	<20:99.5%	<60:99.9%
CPU Time	182.0	0.088	5.848	<.05:40.1%	<0.1:78.4%	<0.2:97.0%	<0.3:98.4%	<0.5:98.7%	<1:99.3%	<2:99.7%	<5:99.9%
I/O	26710	13.02	1171	None: 0.7%	<5: 5.0%	<10:60.5%	<15:90.8%	<25:96.2%	<50:98.5%	<100:98.9%	<300:99.7%
FIN TW	364	11.29	293.2	<0.5: 9.0%	<1:26.0%	<2:50.0%	<3:60.4%	<5:71.1%	<10:82.6%	<20:89.0%	<60:94.5%
CPU Time	340.5	0.935	20.194	<.05:19.5%	<0.1:35.1%	<0.2:57.4%	<0.3:68.6%	<0.5:74.4%	<1:82.1%	<2:86.8%	<5:93.9%
I/O	43941	120.71	2373	None: 1.9%	<5: 9.8%	<10:25.0%	<15:35.7%	<25:50.0%	<50:70.6%	<100:82.6%	<300:88.7%

Fig. 10. Partial Command Report, July 9, 1984.

lows two "computer page" listings on a vertical letter-size page. Since the 9700 will also print both sides of a sheet, this allowed us four "pages" on a single sheet.

A little testing showed that the monthly chart would be nearly as readable, and perhaps easier to interpret at a glance, if it was printed in the smaller size; this would leave another "page" free for a new chart. On the verso, the long-term graph could keep growing to cover two full years (and more), since 120 print lines would be available. Figure 11 shows the result of these calculations. This half-page includes five small charts, all for May 1984.

All other charts have response time along the horizontal axis and days along the vertical axis. These five charts have days along the horizontal axis and percentages (starting from 60 percent)[7] along the vertical axis, to conserve space. In other charts, "the shorter the better": shorter bars represent better performance. In the new charts, "the taller the better": taller columns represent better performance.

The individual columns of asterisks represent percentage of commands completed within three seconds (crisp performance). The first chart includes all commands. The others include searches except record numbers, *BUIld* commands, display commands, and record number searches (*FIN ID*). Searches are always slowest, and display and BUIld commands are usually the fastest. The *1* in most columns represents percentage of commands completed within one second.

Long Search Reports

The *ITAL* communication on long searches[5] resulted in an addition to the daily reporting. This addition consists of two sections. Figure 12 shows part of the long search report for July 9. The first section lists each search that took 2 or more CPU seconds to process. For each search, the I/O and CPU times are shown, as are the response and actual search times. The second section shows comparisons between long searches and all other commands, giving the CPU and I/O averages for all other searches and all other commands, the ratio of long search to other search or other command, and the percentage of search (and all) CPU and I/O usage taken up by long searches.

July 9 shows a large number of long searches and a fairly typical ratio of resource usage. The average long search used 115 times as many I/Os as the average command (51 times as many as the average search) and 67 times the CPU resources of the average command (48 times the average search). The 89 long searches, 4.4 out of every thousand commands, took 22.8 percent of all CPU time.

The long search reports are used by RLG library coordinators in training and ongoing user education. They serve as reminders as to what can go wrong (and what sorts of correct searches are resource-intensive). Figure 13 shows part of another tool used by RLG library coordinators and RLIN coordinations within libraries: logs of terminal sessions showing the CPU resources (in milliseconds) and I/O resources (number of I/Os) required for each command. As with all RLIN Command Analysis reports, these logs (which are printed three or four days a month for those libraries wishing to use them) exclude identification of the person using the system; such identification is not available to the Command Analysis System, by design.

RECENT RESULTS AND FUTURE DEVELOPMENTS

The Command Analysis System allowed us to look at the effect of adding nearly four million new records to the RLIN database; we were able to demonstrate that the larger database did not significantly worsen response time. August 1983, with unusually heavy load on the system, showed overall response comparable to April 1983 (a very good month). The system also allowed us to determine the actual effect of an upgrade in the RLG computer (from a 3081D to a 3081K): we were able to demonstrate to our satisfaction that IBM's claimed improvement of 40 percent was legitimate. Average CPU time per command, by command group, and overall, was reduced by a factor of 1.4 after the change.

The Command Analysis System also serves as an early warning and confirmation device. Figure 6 shows two days of poor response, May 1 and 2; the daily Com-

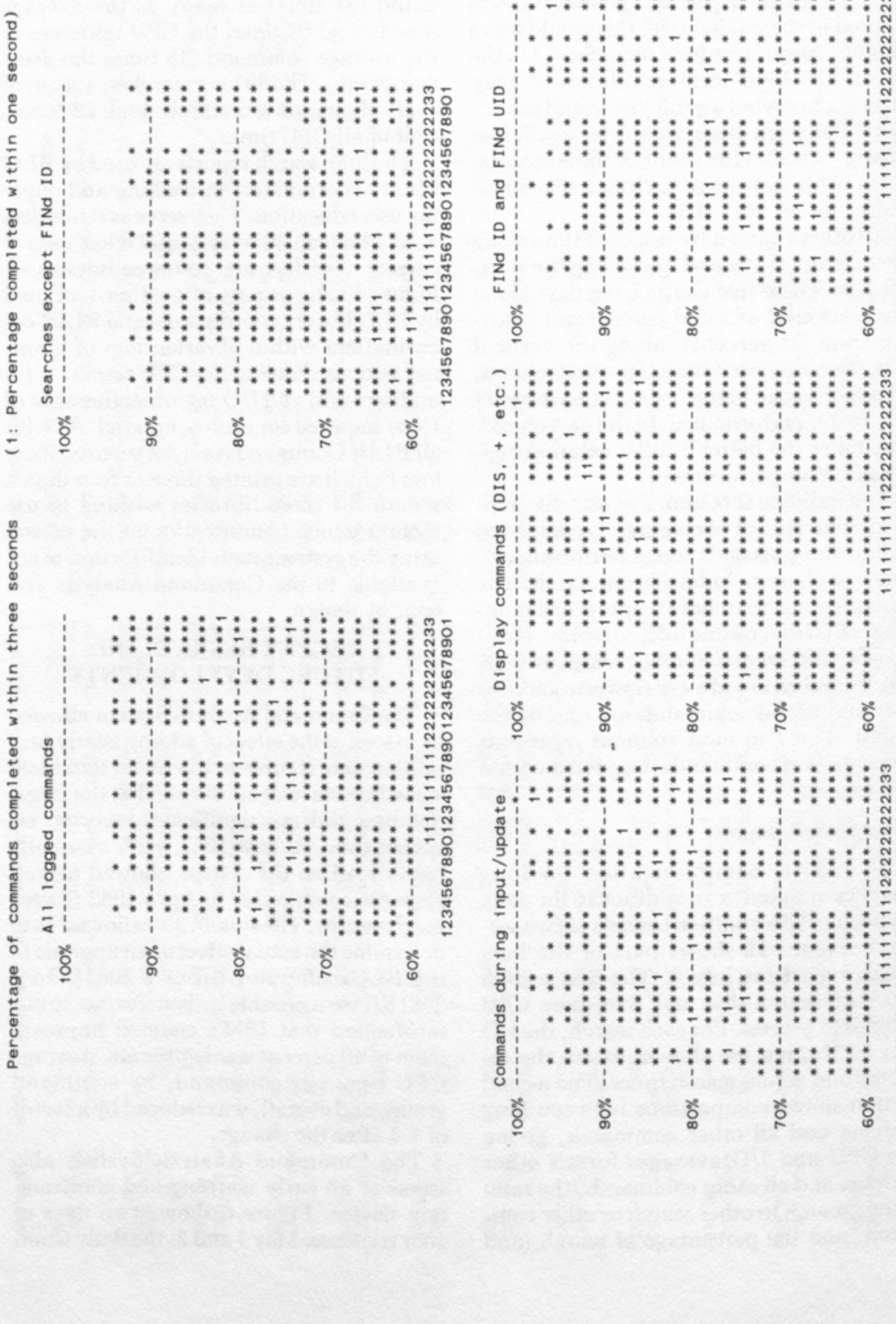

Fig. 11. Interval Charts for May 1984.

```
  I/O   CPU time  Response time                    LONG SEARCHES       840709      Page  1
 Count   msecs.     seconds

  618     5964      120.2    FIN TW JAPAN SOCIETY MECHANICAL ENGINEERS JOURNAL
  645     5019       78.0    AND TW JOURNAL
  880     5986       56.6    FIN TW SPACE RESEARCH TRANSACTIONS ALL UNION PHYSICS
  720     5282       59.0    AND TW RESEARCH
  500     2537       55.8    FIN PN TSCHERNING AND TP CONFERENCE#
  561     4677       29.2    AND TW GUIDE
  310     2455       27.3    FIN TW COST AND MANAGEMENT ACCOUNTING#
  358     2404       17.2    FIN TW MANAGEMENT ACCOUNTING#
 1124     9520      157.1    FIN TW DISCIPLINARY PROCEDURE RESEARCH SYSTEM#
  433     3116       36.1    FIN TW ADVANCED LAW PENSIONS DEFERRED#
  830     6453       66.1    FIN TW ERISA MULTIEMPLOYER PENSION PLAN#
  257     2330       17.3    FIN TW ANNUAL EMPLOYEE BENEFITS INSTITUTE#
  276     2168       39.0    FIN TW QUALIFIED PLANS WHICH INVEST#
  599     5255       65.3    FIN TW PSI THE OTHER WORLD CATALOGUE
 1750     3616       73.5    FIN SP UNITED STATES#OPINION
  297     2447       60.4    FIN TW HANDBOOK DEAL#
   .        .          .     .
   .        .          .     .
   .        .          .     .
  797     7607       76.7    AND TW REPORT
  471     2199       20.5    FIN PN WOODWELL, G AND TP ROLE OF #
  273     2277       53.1    FIN PN ELLMAN AND TW MODERN
 1672    10684      100.3    AND TW UNIVERSITY COLLECTION MUSICAL
  875     7602       83.2    FIN TW HISTORY OF SHIAWASSEE AND CLINTON COUNTIES, MICHIGAN
  292     2399       32.1    FIN CP ASSOCIATION OF AMERICAN RAILROADS AND TW ANALYSIS
  280     2038       17.2    FIN TW JEWISH INFORMATION QUIZ
  638     5372       59.8    FIN TW JOURNAL EARLY REPUBLIC
 1129     8193       54.2    FIN TW HOW WASHINGTON REALLY WORK#
  324     2511       37.8    FIN SP INTERNATIONAL BUSINESS ENTERPRISES# AND TW CULTUR#
  302     2190       68.5    AND TW MANAGEMENT
  652     5391       42.9    FIN SP "ZAIRE--POLITICS AND GOVERNMENT#" AND TW INTERNATION#
  582     5016       69.3    FIN TW GUIDE CLASSROOM FILM
  228     2074       33.7    FIN PN BLASS, B. & TW SURVEY

          Effects of Long Searches  [2 CPU seconds or more]                          840709

                         Count   CPU msec   Average      I/O   Average
Long Searches               89    442365    4970.3     61701    693.2   Long Searches
SEArch Group#             4782    497001     103.9     64151     13.4   SEArch Group#
ALL Commands#            20010   1492847      74.6    120742      6.0   ALL Commands#
Long Search to SEA       1.82%     47.0%     47.8*     49.0%    51.6*   Long Search to SEA
Long Search to ALL        .44%     22.8%     66.6*     33.8%   114.8*   Long Search to ALL

#ALL and SEArch totals EXCLUDE long searches for these figures.
Percentages are of ALL and SEARCH including long searches.  *:Relative use by ave. long search
```

Fig. 12. Long Search Report for July 9, 1984 (Partial).

```
CRLG  I/O   CPU   Command                          *** New Session ***     840709  Page 1
       25   176   AUTO NEWS
       13   105   FIN ID 83S342
        5    74   FIN CP INTERNATIONAL CONFERENCE FOR THE SOCIOLOGY OF RELIGION#
       19   137   FIN TP ARMORIAL CISTERCIEN#
        0    80   CRE
        0    14   CAN
      126   833   FIN TP "CATALOG OF THE ORIENTAL INSTITUTE LIBRARY"
        7    38   FIN ID 790114-B
        7    34   FIN ID 77155090-B
        5    32   FIN CP CHICAGO UNIVERSITY LIBRARY#
        6   114   MUL
        7   117   +
        5    89   +
        6   105   +
        4    85   +
        8    51   FIN ID 9228950-B
        7    64   UPD
       15    85   MAT
        0    38   ENT
       20    79   ENT
        0    28   SET FUN ACQ MAI
        4    63   UPD ITE
       11    64   ENT
        0    25   SET FUN ACQ
       12    49   FIN TP DOCUMENTO CELAM#
        7   104   MUL
        5   121   +
        4   101   +
        6   109   +
        1    32   +
        0    87   CRE
        8   102   UNIT
        0    73   MAT
       10    75   ENT
        9   107   FIN CP CANADIAN SOCIETY FOR THE STUDY OF RELIGION
        1    58   FUL 2
        0    55   DER
        0   108   BIB
        8   140   +
        0   116   MAT
       10    64   ENT
        0    27   SET FUN ACQ MAI
        3    62   UPD ITE
        5    56   ENT
```

Fig. 13. Portion of Command Log Version Used by Libraries.

mand Analysis reports confirmed immediately that user complaints of slow response were justified and gave us useful information in tracking down the system problem that caused the slow response.

The Command Analysis System is working well. We could probably find new ways to get better information from logging or to show the information in a better form. Command Analysis has never been an explicitly funded activity at RLG, and there is no staff member with any direct responsibility for development of this sort of statistics. The system serves us well: on several recent occasions when we have been asked to gather information about the system, we were able to do so by referring back to the past few months of summary reports. Command Analysis serves short-range monitoring and long-range comparison purposes. The system will continue to evolve as we learn more about RLIN II and find more meaningful ways to measure its performance.

CONCLUSIONS

Any online system should produce large quantities of data about system performance and system use. It is worth the trouble to turn all that data into useful information.

The definition of "useful information" will be different for different institutions and different systems. In our experience, "average response" is a nearly useless figure. We would caution against any reporting or storing of averages without simultaneous calculation of either standard deviation or distribution patterns.

Percentile limits are useful measures of system response, but require some assertions about useful intervals. If 90 percent of a system's responses are under 1 second, or 50 percent are over 60 seconds, different intervals will be required. Percentile limits (and interval percentages) can reveal somewhat unpleasant aspects of system performance, which must be dealt with.

The RLIN Command Analysis System has evolved over time and use, and has proved a valuable source of immediate and long-term information on system use and performance. The increasing use, with time and experience, suggests that statistical analysis systems should be kept flexible.

Statistics are of little use unless you know what questions you really want answered. Experience with one set of answers can lead you to a new set of questions. A flexible set of tools for analyzing data can help you to develop new answers for your new questions and to check the validity of answers to your original questions.

REFERENCES AND NOTES

1. Sample CPE charts are available from the author on request.
2. Two earlier articles by Walt Crawford discuss RLIN output products: "The RLIN Reports System: A Tool for MARC Selection and Listing," *Information Technology and Libraries* 3, no.1: 3–14 (Mar. 1984); and "RLIN Product Batch: Fundamental Design Concepts," *Information Technology and Libraries* 3, no.2: 131–43 (June 1984).
3. The RLG Applications Development Group is headed by Glee Harrah Cady. Lenore Jones manages the Online Group, responsible for the development of RLIN II and for command logging. Michael Carroll, Jody Lucas, Mike Pobuda, Paula Schwartz, and Kitty Shih developed RLIN II Online. Paula Schwartz developed initial analysis techniques, and Mike Pobuda established the "command groups." Walt Crawford, manager of the Product Batch Group, also designed and implemented the Command Analysis System. Jessie Herr (former manager of RLIN's Database Group) provided assistance with statistical definitions. Many other RLG staff members provided suggestions and feedback on useful reports and graphs.
4. Webster's Third New International Dictionary (Springfield, Mass.: Merriam, 1966).
5. Crawford, Walt, "Long Searches, Slow Response: Recent Experiences in RLIN," *Information Technology and Libraries* 2, no.2: 176–82 (June 1983).
6. The algorithm used compares the last digit of the time when the user logs on with the last digit of the date. Thus, on July 9, anyone whose log on reached this stage at nine seconds, nineteen seconds, twenty-nine seconds (etc.) past the minute was logged. Users do not have control of this function in any real way. Log on is one of the slowest and most erratic functions, and there is no way to predict what actual second you will hit the logging algorithm.
7. Normal interval percentage graphs begin at 50 percent; portions of the May graphs were deleted to conserve space. ■■

Communications

MARC Tags and Retrospective Conversion: The Editing Process

Kathleen Joyce Kruger

In 1982, a small-scale retrospective conversion project was begun by the catalog department of Colorado State University Libraries as a result of a grant received from the Colorado Union Catalog to fund the conversion of 5,400 CSU theses and dissertations and 2,600 monograph titles in the area of water resources.

EDITING PROCESS

A search of *Library Literature, 1980–1983*, under the subject heading "Cataloging—Recataloging" revealed articles that described "hit rates" of various utilities used for the conversion, the costs of the projects, statistics generated by the projects, and the staffing patterns and routines developed for the projects. Though all this information is useful in the analysis of retrospective conversion projects, something more seemed necessary. Only Christine Bolgiano's article, "Toward Retrospective Conversion" [*Alternative Catalog Newsletter* 18–20:74–83 (May 1980)], discussed the editing process that had been mentioned in passing in the other literature. The editing procedure is the heart of the conversion process; quality in a recon project is attained only through consistent editing decisions and the development of rules and standards against which the bibliographic information can be evaluated. Simple sets of rules applied in the editing process were missing in the literature describing retrospective conversion projects.

Though the conversion of titles that were not represented in RLIN went fairly smoothly, the conversion of titles already entered in the database by other libraries was a more difficult task to accomplish. A consistent approach to the editing procedure was necessary so that the library assistant who was doing the conversion online could make expedient decisions. The comparison of local cataloging, some of it done twenty years ago, with MARC-tagged LC copy or RLIN-member copy led to questions such as: (1) Is the title in the database the same item described on the shelflist card? (2) How can this manual process of describing the title be meshed with the requirements of the online environment? (3) Should this detail be retained or omitted? (4) Should the book be examined to make sure of this fact? It became strongly apparent that if any progress were to be made at all, guidelines for interpreting the records were needed. Serious interpretive problems with the theses and dissertations conversion had not occurred, of course, because adaptation of someone else's machine-readable cataloging was not involved; all of that conversion work was original.

With the objective of developing concrete touchstones for decision making that could be taught to the library assistant and would use time advantageously, it was necessary for the project reviser to take time out to do derivative (adaptive) cataloging online. This was valuable experience both in terms of broadening a professional's experience of manipulating a computerized database, but also, more importantly, of giving first-hand experience at solving problems of interpretation of the data and coming to grips with specific problems. For adequate training and supervision of the paraprofessional who would soon be assigned to doing the derivative work online,

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it was imperative that the reviser have some first-hand experience of the conversion work also, rather than just the theoretical background. After the guidelines were written, it was a simple matter to train the library assistant to their application.

BASIC RULES

The utilization of records in the RLIN database involved many decisions and infinite variations of circumstances. Every effort was made to be consistent in making decisions. Sometimes the situation was "six of one, half dozen of the other." However, four basic rules that provided touchstones during numerous perplexities were formulated:

- More is better. This simply meant that whenever the cataloging copy contained information that the RLIN record did not have, it was added to the online record during the adaptive process. If, in the illustration statement the card showed "ill., map" and the online record showed only "ill.," "map" was inserted into the #b subfield of the 300 field. Drop notes were added from the cataloging copy if the information was not present in some form in the online record being adapted. Also, data were never omitted from the online record just because those data were not on the local cataloging copy.
- CSU Libraries' (CSUL) cataloging has been historically and currently of high quality; accept the cataloger's work with confidence. It was fortunate that the shelflist cards had, in most cases, complete cataloging data on them. Also, thinking positively about the past work of former and present catalog librarians on the staff prevented dickering over minutiae or retrieving many titles from the stacks.
- Exercise wariness in regards to typographical errors and typographical idiosyncracies on the locally produced catalog cards. Sometimes there would be a discrepancy in the spelling between the name in the access point and the name in the author statement; usually these inconsistent spellings were attributed to typing errors and were resolved by appropriate checking. An example of a typographical idiosyncracy is the typing of the subject heading "Art, French" as "Art-French." In this case, the online subject heading was constructed as "650b/0 Art, French" rather than "650b/0 Art#xFrench."
- Find a solution that has a constructive relationship to the requirements of a machine-readable/retrievable environment. In other words, RLIN standards for content designation were carefully followed. Also, the structure of an online, machine-readable record cannot accommodate some practices of manual cataloging. The old practice of dashing on supplements, appendices, and audiovisual material caused numerous difficulties since the items cannot be treated as "dash-ons" in the online environment.

FIXED FIELDS

On the whole, the fixed fields caused very little difficulty in the conversion effort. Complete tagging was provided in the fixed fields and data in the fixed fields was carefully coordinated with information in the variable fields.

The Cataloging Category is an RLIN fixed field which gives clues to the level of cataloging of the record. This fixed field is very useful to other users of the database because through the 4-digit code, it provides information about the level of authority control, level of cataloging, level of content designation, and source of the machine-readable record, respectively.

The Cataloging Category for original input was 9124, meaning (*a*) record does not have authority control (9); (*b*) record meets RLIN full level of cataloging (1); (*c*) record meets RLIN full level of content designation, item not in hand (2); and (*d*) RLG member cataloging input online (4).

The third digit was very important during the conversion project. Setting the third digit at 2 provided the means of informing other libraries that the record was entered into the database, either through original creation or derivation, without examination of the piece.

The DCF code (Desc in OCLC) was another code that was attended to very carefully. In creating a record, the paraprofessional had to be taught the codes and how to recognize the cataloging style of the local work. This detail was accomplished fairly easily by noting the date of cataloging typed on the shelflist card and assigning the code for the cataloging rules in force at the time of cataloging. Adapting records already in the database involved accepting the style of the record as it was coded by the contributing library. For example, if the record in the database was in ISBD format and the DCF was coded *i*, for ISBD cataloging, the online record derived from the RLIN member record is also in ISBD form, even though the cataloging information on the card being converted was in pre-ISBD form. It was necessary to shift from ALA cataloging rules, to AACR1, to AACR1-revised chapter six rules, and so forth. Whenever it was possible, changes made on the records were consistent with the practice of the cataloging code indicated in the DCF field. This aspect of the retrospective conversion project was the most difficult for the paraprofessional to understand. Guidelines for coping with description done according to the various cataloging codes is one area in which retrospective conversion projects need special attention and pragmatic solutions.

MAJOR VARIABLE FIELDS

• lxx/7xx. Main entry of the RLIN record was accepted in most cases if it was judged correct as to choice of entry stipulated in the cataloging rules that were applied by the RLIN member library. So as not to lose any access points, special attention was given to creating a 7xx access point for the CSUL main entry if justification for the added entry could be realized without cumbersome rearrangement of the data. Of course, the result of deciding to accept the main entry of the member library as opposed to the local main entry was to create discrepancies in the Cutter line of the call number. In some cases, it was judged better to change the choice of main entry of the RLIN record to the choice of CSUL. This decision was a variable and the decision made in each case was dependent, in part, upon the completeness of the information available and the cataloging rules being applied.

• 245. This field was carefully checked for filing indicator and spelling and correct subfields. Occasionally, information that appeared in a drop note on the CSUL card was in the #b or #c subfields of the 245 area of the member copy; the information was left in the subfield.

Problems in the recording of the title occasionally made it necessary to examine the piece, because in an online system accurate coding and spelling of the title are crucial to future retrieval of the information.

• 260. Surprisingly, this field caused very few problems. Information in this field aided any decision made about whether or not the record in the database and the CSUL items were the same.

• 300. Great disparities between information on the CSUL card and the RLIN record hinted that perhaps the two records did not represent the same item.

The #a subfield (extent of volume) posed few difficulties. The library assistant became very adept at interpreting whether or not the description of the member library "meant the same thing" as the local description. There were few changes in this area.

The #b subfield was often supplemented by information on the CSUL card. If the RLIN record was more complete than the CSUL description, the RLIN member description was not changed.

The #c subfield was tricky, mainly because of local practices regarding the size of the volume. At CSUL the oversize designation is FOLIO and this rubric becomes part of the call number whenever the item is over 28cm. Thus, when the online record showed 28cm and the local record showed 29cm with FOLIO in the call number, the online record was changed to 29cm; FOLIO was retained in the call number on the holdings screen in all cases. When the online record showed 29cm and the local record showed 28cm, the online record was changed to 28cm.

Other measurements below 28cm were accepted as they appeared in the RLIN member record if they were only one centimeter different from the CSUL measurement.

Given all the confusion the centimeter problem caused, it is recommended that the paraprofessional be instructed to change the online measurement to match the manual record in all cases. Also, the instruction to retain the oversize designation in the call number in all cases ensures that the paraprofessional can be taught, without exception, to input the call number exactly as it appears on the shelflist card.

- 4xx/8xx. Local treatment and form were carefully followed in this area. The library assistant was instructed to change online information to match the manual record.
- 5xx. Notes appearing on the manual record were added whenever appropriate. In one instance, the online record noted a physical part that the CSUL record did not mention and CSUL did not possess; the note was omitted for the CSUL online record. Notes made by the RLIN member library were usually retained for the CSUL online record, though they might not have been present in the manual record.
- 6xx. Subject headings on the CSUL card were used in addition to any subject headings on the RLIN record. This approach led to some repetitions such as "Water resources development—California" and "Water resources development—United States" for the same record. Without the piece, it was difficult to judge whether the subject analysis done by the RLIN-member catalog librarian or the CSUL catalog librarian was the accurate analysis. It was decided that a judgment should not be made in this situation and it was better for information retrieval purposes that there be additional subject access points rather than time being lost debating over which of the subject headings was more correct. This approach also made it easier for the library assistant to proceed with dispatch in the online adaptation of records.

Obsolete subject headings were updated, but lack of time and staff resources did not allow for checking every one. An advantage to converting bibliographic records by subject blocks or specific class-range areas is that many of the subject headings will be the same and the obsolete subject headings will be recognizable after a period of working with titles that often require the same subject headings.

AUTHORITY WORK

No attempt was made to do authority work on the access points used for the machine-readable record. This is a controversial point in cataloging circles; the decision was purely pragmatic, possibly described as "sufficient unto the day is the evil thereof." Given restrictions on staff and other resources, the Pandora's box of authority control on the retrospectively converted records had to remain closed.

Because there were no cards being ordered that would conflict with AACR2 cards in the card catalog, and RLIN standards for retrospective conversion did not stipulate that records must be converted to AACR2, and since CSUL name verification procedures had historically followed LC practice, it was decided that records with pre-AACR2 access points would not be a gross disservice to the database. There had been complete name searching and verification at the time the item was locally cataloged and the form of access point was correct for that time period. The information is still retrievable for the library community through pre-AACR2 forms of names and, more importantly, through title and subject access, which are significant approaches in an online system. Of course, a retrospective project of authority control on the records converted in this project remains a possibility for the future.

BENEFITS OF THE PROJECT

The benefit of the retrospective conversion project is online access for the library community, through national databases, of important research materials in the area of water resources. Additionally, many of the CSU theses and dissertations converted in the early stage of the project represent graduate research in technical areas. Though the details of the conversion routines for the theses and dissertations have not been discussed in this paper, an additional result of converting those bibliographic records can be a COM catalog of CSU theses and dissertations.

Since new cards to replace our manually produced cards were not ordered, the RLIN ID number was written on the shelflist card so that there would be tangible evidence that the bibliographic record was in machine-readable form.

After conversion, in many instances, the card in the card catalog and the online record for the item are not identical in their content. An attempt to have the manual card record and the online record match during a retrospective conversion project, though not impossible, would involve so much juggling of the data on the screen that the approach is not practical. To have a retrospective conversion project that results in a quantity of online records that meet present-day quality standards for machine-readable/retrievable records, the database must be used as advantageously as possible during the derivative cataloging procedure. Changing online records to match cards produced twenty years ago is not in the best interest of the communal database or efficient for the staff doing the conversion. When an LC online record was used as a base for derivative cataloging of a locally cataloged title, LC cataloging was accepted and thus the greatest divergence between the local catalog cards and the online record was reached.

The range of quality of RLIN member cataloging ran from complete records that were quick to adapt, to minimal records that required considerable editing. The use of minimal records resulted in the conversion work upgrading the information in the database; in this instance, the project was a major contribution to the users of the RLIN system.

In addition to creating complete online bibliographic records that are accessible through the RLIN network, there were some benefits for the staff involved in the project. Though labor-intensive, the project provided the professional and paraprofessional staff with an opportunity to broaden their experience and utilize expertise in a creative way. In this light, the library assistant benefited, particularly because the task of editing copy online without the pressure of ordering cards became experience that the regular duties of inputting the professional's original cataloging and adding copies and volumes had not provided. As a result of the project, the library assistant has been able to learn more about cataloging rules and interpretation of records, thereby enhancing technical skills for the future.

Also, though the project was a small-scale one, it provided a test run for a variety of routines, accumulating statistics and other documentation, that will be useful in the planning of future projects. ■■

Record Matching: A Discussion

Karen Coyle

The LITA/ISAS Programmer/Analysts' Discussion Group met at the ALA Dallas Conference to discuss record matching in automated systems. Representatives from Research Libraries Information Network (RLIN), Washington Library Network (WLN), OCLC,[1] and University of California Division of Library Automation (DLA)[2] described the algorithms used by their systems to bring together records that describe the same bibliographic work. (The Library of Congress also participated, but is not using a record-matching algorithm at this time.)

Record matching in an automated system is an interesting exercise in using a machine algorithm to imitate a complex human decision activity. A cataloger can look at two books and decide if they represent the same edition of the same bibliographic work. The same cataloger, book in hand, may find it less easy to decide which of a number of plausible online records is the right one for the work. An algorithm comparing two machine-readable records is clearly working with a reduced set of clues with which to judge "sameness" and has much less inferential ability when faced with ambiguous or conflicting data.

The similarities between the algorithms presented at Dallas are striking when one considers that they were developed independently. The differences sometimes reflect differences in system scope or the consequences of the match result. Not only is there no objectively "best" match algorithm, none of the discussion group participants felt that they had arrived at a satisfactory means of measuring the performance of such an algorithm.

THE AUTOMATED SYSTEMS

RLIN, OCLC, and WLN are primarily cataloging support systems. All three are

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used to some degree for patron access and reference services. DLA's system, MELVYL, is primarily an online patron access system, with some technical services support.

THE ROLE OF RECORD MATCHING

Both OCLC and WLN strive to maintain a single database record for each distinguishable bibliographic work. It is also important that this single database record be of a high quality. Both of these systems have record-matching algorithms that are very strict, as one of the matching records will be removed from the database. WLN also has a process of human review for cases where the match cannot be decided by a machine algorithm.

Both RLIN and DLA keep multiple copies of records. RLIN clusters its records for user convenience, but keeps a separate record for each holding library. DLA combines its records into a composite record, saving each field that varies from other fields in the record. In these systems, the matching algorithm can be freer. Though mismatching can mask the presence of a record, data are not lost from the database and can be recovered when the error is found.

SOME SIMILARITIES AMONG THE ALGORITHMS

For the purposes of the discussion, the algorithms presented were limited to those matching records for Books format materials. As a matter of fact, two of the systems, RLIN and DLA, currently only match Books records. WLN and OCLC have algorithms for matching other formats, which vary some from the algorithm used for Books. It was generally agreed that matching Serials format records presents particular problems.

OCLC, WLN, and DLA have more than one level of record-matching algorithm. Both OCLC and DLA have a reduced algorithm for records with matching LCCNs. WLN uses a separate algorithm for its Recon system matches, one version of which also leans heavily on the LCCN match.

Both RLIN and DLA use the LCCN, ISBN, and a portion of the title to do a first "sweep" of the database to locate possible matches. This set of records is then subjected to the full algorithm.

As can be seen from the Table of Data Elements given here, the choice of data elements used is very similar. The title or

Table 1. Table of Data Elements Used for Record Matching.

Data Element	MARC Tagging	Systems Using
LCCN	010 $a	WLN, RLIN, DLA, OCLC
	010 $z	RLIN, DLA
ISBN	020 $a, $z	DLA
Author	1xx $a	WLN
	1xx	DLA
	7xx $a	WLN
Author/title key	1xx/245 $a	OCLC
Title	245 $a,$b	WLN, RLIN, DLA, OCLC
Edition	250 $a	RLIN, DLA
Place of publication	260 $a	RLIN, OCLC
Publisher	260 $b	RLIN, DLA, OCLC
Pagination	300 $a	DLA, OCLC
Date of publication	008/7-10	WLN, RLIN, DLA
	260 $c	RLIN, OCLC
Country of publication	008/15-17	WLN, DLA
Record type	Leader/6	WLN, OCLC*
Bibliographic level	Leader/7	WLN, OCLC*
Reproduction code	008/23	DLA, OCLC

*RLIN and DLA do not currently merge records for nonbook formats, so these codes are not used.

author/title combination is the chief identifier of the bibliographic work. Some form of the date or a combination of date and edition is used to distinguish between editions. The place, either from the 260 field or in the form of the country of publication code, and the publisher are used. The LCCN is an important match data element, while the ISBN is virtually ignored.

SOME DIFFERENCES IN THE TREATMENT OF DATA

• LCCN. OCLC and WLN use both the prefix and the number in their LCCN match. The others use only the number.

• Title. WLN does a comparison of the keywords in the titles. All of the keywords in the incoming record must be found in the database record, though there may be additional keywords in the database record. RLIN uses a string match, allowing a shorter title to be embedded in a longer one. OCLC uses their title search key as the match element when the records have matching LCCNs. Otherwise, the first and last sixteen characters of the title must match. DLA compares titles first as a string, allowing one to embed as RLIN does. When the string match fails, title keywords are compared, and the title match is given a value based on the percentage of matching keywords.

• Author. RLIN does not use author in its record-matching algorithm. OCLC and WLN use the author in combination with the title. WLN's algorithm does an author/title match for each 1xx and 7xx in the records. OCLC takes its author information from the 1xx field. DLA compares 1xx fields to each other, but does not use any 7xx fields in matching.

• Edition. RLIN compares edition statements from the 250 field. DLA only uses this data element when the editions are expressed as numbers. The others do not use this field.

• Publisher. RLIN and OCLC look at both the place of publication and the publisher name from the 260 field. DLA uses only the publisher name. WLN doesn't use this field.

• Pagination. DLA uses the largest numeric from the pagination subfield. OCLC uses the first set of contiguous arabic numerals.

• Date. RLIN, DLA, and WLN use date 1 from the fixed field area of the record. RLIN also uses dates from the description (260 $c). OCLC derives up to two dates for matching from the 260 $c.

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Implementation of UTOC: An Online Catalog

Nancy Wikholm

The United Technologies Online Catalog (UTOC) is a minicomputer-based automated library system that uses the Integrated Library System (ILS) applications software package. It is designed to support a full range of technical processing and retrieval activities using a single bibliographic file. UTOC subsystems support catalog access, bibliographic control, circulation, serials control, and administrative functions.

During 1984, UTOC will become available throughout United Technologies Corporation (UTC), a diversified, multinational industrial organization employing close to two hundred thousand people in three hundred principal locations worldwide. The development and implementation of UTOC allows all technical and ad-

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ministrative personnel access to materials in the United Technologies Library System using a computer terminal.

HISTORICAL BACKGROUND

The United Technologies Library System presently consists of a main library located within United Technologies Research Center (UTRC), seven branch libraries in Connecticut, Florida, and Texas, and seven affiliate libraries in California, Connecticut, New Jersey, New York, Pennsylvania, and Canada. Administration of the main library and the seven branch libraries is centralized at the Research Center, whereas the seven affiliate libraries are administered autonomously. The library system staff numbers fifty, twenty-five of which are professional-level positions.

In the early 1960s, a traditional card catalog for books and reports numbering more than one million cards was maintained at the main library. A manual circulation system with limited control of overdue and lost items was in use. The complete record of books and reports in the library system was available in the main library only.

During the mid-sixties, an in-house data processing system was implemented, where keypunched card input of report and book bibliographic information was processed to produce cumulative printouts indexed by call number, author, title, subject, and report numbers. In addition, copies of the printouts were distributed to branch locations, and a batch process circulation system tracked the availability of books and reports and maintained overdue notices on a regular basis. Periodical records were maintained on tape, and the resulting printouts listed holdings indicating location, cost, expiration dates, and a listing of journals by twenty-six general subject codes. Also, a biweekly reports announcement bulletin titled "Reports Received" was produced from the card input.

Replacing keypunched cards with data entry at a terminal located at the main library was implemented in stages during the 1970s. The use of COM (computer output microfilm) in conjunction with the cumulative paper printouts was also implemented, and by the middle of 1982, only the COM catalog was being used throughout the United Technologies Library System.

UTOC IMPLEMENTATION

Because of the growing need to provide UTC technical and administrative personnel immediate access to materials in the Library System and the limited accessibility the present system was providing, an investigation of commercially available automated library systems was conducted during 1981. Although turnkey systems were considered, it was decided to purchase commercially available software and use in-house equipment and staff for maximum flexibility in implementation and maintenance.

The ILS applications software developed by the National Library of Medicine running under the Meditech Interpretive Information System (MIIS) operating system was purchased in December 1981. During the following year, the Library System staff working closely with the UTRC Computing Center staff defined the appropriate system necessary for implementation of the new automated library system christened UTOC.

After purchasing a DEC PDP 11/70 computer for UTOC implementation in March 1983, modifications to ILS and extensive testing were conducted throughout 1983. Since the Library System collection was stored on tape using an in-house format developed during the 1960s, a conversion program was designed by the UTRC Computing Center to convert the data tapes into MARC format to conform with ILS bibliographic format. Loading of the converted data tapes commenced in October 1983. The data consist of 33,000 book records, 106,000 hard-copy report records, and 168,000 microfiche report records.

UTOC is designed to support a full range of technical processing and retrieval activities using a single bibliographic file. Implementation of UTOC during 1983–84 involves the following subsystems: Catalog Access, which provides an online catalog for patrons and library staff; Bibliographic Control, which creates and maintains MARC format bibliographic and authority records; Circulation, which tracks location and status of library material; Serials Control, which checks in serial issues; and Administrative, which sets processing parameters and displays reports.

Completion of the following schedule by the end of 1984 will conclude the implementation process:

- *Purchase ILS software, operating system, PDP 11/70 and peripherals, terminals, wands, and barcode labels.
- *Install, test, and debug PDP 11/70, operating system, and ILS software.
- *Set system parameters and formats.
- *Develop record conversion algorithms.
- Load *book, *report, and microfiche records.
- *Barcode collection.
- *Write UTOC procedures manual.
- Develop data entry program.
- Staff training—*catalog access, circulation procedures, and bibliographic entry and maintenance.
- *Create patron file and implement use of Circulation subsystem.
- Develop announcement bulletins program.

Those items preceded by an asterisk have been completed as of July 1984.

UTOC will eventually involve every facet of the library's activities. Bibliographic records will always be up-to-date, and the circulation status of library items will be kept current since all interaction is online.

During 1984, UTOC will become available not only at the library facilities, but also throughout the corporation. UTC employees will be able to query the online catalog at any UTC location using a suitable computer terminal or modem-equipped microcomputer. The catalog can be queried by author, title, subject, term, and a number of other bibliographic search points, such as report number, series, or conference place and date. The user can then determine immediately the location and availability of any item.

The implementation of UTOC throughout UTC will dramatically reduce the distance barriers to accessing information. Employees are adapting to the procedure of accessing information at a terminal. The growing need for information that is readily available and easily accessible is being met by the use of automated information systems such as UTOC. ■■

Scholarly References to Machine-Readable Documents

Gisle Hannemyr and Even Flood

Today, much communication in the scientific community takes place through computer-based message systems (CBMS). This exchange of information occurs through various mail systems, databases, computer-based bulletin boards, computer conferences, and "electronic magazines." So far, most of this exchange of information has taken place in what may be regarded as a closed and private system, in which access requires membership in a specific research group, an account with a particular computer system, and knowledge of a special password. However, this is changing rapidly. Increased computer literacy and a fast-expanding network of interconnected CBMS are adding new numbers daily to the group of people who use computers as a communication carrier. In the very near future, this should converge toward a service that operates like an "open shop," a metaphor that has been suggested in the network community.[1] The open shop is an electronic emporium in which information is the commodity. Providers and consumers can conduct their trade through a geographically distributed network of computers. It is possible to "walk in" to this network and to gain access to any system without the need for prior administrative arrangements (account, password, access right). Instead, there will be a standardized way of dealing with identification, authentication, accounting, and invoicing, as well as a standardized user interface that makes it possible to procure different services from various systems in a uniform and simple way.

Computer conferencing[2] is probably the best known example of a system that provides open shop in an embryonic form, but electronic magazines (papers and articles

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made available on a computer network in the form of publicly available files),[3] computer-based bulletin boards (a network node where anyone can post announcements, contribute to newsletters, request information, publish preliminary results, or express opinions), the new public telecommunication services, and some databases[4] are part of a trend toward the use of computer-based systems as media of mass communication.

These various systems differ in emphasis and the type of service they provide, but all are information carriers. The interesting aspect of these services is that they provide a form of publication of documents, and that these "documents," in many cases, only exist in a computer system. Such files might be called *public access machine-readable documents* (PAMD).

In this communication we shall briefly consider one minor but important point: How does one provide scholarly references to public access machine-readable documents?

A brief discussion of the topic took place in January 1984 on the computer conference system KOM in Stockholm. It turned out that, due to the lack of guidelines, those who needed to write a reference to PAMD had avoided the problem by listing it as a "personal communication." The publishers of major electronic journals, such as those provided by American Chemical Society and Elsevier on the BRS retrieval system, bypass the issue by publishing parallel editions on paper, so that references may be made to the printed version. Without any established practice, bibliographic descriptions relating to PAMD tend to be arbitrary and confusing. A recent experience at the local university library illustrates this point. A user requested copies of several documents where the only bibliographic description was the letters *RFC* and a three-digit number. It turned out that the documents were stored electronically in the ARPA network in the United States and that RFC was an abbreviation for "request further comments." The references had been taken from a published conference paper,[5] where no explanation for the bibliographic notation was given.

There are a number of difficulties in creating formal bibliographic citations to PAMD. These may be briefly summarized as

1. There is no established format for PAMD references in the tradition of scholarly writing. Ad-hoc inventions by authors will not readily be accepted by established journals.

Online conferences, electronic publishing, computer-based message systems, and database document storage and retrieval are still unknown concepts to the general audience. A bibliography that contains a number of unfamiliar references to things like host computers, databases, conference systems, and message identifiers would be meaningless to a large part of the prospective audience and would not be useful to them because it would not be retrievable.

2. The special structure of computer conferencing often results in authors using language that is different from the language they would have used in other written communications. (Indeed, the pragmatics of computer conferencing would make a very interesting study in linguistics.)

In some cases the "natural-language" quality of much of what is expressed in computer conferences make a verbatim quote and a formal reference unsuitable. In particular, notices are posted that assume a great knowledge of the context (e.g., the "comment tree" up to the particular point in the conference where the notice was inserted) and the (private) semantics of the particular research group participating in the debate. Hence, there exist computer conference entries in which somebody has offered interesting and valuable comments, but a quote or formal reference to them would not be very helpful to an outside audience. While "a gentleman [or gentlewoman] and a scholar" would never attempt to pass off the ideas disseminated in such a way as his or her own, the appropriate reference to such off-the-cuff remarks should probably be the same as to remarks exchanged in convention cocktail-bars (which also are public events of some sort)—i.e., "personal communication."

3. Computers use very different mechanical and logical structures from those of published books and journals to store in-

formation. This creates problems that are unique to the computer as medium:

Volatility: computer systems are routinely purged of all data, including PAMD. While backup procedures exists, they rely on magnetic media of limited life. In addition, organizational routines often dictate the destruction of backups after one, five, or ten years for economic reasons. There is no "Library of Congress" for PAMD.

Identification: While published books and journals usually exist in a number of identical copies in several libraries around the world, PAMD usually exist as unique files in a particular computer's filing system. Thus, while a reference to: "Smith, J. My first ABC.—This book may be found at shelf 123:4 in the XYZ university library" is silly, a reference locating a specific PAMD entry to a specific computer file system is currently the only way of identifying it. What happens when that file is moved to backup storage or another computer? What happens when the new releases of the operating system or the PAMD retrieval system change their naming strategy?

Authentication: The fact that PAMD usually exist as a single master copy in a specific location, also means that they are alterable in the most Orwellian fashion. Change the single master copy, and you have changed history!

The current inability to recognize references to PAMD is a cultural problem. As people become more accustomed to computers, they will become familiar with the use and existence of CBMS and PAMD.

It is to be hoped, but not very likely, that the current informality of computer conference systems will vanish in time. As information overload sets in through increased participation in such systems, authors and audience may be forced to structure their use. If this does not happen, it will be necessary to close off larger and larger areas of CBMS from the public. This trend is already highly visible in several systems in which we participate, where earlier democratic intentions of having group conferences open to the public have given way to a desire to communicate through a less noisy channel.

The last group of problems are those that are intrinsic to the computer as a medium. However, just as computer technology creates these problem, it may offer a solution. One of the more interesting aspects of videodiscs is that information written on them will remain there "forever" unless willfully destroyed (something as sacrilegious as the burning of books?). While public key encryption offers a solution to the problem of authentication, this technology requires too many computational resources to be economically viable for use in routine PAMD systems. When dedicated very large-scale integrated circuits that perform this task become available, this may change.

In addition to these technical considerations, there are two more particular questions related to the usability of bibliographies that we should address in particular:

Description—given a document, how does one write a reference to it?

Accessibility—given a reference, how does one locate and order a copy of the document?

Jacob Palme has pointed out that the GILT[6] project, which is carried out within the framework of the International Standard Organization model for Open Systems Interconnections, has established syntax for unique identifier for any CBMS entry. The syntax consists of an internal string that is recognized as a unique internal identifier by the CBMS system where PAMD reside, followed by a separator usually written as "@" (pronounced *at*), followed by an externally recognized identifier of the CBMS. So far, only the CBMS that are interconnected through public computer networks have been assigned external identifiers, but if we assume that the "KOM" CBMS database at the "QZ" computer center is known as "QZKOM" and that every message is tagged with a unique number, then the following reference will provide a unique identification of an entry in this system:

166547 @ QZKOM

Incidentally, it identifies the note in which Palme first pointed out this identification exists. This is a good starting point. The @ character is already established in networking communities as a prefix for system identification, just like the word *vol.* in scholarly references today identifies the object referred to as a journal. However it would probably be a good idea to also include the name of the "author," the subject heading of the entry, the name of the conference in which it appeared, and the date it was entered in the system. This would give the reader a better idea of whether the reference was worth looking up, aid document retrieval (several keys are always better than one, particularly if the single key is particular to a specific CBMS system's way of identifying its entries), and make compilations of catalogs and indexes more meaningful. Both to continue the convention used in references to literary works and provide additional information if the CBMS identifier is damaged, the "place of publication" (the geographic location of the particular CBMS database) should appear in its customary place in the reference. Hence, the previous cited entry would be referenced as:

Jacob Palme, References to conference discussion (in Swedish), Computer conferencing experience, 166547 @ QZKOM, Stockholm (14 January 1984).

With a standard format describing references established, the next problem is locating a document given the reference. In most cases, the task of obtaining a copy of some document that exists as a PAMD on some remote CBMS will be performed by the librarians, just as they today chase references to papers printed in obscure journals by mysterious publishers. To help them do this, we see a need for some standard reference work that establishes a mapping between the CBMS identifier as well as some agent that administers the texts that are continued within the CBMS. This agent should obviously use the mail and file transfer facilities of the CBMS to provide a network address to which requests for copies (both machine-readable and paper) can be directed. In addition, a postal address for more traditional channels of communication should be given for requesters that do not have access to, or the inclination to use, a CBMS. The compilation of the cross-reference of CBMS identifiers and administrative agents should preferably be conducted by some authoritative professional organization (e.g., International Federation for Information Processing [IFIP] or Association for Computer Machinery [ACM] or LITA), should also include CBMS outside the Open Systems Interconnections environment (in particular, the Arpa network), and should be published in readily accessible journals (e.g., *ACM Communications* or *ITAL*). If PAMD are to be regarded as published—and they should be—there should exist some legal obligations for the agent administering the CBMS to forward copies to a central organization responsible for the storage of tapes or videodiscs with document originals, both for archival purposes and to be able, in cases of doubt, to ascertain the authenticity and provenance of the document.

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News and Announcements

The Information Works

Brian Aveney has announced the opening of The Information Works of El Granada, California, to offer consulting services to libraries and the information industry. He was most recently director for research and development for Blackwell North America.

Aveney has worked in library automation and information systems since 1967 at the Library of Congress, Harvard, the University of Pennsylvania, and Berkeley. He has taught library science and automation at Harvard, Rutgers, Berkeley, San Jose State, and the University of Oregon.

Aveney has been appointed editor of *Information Publishing*, a new electronic journal to be published by Information Access Company and available on DIALOG beginning in January 1985. He edited *Information Technology and Libraries* for ALA's Library and Information Technology Association from 1981 to 1983, is a consulting editor of *EPB: Electronic Publishing and Bookselling*, and is a member of the editorial board of *Library Hi Tech*. He recently edited *Online Catalog Design Issues* (CLR, 1984) and *Online Catalogs, Online Reference: Converging Trends* (ALA, 1984).

Aveney has been active in the American Library Association and American Society for Information Science, and is a frequent contributor to library and information technology journals. ■■

CLR Publishes Online Catalog Design Report

The Council on Library Resources has published the results of a meeting on the design of online catalogs. *Online Catalog Design Issues: A Series of Discussions*, edited by Brian Aveney, is the result of a conference sponsored by the Council's Bibliographic Service Development Program and held in Baltimore, September 21–23, 1983. Thirty-three system designers from libraries and commercial organizations participated in the meeting.

The purpose of the Baltimore meeting was to extend discussions held among library administrators and system designers in December 1982 and summarized in *Online Catalogs: Requirements, Characteristics and Costs*, published by the Council in March 1983. System designers who attended the 1982 meeting discovered a need to share specific information on issues and problems of online catalog design. In Baltimore, designers considered improvements for online catalogs and questions that need to be considered in refining them.

The sessions consisted of a series of challenge papers followed by group discussions. All of the papers, plus summaries of the discussions, are included in the publication. The subjects of presentations included system resources needed to support online catalogs; search options; implications of users' comments for catalog design; display formats; command languages and codes; online user prompts and aids; linkages between online catalog systems; and options in telecommunications. A concluding summary emphasizes two themes of the meetings: the need for standards and the evolving nature of online catalog design models.

Online Catalog Design Issues is available from the Council for $9.00 (prepaid only). Orders should be addressed to: *Online Catalog Design Issues*, Council on Library Resources, 1785 Massachusetts Avenue, NW, Washington, DC 20036. ■■

OCLC Microcomputer Exchange Begins

OCLC has begun an exchange program for IBM PC and M300 Workstation microcomputer programs.

The OCLC Microcomputer Program Exchange (OMPX) collects and distributes public domain programs relating to library operations.

The OMPX collection contains three general types of material: contributed programs from the community of IBM PC and M300 Workstation users, written in BASIC or other languages; command files and templates for use with commercially available programs such as DB Master, VisiCalc, Supercalc, Lotus 1-2-3, dBase II, dBase III, and similar products; and data files, such as the names and addresses of library schools, library periodicals, and the like.

OMPX is the successor to the LIS/PX (Library and Information Services Program Exchange) begun by Dr. Allan Pratt at the University of Arizona Graduate Library School. Dr. Pratt is presently serving as visiting distinguished scholar in OCLC's Office of Research. The disks, which were formerly available from LIS/PX, are now part of the OMPX collection.

The collection contains two general classes of materials. One class comprises programs that are freely contributed by individuals and are in the public domain. The other class is a limited number of "shareware" programs. These are freely available and copyable. However, if a user finds one of these to be useful, he or she is requested to send a monetary contribution as specified in the program (typically in the range of $15-$75) to the author. ■■

AMIGOS and SOLINET Boards Explore Cooperation

The AMIGOS Board of Trustees and the SOLINET Board of Directors met on October 26, 1984, in New Orleans to explore possible cooperative programs and strategies, and to discuss the issues surrounding the OCLC/Networks contract negotiation and the copyright claim by OCLC.

After reviewing the organizational structures and service offerings of each network, the board members focused on areas of program development that might be applicable to the members of both networks. The boards discussed ways of making selected services reciprocally available. Of particular interest were the AMIGOS Collection Analysis Service and SOLINET programs in preservation, microcomputer-based service to small libraries, and the regional serials project that includes 13 ARL libraries in the Southeast. The boards also observed that new technologies will facilitate distributed processing and will spur the formation of state and local resource-sharing networks, and they discussed ways that SOLINET and AMIGOS can encourage the development of such consortia. Staff members were directed to develop detailed strategies for cooperation in the projects discussed during the meeting and to begin planning for a special AMIGOS/SOLINET membership meeting.

The boards also reviewed the status of the contract negotiations with OCLC and of the OCLC copyright claim, and adopted the following resolution:

> Following discussions of the issues surrounding the OCLC/Network contract and the copyright claim by OCLC, the AMIGOS Board of Trustees and the SOLINET Board of Directors, meeting in joint session in New Orleans on October 26, 1984, each affirms
>
> • Its commitment to proceed expeditiously with network group negotiations with OCLC,
>
> • That appropriate uses of the database be governed by a cooperatively developed and approved code of responsible use, and
>
> • Its continued opposition to any exclusive claim by OCLC of ownership of the database.
>
> The two boards also resolve that if prompt resolution of the issue of appropriate uses of the database cannot be obtained through the current contract negotiation process, then necessary action be taken to achieve recognition that members own the database, to reaffirm members' rights to use the database individually, and to authorize cooperative uses by their networks.

Finally, to ensure continued cooperation in program development and contract/copyright strategies, the boards established a standing AMIGOS/SOLINET Board Liaison Committee. ■■

CLSI Releases Professional Workstation

CLSI has introduced the Series 3000 professional workstation, providing standalone processing and operation as a system terminal. Offering terminal emulation, the workstation operates as an active terminal to the CLSI LIBS 100 system. Also, it interfaces with OCLC to receive MARC records, format them to the library's specifications, and input the data to the LIBS 100 system.

The Series 3000 professional workstation also has stand-alone ability. It can operate as a separate computer with word-processing, spread-sheet, and database management capability. A self-instruction program teaches basic system operations to new users with ease.

Two basic configurations of the workstation offer a choice of floppy disk, or floppy disk plus Winchester (10 million character) disk drive. The system has an LSI-11/23 processor with 16 bit data and 22 bit addressing capability. The screen offers a choice between 80 or 132 characteristics per line. ■■

Information Access Company Announces Electronic Journal

Information Access Company has announced the debut of what it believes is the world's first commercial electronic professional journal. *Information Publishing: An Electronic Journal* will focus on areas related to IAC's primary business: information storage and retrieval, online and other innovative distribution services, and information technologies related to electronic publishing.

Information Publishing will be available starting January 1985 as part of the ASAP full-text databases on Dialog.

Brian Aveney of the Information Works (El Granada, California) has been appointed editor of *Information Publishing*.

Topics will include: online search and retrieval systems and databases; library public catalogs and information services; economic analysis of traditional and electronic publishing; case studies; and perspectives on microcomputers, videodiscs, microform, satellites, and other information technology. Because electronic publishing removes the limitations of the print medium, *Information Publishing* encourages submission of original papers in any length.

Information Publishing will be fully indexed in IAC's *NEWSEARCH* and *Trade & Industry Index* databases. The full text of each journal article can be displayed in TRADE & INDUSTRY INDEX. In addition, *Information Publishing* will be added to the more than eighty journals available in *Trade & Industry ASAP*, the full-text database.

For further information contact Blodwen Tarter or Richard Carney (415) 591-2333 or Veronica Kane (408) 965-7828. ■■

OCLC to Acquire Advanced Telecommunications Equipment and Software

OCLC will acquire $2.6 million in state-of-the-art computer equipment and software to modernize its telecommunications network to improve service to its members by the summer of 1985.

As of mid-September there were 5,900 terminals linked to OCLC's central system via dedicated, leased telecommunication lines. There were also more than 1,200 dial-access authorizations.

The following are features of the new OCLC telecommunication network that will be in place in the summer of 1985:

- OCLC-controlled packet switched network employing existing and emerging standards for Open System Interconnection;
- Off-the-shelf hardware;
- Custom software for the OCLC polling protocol and enhanced network monitoring and control;
- Telecommunication service alternatives to multidrop leased lines and their associated costs;
- Dial-up use of OCLC network rather than through value-added networks (for those near the distributed network nodes); and
- Greater flexibility in offering new services such as electronic document delivery to member libraries

The OCLC telecommunications network today is described technically as an interstate, multipoint, synchronous polled network using private lines leased from AT&T. It is a star configuration consisting of over 180,000 miles of leased telephone lines on 218 circuits (and 36 multiplexed circuits) with an average of 21 terminals per circuit, with a total of 3,470 modems.

These circuits are linked to OCLC's telecommunications center in Dublin, Ohio, which comprises 26 D-116 minicomputers, a distributed communications processor (a Tandem TNSII 16 processor system); and modems; there are also Telenet minicomputers for the more than 1,200 dial-access authorizations for the OCLC system.

The OCLC network in the summer of 1985 will use a distributed architecture with central control available from any Advanced Communication Processor (ACP) node. The ACPs are specially designed computer digital switching equipment that will replace OCLC's D-116 minicomputers, which have been in use since 1974. The ACPs are more modern equipment capable of handling OCLC's polling protocol and other standard protocols. The new network will be packet-switched, and the ACPs will enable OCLC to use wire, satellite, or microwave transmission. ■■

Libraries Choose ADLIB

The University of Hawaii, Gettysburg College, Southwestern Christian College, and the Jefferson County Public School District have selected the ADLIB Integrated Library System from Advanced Library Concepts of Sacramento, California. The ADLIB System is transportable to a broad range of microcomputers, minicomputers, and mainframes.

The University of Hawaii system is using a 2MB (Megabyte) Ultimate E-2 System with four 288MB disk drives, one 800/1600 and one 1600/6250 bpi tape drive, and fifty-four terminals for the initial installation now in test phase in the Hamilton and Sinclair Libraries at the Manoa campus. The online catalog file, supplementing the current COM union catalog, consists of over 450,000 OCLC and GRC records. The University of Hawaii's plan calls for support of three hundred terminals on the nine campuses for online catalog, cataloging and authority control, acquisitions, serials, and circulation for the more than two million volume book collection.

The Musselman Library of Gettysburg College in Gettysburg, Pennsylvania, will initially install online catalog, cataloging, and circulation on a 2MB Prime 250 with two 300MB disk drives supporting thirty-two terminals. The online catalog of 160,000 OCLC records will replace the existing COM catalog.

Southwestern Christian College in Terrell, Texas, will use a 256K Climax 60 Supermicro with one 11MB and one 26MB disk drive to support five terminals for the ADLIB online catalog. The library plans to enter records from the manual short entry shelflist for the twenty thousand volume collection and later expand the records by matching to other libraries' MARC files.

The initial file of two thousand records for the online catalog at the new Mandalay Junior High School in Arvada, Colorado, has been converted from an Apple-based DB Master acquisitions system. Mandalay will use a 256K Climax 60 Supermicro with one 11MB and one 26MB disk drive to support three WYSE 50 terminals and three existing Apples used as terminals. MiniMARC will be used for further catalog conversion. ■■

Multi-Vendor Library Systems Datalinked in Massachusetts

CLSI has successfully connected the CLSI LIBS 100 System at the Peabody Institute Library with a Data Phase system at the University of Lowell through the use of CLSI's DataLink module.

The LIBS 100 DataLink software uses a communication link that permits searching of remote databases to find information unavailable in the library's own system. The library can search remote information databases such as BRS and Dialog, databases of libraries using LIBS 100 Systems, and now, databases of libraries using other vendors' equipment.

Peabody Institute Library can search author and title information at the University of Lowell. Furthermore, the University of Lowell's ALIS II system can connect into an auto-answer port on the LIBS 100 system at the Peabody Institute Library, offering intercommunication between the two different systems. ■■

Geac Signs Contracts with Georgetown and Lehigh Universities

Geac Computer Corporation Limited of Markham, Ontario, announces the signing of contracts with Georgetown University, Washington, D.C., and Lehigh University, Bethlehem, Pennsylvania.

Both Geac Integrated Library Systems include the On-line Public Catalogue with Marc Records Management module and Geac System 8000 CPU's.

The Lehigh University system, also encompassing circulation and acquisitions, will consolidate the 800,000 volumes of the three campus libraries. Fifty-seven terminals will be linked to the CPU.

The Georgetown University system will be implemented in three phases. In Phase One, seventeen terminals will be linked to the System 8000 running the circulation module. Phase Two will see the addition of the acquisitions module and seven more terminals. In Phase Three, the On-line Public Catalogue and twenty on-line public catalogue terminals will complete the system. ■■

OCLC to Acquire Computer Equipment for Linked Systems Project

The OCLC Board of Trustees has authorized the acquisition of hardware for OCLC's computer link in the name-authorities phase of the Linked Systems Project (LSP).

LSP involves computer-to-computer links between the Library of Congress, the Research Library Information Network, the Washington Library Network, and OCLC.

In the name-authorities portion of LSP, OCLC-affiliated NACO (Name-Authority Cooperative) libraries will have online input via the OCLC System into the LC Name-Authority file. According to OCLC, all OCLC users will benefit from the more timely updating of the LC Name-Authority file that is expected to result from LSP. Present plans call for transmission of additions and corrections from the Library of Congress to each of the bibliographic networks on a daily basis. LSP files would never be more than twenty-four to twenty-eight hours out of date from LC's own file.

LSP has been funded primarily by the Council on Library Resources. OCLC will seek third-party funding to help defray the cost of software development for the name-authority file on the Data General 16-bit Eclipse S/280 minicomputer, which will serve as in interim system until the implementation of OCLC's overall system redesign. ■■

Three Libraries Sign with DYNIX for Turnkey Systems

DYNIX has announced contract finalization for three libraries: Bellingham Public Library, Brigham Young University–Hawaii Campus, and Burlington County Library.

Bellingham Public Library (Bellingham, Washington) includes the main library and one branch. DYNIX cataloging and circulation modules are scheduled for installation as soon as library renovation and expansion are completed in February 1985. Bellingham Public Library has a collection of 130,000 titles. DYNIX software will be operated by an Ultimate 2020 computer (512K memory, 150 MB disk) and thirty initial terminals.

Brigham Young University–Hawaii Campus has over 120,000 titles. Installation was completed in October using an Ultimate 2000S computer (512K memory, 150 MB disk) with twenty-four terminals.

The Burlington County Library system (Mount Holly, New Jersey) has a total of 250,000 titles (445,000 volumes) and an annual circulation of over 750,000. Installation of the DYNIX system began earlier this month. Burlington County Library will use a Prime 9950 computer (16 MB memory, 1500 MB disk) with 108 terminals. Burlington is also using DYNIX conversion software to speed up the transition.

The signing of these three libraries brings the total number of DYNIX clients to twenty-five. ■■

OCLC Introduces Micro-Based Services

At the ALA Midwinter Meeting, OCLC unveiled new microcomputer-based services for retrospective conversion (MICROCON) and serials control (Serials Control 350).

MICROCON is a microcomputer-based batch retrospective conversion service that enables libraries to obtain retrospective conversion. It allows input of local information by the library staff onto a rent-free microcomputer and diskettes for subsequent automated searching of the OCLC database.

Serials Control 350 is a microcomputer-based serials control system that enables serials librarians to decentralize certain processes and at the same time enjoy the benefits that derive from access to more than six hundred thousand serials bibliographic records in the OCLC Online Union Catalog.

SC 350 has been developed for use with the OCLC M300 Workstation, a modified IBM Personal Computer. It supports a full range of technical services needs, including bibliographic record selection and transfer, automatic check-in and claiming, routing, binding, financial control, report generation, as well as a public searching capability.

In addition to its microcomputer-based service, SC 350 maintains links to the OCLC Online System that enable users to benefit from access to services provided by a centralized system. These services include transfer of bibliographic data to the local site and transfer of union list holdings from the local site to the central and national database of union list holdings.

LS/2000, OCLC's Local Library System, will be providing an interactive link with SC 350. The link will allow libraries to transfer summary and detailed holdings information into the LS/2000 Online Catalog and Circulation System in order to maintain a true integrated local library system. SC 350 software was developed by MetaMicro Library Systems of San Antonio. ■■

Information Access Company Introduces Videodisc System

Information Access Company has announced that it has combined videodisc storage and microcomputer technologies to create a self-contained, automated periodical literature reference system.

The new product, called InfoTrac, enables up to four users to simultaneously search, by computer, fully indexed references recorded on a videodisc. Nearly half a million individual articles drawn from more than one thousand business, technical, legal, and general-interest publications are indexed on the twelve-inch videodisc.

The InfoTrac database contains several years of retrospective material, with indexing to the latest issues of the covered publications added monthly. System subscribers will be provided with a new videodisc each month that will contain the full updated and cumulated InfoTrac database.

The InfoTrac system provides for a multistation setup allowing two to four users simultaneous access to the database. The InfoTrac system configuration consists of four microcomputers (one for each station), one laser disk player, one laser disk interface, and one silent printer. Subscribers have the options of starting with fewer than four stations as well as adding printers for each station. Additional computers and printers may be added as usage demands.

InfoTrac software prompts the user in establishing a search. The searcher responds to menu prompts to define the specific information sought. The program searches the videodisc for the word or phrase the user has entered. The searcher can choose to view either a display of related headings and subheadings or the full index containing his or her topic citations. Simply moving the index to any topic under a *see* or *see also* heading will bring up the alternative subjects. For loosely defined searches, the InfoTrac system allows the user to "browse" among related subjects to stimulate further refinement of the research.

When the user locates a citation or a list of citations of interest, pressing a button produces a printed copy. An accession code is included if the full text of the article is available in one of Information Access Company's companion products, *Magazine Collection* or *Business Collection*.

The videodisc used by IAC is capable of containing the equivalent of more than 530,000 printed pages of information. The InfoTrac system can retrieve relevant references in less than ten seconds.

Major public and academic libraries assisted in the development of the InfoTrac system concept to ensure that the product addressed patrons' search needs. Deliveries of the first InfoTrac products to subscribing libraries will begin in May 1985. Price of a subscription has not yet been determined. ■■

Recent Publications

Reviews

Daniel, Evelyn H., and Notowitz, Carol I. *Media and Microcomputers in the Library: A Selected, Annotated Resource Guide.* Phoenix: Oryx, 1984. 157p. ISBN: 0-89774-117-X, hardcover, $24.95.

Weihs, Jean. *Accessible Storage of Nonbook Materials.* Phoenix: Oryx, 1984. 101p. ISBN: 0-89774-084-X, softcover, $19.50.

Since the post–World War II explosion of educational and entertainment films, librarians have been planning for the incorporation of nonbook materials into book collections. The advent of microcomputers and other new technologies has stirred new interest in nonbook information resources by posing some new questions: Is computer software just another media format, or is it something else? Do microcomputers belong in the media center or at the reference desk? Is videotex a print product or not?

The two books reviewed here represent very different responses to the upsurge of interest in this area. Both discuss new technologies, including microcomputers and videodiscs. One provides a sense of the range of questions (and answers) currently discussed in the library literature. The other presents an apologia for a particular treatment of nonbook materials and describes how that treatment might be undertaken. One represents itself as an "idea" book; the other is offered as a "resource guide."

Accessible Storage of Nonbook Materials is based upon the author's recognition that "intershelving all or almost all materials in the collection in one classification sequence was a good storage method for circulating libraries" (preface, p.1). Intershelving book and nonbook materials can, she argues, create a dynamic collection that reaches new patron markets and raises the circulation and use of all library materials. The book seems to be aimed mainly at small public or school libraries; the author admits that intershelving may not be appropriate for libraries that have an archival function (whatever that means).

The meat of Weihs' book begins in chapter 4, which introduces various storage media useful for full or partial intershelving: boxes, albums, binders, clip-on holders, modular units, hanging devices, media shelves, and cartmobiles. The remaining seven chapters each cover a single nonbook format: sound discs, magnetic tapes, film media, two-dimensional opaque materials, three-dimensional and boxed materials, videodiscs, and microcomputer disks are discussed. After a brief summary of care and handling information, each chapter recommends which storage media are most appropriate for the nonbook format at hand. The length of coverage varies considerably: sixteen pages are devoted to film media, while microcomputer disks receive only two pages.

The bibliography, covering 126 books and articles published in 1975 or later, is arranged alphabetically by author. Each entry has a one-sentence description of the item; most are nonevaluative. Citations from the bibliography are indexed in a very general way; one can expect to find something about storage on page 91, but it is necessary to browse the entries to locate one on the specific subject of interest.

I have several criticisms of Weihs' book, even given the proviso that it is not meant for an academic library. First, most of the commentary is very general, unsupported by hard numbers and facts. For example, here is what the book says about the care and handling of microfiche:

> Each microfiche may be housed in an acid-free paper envelope and stored vertically in one of the ways described below. This will protect the fiche and prevent it from sticking to another fiche. If

proper temperature and humidity conditions can be maintained, it is possible to store them without individual envelopes (p.47).

What are the "proper temperature and humidity conditions"? What about the hazards of storing diazo and silver-halide fiche together? Is vertical storage the only appropriate style?

A second complaint I have is the lack of vendor and/or cost information. Weihs describes a rich variety of materials without once telling the name of a source for the material, or the approximate cost one might expect to pay, or even the comparative quality of the various commercial products she assures us exist. Although the volume is illustrated with nice line drawings showing different storage media, no photographs of actual materials in place on the shelf are used.

Finally, I question the need for a separate chapter on each nonbook medium that simply reiterates what has been said earlier about storage formats. An expansion of chapter 4 to article length would probably have done the job. Although I find Weihs' argument a provocative one, I cannot recommend this volume, particularly at this price. The ideas laid out here could only be put to use after consultation with at least several other sources (such as the book whose review follows).

Media and Microcomputers in the Library: A Selected, Annotated Resource Guide updates *Media in the Library: A Selected, Annotated Bibliography*, which was compiled by one of the authors for publication in 1978. A well-detailed introduction lays out the criteria for inclusion and exclusion, the method for locating citations, and the arrangement of contents. According to the authors, this volume favors reference works, guides to the literature, and articles from periodicals and serials. The 579 citations, drawn largely from the library literature, cover media and equipment but exclude microforms, other "near-print" materials, and library automation.

The organization of the Daniel/Notowitz volume is logical and easy to follow. Consecutively numbered citations are grouped into three main sections: "General Information," "Types of Media," and "Functional Activities for All Media." The table of contents gives a complete picture of the arrangement within each section. Subgroups on guides to the literature, sources of material, sources of equipment, periodicals, and readings appear in each section. Other subheadings may also be included, depending on the topic.

The media types covered in section two include audio, film, slides and other photographic media, toys, video, and computers. Nearly every medium has some special area of listings: oral history and music librarianship for audio media, production for film media and so on. Section three adopts a functional approach, covering selection, organization of materials, storage and care, production, instructional technology and design, and the management of school media centers. The final section provides brief coverage for two special topics: copyright and telecommunications/technology forecasts.

Daniel and Notowitz have included an author/title index that also incorporates materials cited in the annotations. An alphabetical directory of producers, distributors, and publishers is also provided. Annotations vary in length and style. For example, entries for some organizations include a list of their publications, and partial or full contents lists are provided for some monographs. Though recommended selections are starred, annotations are mostly nonevaluative; Weihs' book is described thus:

Offers librarians suggestions for the integrated storage of audiovisual materials that makes them accessible for browsing while assuring orderly, safe storage. Discussion of general storage and circulation considerations is included in the text along with separate chapters on various kinds of audiovisual materials (p.100, item 494).

Daniel and Notowitz are to be commended for the professional quality of this offering. While many of the materials listed were written with general, all-purpose collections in mind, a credible job has been done of addressing the needs of special libraries too. The inclusion of equipment considerations, organizations, and distributors makes this volume more than a bibliography; I would recommend it as a worthwhile addition to the technical collection of any library, large or small, academic or otherwise.—*Valerie Florance, Eccles Health Sciences Library, University of Utah, Salt Lake City.* ■■

Davis, Lanny J.; Allen, Don A.; Bowman, Terry; and Armstrong, Joseph. ***A User's Guide to Computer Contracting: Forms, Techniques and Strategies.*** New York and Washington, D.C.: HBJ, 1984. 619p. ISBN: 0-15-004368-6, binder with removable pages.

In this era of turnkey systems, proprietary software, and commercial services, the librarian or other person without a technical background is at a distinct disadvantage in negotiating agreements with vendors. Even those with considerable systems design or operational experience are not necessarily versed in the legal or practical nuances of the agreements vendors present to codify their sales or lease arrangements.

It is common for the vendor's standard agreement to be used intact or to be the basis for negotiating a contract that in the end is determined by the language of the vendor's agreement model. Yet, it is in the best interests of both parties to establish a sound and fair basis for their future relationship—and that relationship usually has some considerable future. The library will need support to install, operate, and maintain its system. The vendor will want to continue selling products to enhance or expand the installed system or will want to sell additional products to a satisfied client.

Therefore, the risks attendant on the acquisition of computer equipment, programs, or services should be well understood and accommodated in purchase or lease agreements so that both sides are protected. The purchaser would want protection from undue loss as a result of a system's failure to perform as represented in the marketing effort. The vendor would want protection from legal action and significant damage awards arising from computer-related losses incurred by a client.

Ultimately, the goal is to have the risk shared in a balanced way by vendor and purchaser alike. The means to accomplish this are through a careful negotiating process and written agreements that clearly indicate the responsibilities assumed by each party and the remedies for failure to meet the responsibilities.

A User's Guide to Computer Contracting: Forms, Techniques and Strategies is an excellent source for contract language and logic as well as for techniques to establish balanced relationships between clients and vendors. As the title suggests, it is written as an aid to users. It is, therefore, generally concerned with creating equilibrium in an environment that has been strongly weighted in favor of the vendor, based on vendor-provided standard form contracts.

After several well-written preliminary chapters on contracts and the contracting process, an introduction addresses risk allocation and the negotiating process itself. It then goes on to postcontract performance monitoring and recourse in the event the delivered goods or services are deficient. These introductory chapters, numbering 119 pages, are intended for a business audience, but are general enough to be useful in any environment. They are also lucid enough to be comprehensible to any person engaged in a computer system purchase, whether in business, librarianship, government, or other enterprises. The search for improvement through computer technology makes strange bedfellows of us all. If we are evolving toward a common and homogeneous culture, it may be as much in the experience of the computerization process as in the content or substance of the computer applications themselves.

The remaining 500 pages of this worthwhile volume are devoted to balanced, user-protective contract forms. Each of the thirteen forms is accompanied by an annotated version. The annotations interpret clauses of the agreement and offer reasons, examples, and strategies bearing on their inclusion. In some cases, fallback positions are offered if the vendor resists certain language.

The agreement forms included are request for proposal, hardware purchase, hardware lease, hardware maintenance, end-user software license, software license with source code escrow, escrow, software development, software maintenance, consulting services, time-sharing, combined hardware and software maintenance, and combined hardware lease, software license, and software development. The source code escrow agreement is intended to protect software licensees from failure on the part of the vendor to correct defects or properly maintain the software or to protect against certain business contingencies, such as sale of the vendor's company or insolvency.

The book is probably as successful as it is because it was written by both computer professionals and attorneys and originally developed for use within the authors' company. An important feature of their approach is the focus on planning and then negotiating agreements through an interdisciplinary team of business, technical, and legal experts. They emphasize a comprehensive system for the contracting process. This entails involving individuals who will promote interests that may be at stake in the pending acquisition and who can make important contributions to the success of the negotiations. Hence, there is a chapter devoted to organizing the contracting process. It addresses the membership and activities of the negotiating team as well as the use of a request for proposal and vendor evaluation in the absence of an RFP.

The chapter on negotiating the contract contains some valuable advice on the process itself. The authors recommend a simulated negotiation to prepare for some of the problems that are likely to be encountered in the actual contract discussions. They offer negotiating techniques and strategies as well as standard vendor ploys to watch for.

In all, the volume should be invaluable to users who want to get their wherefores and hereinafters together in preparation for a purchase that is likely to be of financial and operational signficance.—*Jerome Yavarkovsky, Adelphi University, Garden City, New York.* ■■

Intner, Sheila S. ***Access to Media: A Guide to Integrating and Computerizing Catalogs.*** New York and London: Neal-Schuman, 1984. 301p. ISBN: 0-918212-88-X, softcover, $35.

This book is a welcome addition to the literature of library management and administration. It is a very comprehensive guide to the planning necessary for integrating audiovisual material or online catalogs, or both, into small and medium-size libraries. It is addressed primarily to librarians in public libraries, but it will also be valuable to school librarians and to managers and administrators of college libraries. In addition, it should prove very valuable to library school students taking classes in audiovisual materials or in library automation. Indeed, for such classes, it should be required reading.

The first half of the book (part one, "History of Media Collections") provides background for the planning guide that makes up part two. Two of the five chapters in part one give the results of a survey of more than 450 public libraries in all fifty states. The survey questionnaire (reproduced in appendix C) was designed to determine the actual treatment of nonprint media in public libraries as well as the attitude of public librarians toward the treatment of nonprint media. Part one also contains an excellent survey of the treatment of audiovisual material in cataloging codes in the English-speaking world since the turn of the century. One chapter in part one summarizes the investigations of others into bibliographic practices in academic and school libraries.

The second part introduces the library manager to planning for online catalogs, for integrating bibliographic records for print and nonprint materials into a single catalog, and for staff training. The author also devotes a good bit of attention to integrating headings constructed under differing and sometimes conflicting rules. Although these chapters synthesize a great deal of very useful information about turnkey systems, vendor-based systems, and microcomputer-based systems, their purpose, which they accomplish admirably, is to guide librarians in weighing the strengths and weaknesses of each type of automated service, not to supply the voluminous data with which the planner must work. The chapter on staff training contains a wealth of suggestions as to where specialized training may be obtained. The chapter also quite rightly presents continuing education as a responsibility both of the library and of individual staff members. It is strange, however, that no mention is made of the extensive training provided by the various networks and their affiliates—e.g., RLIN, OCLC, AMIGOS, ILLINET, etc. The author makes just one statement that strikes a sore point with this reviewer: "Even if staff input is not in itself valuable, participation in the project gives staff members a stake in its success, as well as a feeling of control over the development of their own jobs." I frequently consult the cataloging staff in my library, not to fool them into thinking they have control over their lives, but because I regard their opinions as valuable and because, consequently, better decisions will be reached as a result of consultation. I have been manipulated too often myself by superiors who have no intention of using the advice they request. My feelings on those occasions are dominated by resentment, not satisfaction.

The book concludes with some interesting appendixes. The first lists events of importance to the media librarian for the period 1940–65. It includes such items as the beginning of Schwann's *Record and Tape Guide* and the establishment of a Recorded Sound Section within the Library of Congress Music Division. Appendix B gives a list, in chronological order, of multimedia cataloging codes, starting with the 1967 edition of AACR. Next is the questionnaire used in the author's survey of public libraries. It is followed by a very useful list of acronyms and an equally useful glossary. Sometimes, of course, one could argue the definitions a little. They are sometimes too vague. For example: "Classified catalog—A library catalog in which entries are arranged according to their content or subject matter." This is true, but would apply equally well to a topical subject catalog arranged alphabetically by subject headings. However, I know all too well that it is much easier to criticize a glossary than to improve upon it, and the inclusion of a glossary in this book is a distinct service to the reader. The glossary is followed by a brief but very serviceable index.

Access to Media provides very extensive coverage to planning for integrated bibliographic access to audiovisual media in online catalogs; consequently, it is a rather lengthy book. Fortunately, however, the author has a very pleasant, readable style. This is due in large part to the fair yet straightforward way she deals with the several controversial aspects of her subject. She is a convinced and convincing integrationist in the dispute over whether AV materials should be listed in the same catalog as books. Yet she represents her opponents' viewpoints courteously and honestly. It is seldom that our professional literature presents us with a work that is at once so useful and so pleasant.—*Arnold S. Wajenberg, University of Illinois at Urbana-Champaign.* ■■

Kenney, Brigitte L., ed. ***Cable for Information Delivery: A Guide for Librarians, Educators and Cable Professionals.*** Professional Librarian Series. White Plains, N.Y., and London: Knowledge Industry, 1984. 172p. ISBN: 0-86729-056-0, hardcover, $34.50; 0-86729-055-2, softcover, $27.50.

For years librarians have been talking about the potential of cable television as an information delivery vehicle. At first discussion centered on traditional television programming, perhaps a story hour or a "talking-head" show. More ambitious library efforts produced pseudodocumentaries. The American Library Association has even produced some of its own satellite teleconferences. Now that libraries have gotten involved in cable, *Cable for Information Delivery* takes us to the next step and shows us how the library of the near future may exploit the coaxial cable that will soon run into everyone's home. We are on the threshold of communicating with new forms of technology such as videotex, videodisc, and satellites. Many experiments have been made with these new forms, not always involving cable and not always involving libraries. Kenney and her authors demonstrate how this new technology will coexist with libraries as we move further into the information age.

Kenney has brought the best authors to collaborate on this book. Kenneth Dowlin, author of the chapter on data communications, is director of the Pikes Peak Library District and the force behind *Maggie's*

Place, the library's sophisticated local database. Mary Diebler, author of the chapter on satellite services, not only set up a network of libraries for teleconferencing, but also produced the ALA teleconference in 1983. The other contributors are also on the cutting edge of library technology, which adds to the value of the book.

The book's structure allows the reader to find quickly just what is needed. The opening chapter on cable technology provides a base of information that is not limited to cable and includes other new communications forms. The chapter on regulatory issues is becoming out of date but still provides insight into the regulation of the cable industry. "The Library's Role in Cable" is an excellent summary of library video activities and offers good advice for those who want to become involved. This chapter was cowritten by Lynne Bradley and Kathy Coster, two pioneers of library video services. Although the chapter on library satellite services is an "all you want to know" piece on library-cable-satellite services, it contains five pages of needless listings of satellite entertainment services.

It is the last two chapters of this book that are the most interesting. Dowlin's chapter on data communications provides an excellent overview of new technologies, videotex, videodiscs, and teletext. This is the technology that is available today and that one hopes will become commonplace in libraries. Information will be supplied to patrons at their homes or offices through cheap terminals or home computers. What is holding libraries back, Dowlin says, is the development of standards within the information industry, something that may be unlikely in the "let the marketplace decide" atmosphere of the current federal administration.

Kenney's final chapter, "The Library Cable Partnership," proposes a change from the existing role libraries play in the community to a sophisticated electronic local information provider. More and more librarians are suggesting that this is the future for the library, an information machine linking the library patron to the desired information. Kenney says that the library profession will be an aggressive advocate to assure that everyone has an equal right to information.

Included in the book are two appendixes compiled by Richard G. Akeroyd, Jr. One appendix is a comprehensive bibliography of cable, telecommunications, and video technology. The other is a list of cable programming sources available to libraries. This second appendix may not be too useful in light of the possible costly copyright fees required to cablecast the material.

Although cable will have an impact on the future of the library, it will face stiff competition from new and existing technologies. New technology may certainly allow the cable operator to form a relationship with the library, but it may not be at the expense of the telephone company, which also has access to new technology and the desire to keep both stockholders and customers happy. *Cable for Information Delivery* will be useful to librarians, students, and perhaps cable operators. It provides both an explanation of emerging technologies and a glimpse into the future.—*Bob Katz, Albany Public Library, Albany, New York.* ■■

Kesner, Richard M. *Automation for Archivists and Records Managers: Planning and Implementation Strategies.* Chicago: American Library Assn., 1984. 222p. ISBN: 0-8389-0406-8, softcover, $27.50.

Richard Kesner bemoans the dearth of automated applications in archives and records administration and cautions archivists and records managers that they "must broaden the scope of their own concerns if they are to cope with the emerging information environment. Failure to do so may relegate these persons to a non-professional cum clerical status within larger information services organizations." In his latest book, the issue of the impact of technology on information management is addressed in a lucid and intelligent manner. He presents an overview of the recent advances in computer technology that promise to solve the problems brought about by the tremendous growth of information. The subtitle is apt because the author does suggest realistic strategies for planning and implementing scenarios that will enable information managers to take advantage of electronic data processing (EDP).

Kesner begins his book with a presenta-

tion of information system typologies in which he describes existing computer hardware and software and EDP options; proceeds through planning and implementation; and, in later chapters, concludes with specific applications in the fields of records management, archival administration, and machine-readable records and archives.

Although the subject matter is technical, Kesner writes clearly and does not confuse the reader. For example, he provides definitions for terms and concepts as they are introduced and effectively summarizes each section. He intersperses charts and matrixes throughout the text and explains the way they might be used for planning purposes. The book itself is especially well designed; the choice of typeface and arrangement of illustrative matter are pleasing. The extensive notes with bibliographical references are current, and Kesner alerts the reader to items that are important for background reading but not up-to-date. He adds an appendix with sample forms and a helpful index of terms with cross-references.

The most useful and detailed section in the book is the analysis of the planning process for EDP applications because the entire process of planning is broken down into manageable segments. It becomes evident in the chapter on implementation that any action plan should be flexible and based on thorough planning. He provides practical steps and suggestions for implementing the process, including sections on documentation and training. However, the psychological impact of automation on staff and their reaction to new procedures should have been included in his study.

Modern records management is already highly automated, and Kesner suggests ways in which the new technologies can be used to support activities such as the maintenance of current retention and disposition schedules. He then explores the topics of archival administration and machine-readable records and archives. Although he does indicate that there have been efforts to standardize the exchange of information about archival materials, Kesner's discussion does not encompass the developments taking place on a national level. His admitted bias in favor of stand-alone micro- or minicomputers for handling information seems shortsighted. When all the options are presented, the utilities may offer information managers an attractive alternative to the development of independent local systems.

Kesner fails to examine the implications of the new USMARC Format for Manuscript and Archival Control, which has made possible the emergence of a national archival information network. Archivists now have access to automated databases that retrieve descriptive information as well as maintain process control information. Even when setting up local systems, it is important for information managers to be aware of the possibilities for information handling and exchange based on a common format. Many types of archival institutions, such as the National Archives, state archives, and university and college archives, are investigating the advantages of computerized databases for storage and manipulation of information. Furthermore, Kesner's claim that the "absence of even a modicum of standardization in descriptive practices will obstruct the progress towards an effective interarchival network" is not substantiated by the facts. Currently, archivists in a wide range of institutions are discussing standards and definitions for describing their holdings and creating links between local systems and national databases.

His book serves as an introductory manual for information managers who are plunging into the new world of automation. It is especially strong in the area of local application, such as planning for automation and implementation of local systems. Archivists need to look beyond these local concerns and become aware of the national implications of automation in order to foster sharing of resources through cooperative interinstitutional networks.—*Lofton Wilson, Harvard University, Cambridge, Massachusetts.* ■■

Kesner, Richard M., and Jones, Clifton H. ***Microcomputer Applications in Libraries: A Management Tool for the 1980s and Beyond.*** New Directions in Librarianship,

5. Westport, Conn.: Greenwood, 1984. 250p. ISBN: 0-313-22939-2, hardcover, $29.95.

This book is a poor attempt to cover a good topic. It is intended to serve "as a primer to library administrators as they attempt to integrate microcomputer applications into their own operations." The book begins with a technological overview, moves on to sections on planning for, and implementing, microcomputer systems in libraries, and considers seven areas where microcomputers might be used. The organization of the book is sensible; as designed, the book should focus more on principles than on specific technological detail.

The intent is good, but the execution is so flawed as to make the book useless. Many of the facts and names are wrong. The authors advocate a laborious method for selecting and using relatively inexpensive tools. The authors take an overly optimistic view of microcomputers and correspondingly pessimistic view of other means of solving problems. More than a third of the text is taken (with proper credit) directly from another book by Richard Kesner. Finally, the style of the book is repetitive and turgid. I began reading it eagerly, but only finished it as a reviewer's obligation.

The most fundamental problem is factual. The authors show considerable confusion about technical aspects of microcomputers and libraries. CPUs are called "ROM microprocessors," where "ROM" is superfluous and essentially wrong. The authors specifically call the Z-80 and 8080 "ROMs" rather than CPUs. We are told that the arithmetic logic unit (ALU) is "in addition to the CPU chip." In any normal microcomputer, the ALU is part of the CPU (on one chip). We learn that "Pascal is fast becoming more popular than BASIC," which is absolutely not true. The authors state that single, dual, or quad density refers to the "ability to record on one or both sides of the diskette." Actually, single- or double-sided diskette writing is an entirely separate matter from density. A double-sided double-density diskette stores four times as much as a single-sided single-density diskette of the same type; a double-sided single-density diskette would store the same amount as a single-sided double-density diskette. Typing single-spaced or double-spaced on paper is different than typing on one side or both, but has the same effect in terms of characters per sheet.

We are told that "most microcomputer monitor screens provide only forty columns of text at one time," which is certainly not true of most microcomputers suited to library processes. We learn that "all microcomputers come with some type of operating system when purchased," which isn't true; many powerful microcomputers require separate purchase of an operating system. The authors state that the operating system is on a ROM chip, which is almost never true for business-oriented microcomputers (such as those running MS-DOS or CP/M). The authors tell us to consider whether the "ROM interpreter" is appropriate for the program; most word processing, database management, and spreadsheet systems are distributed in machine-readable form and neither require nor use an interpreter. We also learn that word processors "offer some type of simple file indexing and retrieval system," which is not true of any MS-DOS or CP/M word processor I know of (except those supplied as part of integrated systems).

The authors confuse interpreters and compilers and assume that language systems normally come on chips or boards (for most microcomputers, compilers and interpreters are normally loaded from diskette). We learn of "light pens and other optical character readers" that can be employed to "read bar code identification numbers off library cards and call numbers off the materials that patrons are checking out." Light pens aren't optical character readers in most circulation systems, but rather bar code readers; they read bar codes on materials, not call numbers. The authors also refer to the "MARC format set by *Anglo-American Cataloging Rules (AACRII)*," when in fact MARC predates AACR2 by a decade or more, and neither the rules nor the format depend on one another. There are quite a few more errors of substance, enough to call into doubt most of what the authors say.

Typographical errors are nearly inevitable, but this book goes too far. CP/M (which stands for Control Program/Microcomputers) is defined as "a microcomputer (queried)."CLSI is called "Computer Library Services, Inc." UNIX, an operating system from AT & T, is called "Bell & Howell's UNIX." Avatar Systems is called "Auctar" twice in the text. Readers are referred to an article in *Library Trends* "for a more detailed explanation of US-MARC and *AACR2* and their benefits," even though the article never discusses cataloging rules and only mentions AACR2 in passing. The glossary includes five citations for somebody named "Richard DeGannaro," and an article by D. Kaye Gapen is cited as "MARC Format Specifications" rather than "MARC Format Simplification."

These are just some of the factual errors. This level of error makes all the information in the book unreliable by inference; if the authors didn't check their facts (most of which could be verified quite easily), what reason do we have to believe that their assertions are any more correct? An administrator, manager, or other librarian would do better with almost any other book on microcomputers in libraries. This one doesn't work. Not recommended.—*Walt Crawford, The Research Libraries Group, Inc., Stanford, California.* ■■

Oboler, Eli M. ***To Free the Mind: Libraries, Technology, and Intellectual Freedom.*** Littleton, Colo.: Libraries Unlimited, 1983. 124p. ISBN: 0-87287-325-0, hardcover, $15 in U.S. and $18 elsewhere.

To sit down and read a book that forces one to think, that one remembers after reading, and that is written with a refreshing and literate use of the English language is sheer delight. *To Free the Mind* is such a book. Before I begin my review of *To Free the Mind*, the caveat I provide is that I am a longtime admirer of Eli Oboler; I admire what he stood for and his articulate ability to speak out in defense of intellectual freedom. In an age where expedience rules, our loyal gadfly will be sorely missed. In all honesty, while I will attempt to be objective, I can't guarantee it.

To Free the Mind deals with many of the problems that automation and technology have created for librarians in terms of access to information and insidious censorship—that is, censorship by lack of access to an electronic format or by lack of funds to purchase equipment for access to information in microformat. In short while technology and automation have proved to be a blessing in many ways for libraries, they also have generated some interesting problems related to how we use the new technologies without closing off access to information and posing barriers that are truly censorship. Will the new techniques of sending, receiving, storing, and disseminating information invite new methods for censoring vital information so necessary for progress?

In the section "Technology and Intellectual Freedom," Oboler discusses James B. Rule's four technological developments outlined in his article "The Future of Freedom." The possibilities for censorship from use of electronic banking and electronic mail are, at best, staggering in their implications. News and home data services also have potential for giving government the ability to monitor personal choices for information. Last are the electronic dossiers and how they have been and can continue to be used to track political dissidents. Oboler points out in his succinct and literate style the implications of accepting technological innovation without regard for possible civil and political problems in the area of intellectual freedom.

One of the techniques that Oboler uses in this book is going back to primary-source materials with liberal quotations and footnotes. I think this is a marvelous technique, as it opens the door to much additional information and whets the appetite for additional reading. In many ways, Oboler has drawn together articles pointing out the possible pitfalls of librarians embracing technology without first looking at its dark underside.

In a time when library networks are proliferating, Oboler takes us back to 1970 and the Airlie House conference on information networks and interlibrary communication. From this conference came some interesting reports, including a White House memorandum sent to the FCC on January 23, 1970, "emphasizing the need for reliable communications services for public, business, and government use at reasonable rates and the assurance of a healthy environment for continuing innovations in services and technology," as quoted in Kenneth Cox' *Federal Telecommunications Policy and Library Information Networks.* At best one can say that was then and this is now. Oboler then proceeds to act as the healthy and loyal opposition and points out with clarity and humor all the pitfalls and unforeseen considerations that now afflict networking and information utilities, not the least of which are cost, privacy, ownership rights, copyright, for-fee document delivery, postal rate increases, increased interlibrary loan demands, and so forth. And what does this do for the library patron in East Podunk who needs information and cannot afford to pay for it?

The book covers a number of related subject areas—micrographics, networking, education and information technology libraries, information centers and scientific progress, mass communications and intellectual freedom, citizen and computer, a twenty-first-century national information policy, and the humanist and the computer.

In reading the afterword, "The Humanist and the Computer," I had two thoughts: if only I could write so well, and how lucky we are to have members of the profession who are so eloquent. In an age of information and technology, the librarian has two vital roles: being both the builder and arranger of information and the entity that brings the information and the user together. With this in mind, librarians should not become servants of technology and must remember that the end is not the means and that the medium is not more important than the content. It is the human that is basic to library service, not the machine. Oboler has concerns that we are so very caught up in technology that we will forget the human element basic to all library service.

It would be nice to think that this book would become required reading in all library schools, but I doubt we are that enlightened. Librarianship's preoccupation with technology and automation may be the very thing that will make our profession go the way of the dinosaur by the next century. And it will if we forget our prime reason for being. To quote Oboler, "It is only when the librarian, fully aware of the human implications, causes, and consequences of such work, considers and treats the tool as a tool that the needed work will be done humanistically, and not mechanically."

One wishes that the publisher of *To Free the Mind* took some humanistic steps when producing this book, as it is poorly designed, has small type, and is hard on the eyes. Nevertheless, it should be in every library and in every library school. It is a feast for the mind and forces us to come face-to-face with all the grim Orwellian possibilities that could well bury what libraries have done for so many years—serve the users, respect their rights of freedom to access of ideas, and make sure that our personal likes and dislikes do not influence book selection.

Again to quote Oboler, "No one is trying to turn the clock back to quill-pens and hand stamping at circulation desks. But it is to be hoped that no one is unaware of the deleterious possibilities in over-reliance on machine read-outs and the machine processing. . . . The continuing task, the professional responsibility, of the librarian is to bring information and user together in the most accommodating, least expensive, and most freedom of information promoting way."

As I said in the beginning, I have long been an admirer of Eli Oboler and, therefore, have written a positive review. On the other hand, the book deserves such a review. We need to be reminded about why we, as a profession, exist and to be warned to take technology and automation byte by byte, lest we choke.

Eli Oboler died in 1983. At the dedication of the Eli Oboler Library at Idaho State University, Judith Krug had this to say about him: "Scholar, thinker, activist, and educator, Eli Oboler will be remembered wherever the freedom to read, to investigate, and to think is cherished. His voice was rarely quiet, but was always civil, penetrating, and principled. It conveyed Eli's personal integrity and his beliefs in reason and tolerance. And in the final analysis these traits serve as the continuing legacy of his wisdom."—*Martha Gould, Washoe County Library, Reno, Nevada.* ■■

Pearce, B. G., ed. ***Health Hazards of VDTs?*** Wiley Series in Information Processing. New York: Wiley, 1984. 244p. ISBN: 0-471-90065-6, hardcover, $29.95.

Tijerina, Louis. ***Video Display Terminal Workstation Ergonomics.*** Dublin, Ohio: OCLC, 1984. 28p. Softcover, $1.50.

The VDT health-and-safety issue marches on. When I prepared the reviews of new publications about this topic for the past issue of *ITAL*, I had no idea that the two excellent publications that are described above were about to arrive on my desk. I do not want to get into the business of creating a serial bibliography, but the value of these two books is so great that I feel an obligation to call them to your attention.

Health Hazards of VDTs? is the proceedings of three one-day meetings. The first section gives an overview that underscores the pragmatic, nonhysterical attitude of many of the contributors. There are indeed problems with the use of VDTs, but those problems can be controlled with proper precautions. This section goes on to discuss evidence of hazards associated with radiation emissions and ergonomics and presents reports of face rashes and cataracts. The second section presents some solutions for common problems, discussing vision, lighting, VDT design, workstation design, working environment, postural loads, and occupational stress. The presentation on the impact of unions is very enlightening. The third section looks to the future with a wide range of topics: optimal presentation mode, colors of symbols, negative ion generators, union demands, humanized computers, measures of user acceptability, and job design. The experience and knowledge of many of the participants are revealed in the discussions of these papers. Those discussions reject some of the reported research because it does not withstand conventional scientific scrutiny. Without the discussions, the inexperienced reader could be led to inappropriate conclusions by conjectures in a few of the papers.

This book presents current knowledge from many of the foremost researchers of VDT health-and-safety issues. It is well written and, as evidenced by the discussions mentioned above, balanced in its presentation of all aspects of the topic. Although the meetings were held in 1980 and 1981, the conclusions from the information that is given here are as current as any other source (with the exception of recent research findings related to low-frequency pulsed emissions). For anyone with more than a passing interest in the subject, this book is highly recommended. It belongs in any collection that includes the subjects of computers, health and safety, labor unions, ergonomics, or optometry.

Video Display Terminal Workstation Ergonomics by Louis Tijerina from OCLC is the best manual I have found for setting up VDT workstations. Somehow he has assembled a tremendous amount of technical detail into a very accessible format. The book uses very clear and precise language to describe the proper qualities for the video display (including glare control), the keyboard, seating, work surfaces, and the work environment. Each guideline is supported by a succinct background explanation with solid references to supporting documentation. The quantity, quality, and currency of the references indicate that very thorough research has been done and provides credibility to the guidelines. (By the way, the reference format does not interfere with the straightforward reading of the text.)

The purpose of this text is clearly to present information for the proper application of known ergonomic data about VDT workstations. It does not delve into legal or radiation issues, but what it does do, it does very well. It presents understandable information that can be easily used to properly enhance existing workstations or to establish new ones. This book gives the best value for the money of anything like it on the market. If you have a personal computer, buy a copy. If your library uses VDTs, buy a staff copy. If any of your library's clientele use VDTs, buy a copy for the collection.—*R. Bruce Miller, Indiana University Libraries, Bloomington.* ■■

Reed-Scott, Jutta. ***Issues in Retrospective Conversion: Report of a Study Conducted for the Council on Library Resources.*** Washington, D.C.: Bibliographic Service Development Program, Council on Library Resources, 1984. 57p. Softcover, $3 prepaid.

Gregor, Dorothy, ed. ***Retrospective Conversion: Report of a Meeting Sponsored by the Council on Library Resources, July 16–18, 1984, Wayzata, Minnesota.*** Washington, D.C.: Bibliographic Service Development Program, Council on Library Resources, 1984. 140p. Softcover, $6 prepaid.

It is a rare library today that is not grappling with the problem of converting its paper card files to machine-readable form. The operational questions plague us all: Which conversion method should we choose? What are the costs? Where can we find the needed funds? With the publication of two recent reports, the Council on Library Resources (CLR) pulls us back from our day-to-day concerns and asks us to consider the national implications of retrospective conversion. The CLR reports remind us that our primary objective is the building of a logical North American bibliographic database; from this database will flow the machine-readable records needed in local library operations. Thus the contributors to these publications conclude that libraries holding large collections of uncommon, specialized material (i.e., research libraries) can best address the need for retrospective conversion through coordinated, cooperative projects, thereby creating a resource database for all to share. As evidenced in the reports, this will be an ambitious undertaking.

Under the aegis of its Bibliographic Services Development Program, the Council initiated an assessment of the status of existing retrospective conversion work and an exploration of possibilities for strengthening, facilitating, and expanding conversion activities. CLR began its effort in the spring of 1983 by commissioning a report by Jutta Reed-Scott. Her report, which includes contributions by Dorothy Gregor of the Library of Congress, and Charles Payne, University of Chicago, begins with a brief overview of current trends and methods in retrospective conversion. The authors then identify issues and problems—economics, standards, authority work, sharing records—and conclude that a continuation of the status quo will leave far too many records unconverted. In search of a proactive national strategy, the authors offer five alternatives for action and finally recommend the establishment of a planned, coordinated program to be undertaken by major research libraries and the Library of Congress.

The Reed-Scott report is a think piece. Its recommendations were further examined by participants in an invitational conference convened by the Council in the summer of 1984 at the Spring Hill Center. The report of the Spring Hill meeting, compiled and edited by Dorothy Gregor, is an essential companion piece to the Reed-Scott study. Conference participants provided a variety of viewpoints on issues raised by Reed-Scott, identified and discussed important additional considerations (e.g., the use of optical character recognition technology), and formulated recommendations for action. Taken together, the two reports provide a compilation of some of the profession's best thinking on the topic of retrospective conversion.

The conference proceedings include background presentations by Reed-Scott and Tina Kass, status reports on RECON plans at the major bibliographic utilities, thought-provoking reactions to the Reed-Scott report by Richard DeGennaro and David Bishop, and a panel discussion focusing on possible next steps. Reactors, panelists, and discussants raise a wide range of concerns: quality versus inclusiveness, REMARC versus non-LC records, priorities for funding, distribution and maintenance of converted records. In the end, all concluded that an "organized RECON program is a viable alternative at this time."

Conferees were careful to distinguish between two kinds of retrospective conversion. The first is the matching of local library holdings to existing machine-readable records; the second is the creation (or upgrading) of new machine-readable records. The latter was the problem seriously addressed at the Spring Hill meeting, since conversion of holdings is, relatively speaking, a task that individual libraries are able to undertake successfully without a national strategy. Ideally, more attention would have been given to the importance of adding holdings to a national database; the many libraries using vendors and REMARC for conversion are not contributing their holdings to central files. However, the need for *additional* machine-readable bibliographic records is clearly the higher national priority.

Another aspect of retrospective conversion that would have merited further study is REMARC. Responding to questioning by DeGennaro, meeting participants explored the option of attempting to free the REMARC file from its proprietary restrictions (e.g., mounting an effort to buy back the records from Carrollton Press). But like Reed-Scott, discussants were finally daunted by lack of information about the relative coverage and quality of the REMARC records and by the legalities surrounding any change in access to them. One wishes the conferees had tried harder to solve the problem.

After consideration of a variety of options, both reports conclude that cooperative cataloging based on libraries' subject strengths coupled with LC distribution of the resultant records is the most viable approach to an organized RECON effort. Conference participants recommended that the Association of Research Libraries assume responsibility for defining and managing such a program; the ARL Task Force on Bibliographic Control has already picked up the ball. As the task force embarks on its planning, coordinating, and fund-raising activities, the library community will increasingly view retrospective conversion as a problem with a cooperative solution. We should all prepare for our role in the process by reading these two critical reports.—*Carol A. Mandel, University of California, San Diego.* ■■

Other Recent Receipts

Listed here are books and other publications of potential interest to members of LITA, received for review. Some of these materials may be reviewed in later issues of ITAL.

Aveney, Brian, ed. *Online Catalog Design Issues: A Series of Discussions.* Washington, D.C.: Bibliographic Service Development Program, Council on Library Resources, 1984. 249p. Softcover, $9 prepaid. "Report of a Conference Sponsored by the Council on Library Resources September 21–23, 1983."

Chen, Ching-chih. *MicroUse Directory: Software.* West Newton, Mass.: MicroUse Information, 1984. ISBN 0-931555-01-9, softcover, $99.50.

Cook, William J. *The Joy of Computer Communication.* New York: Dell, 1984. 182p. ISBN: 0-440-54412-2, softcover, $5.95 in U.S. and $7.50 in Canada.

Godden, Irene P., ed. *Library Technical Services: Operations and Management.* Library and Information Science Series. Orlando, Fla.: Academic, 1984. 272p. ISBN: 0-12-287040-9, hardcover, $32.

Gorman, Michael, ed. *Crossroads: Proceedings of the First National Conference of the Li-*

brary and Information Technology Association, September 17–21, 1983. Library and Information Technology Series. Chicago: American Library Assn., 1984. 261p. ISBN: 0-8389-3307-6, softcover, $40.

Howitt, Doran, and Weinberger, Marvin I. *Inc. Magazine's Databasics: Your Guide to Online Business Information*. New York: Garland, 1984. 614p. ISBN: 0-8420-7287-1, hardcover, $24.95; softcover, $16.95.

Lau, William W., ed. *American University Programs in Computer Science: Their Resources, Facilities, and Course Offering*. Fullerton, Calif.: GGL Educational Pr., 1984. 210p. ISBN: 0-915751-25-9, hardcover, $20.

Mount, Ellis, ed. *Serving End-Users in Sci-Tech Libraries*. Science and Technology Libraries Series. New York: Haworth Pr., 1984. 122p. ISBN: 0-86656-327-X, hardcover, $19.95. "Also published as *Science & Technology Libraries*, V.5, No. 1, Fall 1984."

The Name Authority Cooperative/Name Authority File Service. Washington, D.C.: Task Force on a Name Authority File Service, Bibliographic Service Development Program, Council on Library Resources, 1984. 123p. Softcover, free.

Naumer, Janet Noll. *Media Center Management with an Apple II*. Littleton, Colo.: Libraries Unlimited, 1984. 236p. ISBN: 0-78287-392-7, softcover, $19.50 in U.S. and $23.50 elsewhere.

Stultz, Russell A. *Writing and Publishing on Your Microcomputer*. Plano, Tex.: Wordware Publishing, 1984. 165p. Hardcover, $21.95; ISBN: 0-13-972019-7, softcover, $13.95.

Taylor, Margaret T., and Powell, Ronald R. *Basic Reference Sources: A Self-Study Manual*. 3d ed. Metuchen, N.J., and London: Scarecrow, 1985. 335p. ISBN: 0-8108-1721-7, softcover, $16.50.

USBC (Universal Standard Book Code): Its Use for Union File Creation. London: British Library, 1984. [70p.]. ISBN: 0-7123-1020-7, spiral-bound, £6.50 in England and £7.25 overseas.

Virginia Library Automation Directory. Alexandria: Virginia Library Assn., 1984. 39p. ISBN: 0-931119-01-4, softcover, $6 plus $1 for billed orders.

White, Herbert S. *Managing the Special Library: Strategies for Success Within the Larger Organization*. White Plains, N.Y., and London: Knowledge Industry, 1984. 152p. ISBN: 0-86729-088-9, hardcover, $36.50; 0-86729-087-0, softcover, $27.50. ■■

INDEX TO ADVERTISERS

INSTRUCTIONS TO AUTHORS

Information Technology and Libraries welcomes manuscripts related to all aspects of library and information technology. Some specific topics of interest are mentioned on the masthead page. Feature articles, communications, letters to the editor, and news items are all considered for inclusion in the journal. Feature articles are refereed; other items generally are not. All material is edited as necessary for clarity and length.

Manuscripts must be typewritten and the original submitted with one duplicate. Do not use onion skin. All text must be double-spaced, *including footnotes and references*. Manuscripts should conform to *The Chicago Manual of Style*, 13th ed., rev. (Chicago: Univ. of Chicago Pr., 1982). Illustrations should be prepared carefully as camera-ready copy, neatly drawn in a professional manner on separate sheets of paper. Manuscript pages, bibliographic references, tables, and figures should all be numbered consecutively.

Feature Articles consist of original research, state-of-the-art reviews, or comprehensive and in-depth analyses. An abstract of one hundred words or less should accompany the article on a separate sheet. Headings should be used to identify major sections. Authors are encouraged to relate their work to other research in the field and to the larger context of economic, organizational, or management issues surrounding the development, implementation, and use of particular technologies.

Communications consist of brief research reports, technical findings, and application notes. An abstract need not be included.

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