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LIBRARY CIRCULATION SYSTEMS -- AN OVERVIEW

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LIBRARY CIRCULATION SYSTEMS

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This paper will attempt to present a model of a circulation system (see Figure 1) indicating a spectrum of functions and benefits. Four types of circulation systems will be discussed in an attempt to measure the capabilities of these systems against the model and each other.

The model circulation system outlined is an on-line real time system in which the circulation file is created from the shelf list and the terminal inquiry system includes the capability to query and browse through the bibliographic system and the circulation subsystem together to determine the availability for circulation of specific documents, or documents in a given subject area, or by a certain author, etc. Most of the subsystems are updated on-line, and there is minimum delay to the user. The system is designed independent of the input medium. It may be an IBM 357 data collection system, a terminal keyboard, an OCR system, etc. The only requirement is the user does not have to be present to borrow an item. The model extends beyond the operational limits of most existing circulation systems and can be considered a reflection of the current state of the art. Some of the system requirements and benefits that can be derived from the model include:

1. Creation of the circulation file from the shelf list input, including complete record of holdings, etc.
2. Activity against the shelf list updates the circulation file.

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3. File accuracy due to computer filing.
4. Up-to-date circulation information including charges, overdues, reserves, renewals, etc.
5. Automatic update of reserve data.
6. Automatic pre-due notices and overdue notices and calculation of circulation fines.
7. Frequency of circulation of each item, including items that don't circulate.
8. Feedback of frequency of circulation data to acquisition and weeding operations.
9. Feedback from reserve and renewal subsystems to the acquisition system to provide information for purchase of duplicate copies.
10. Feedback to shelf list system when item is reported lost or missing.
11. Access to circulation file by book ID, by due date, by borrower, etc.
12. Borrower circulation lists indicating outstanding charges.
13. Statistics on circulation by classification.
14. Statistics on charges, discharges, renewals, reserves, etc.
15. Statistics on borrowers including all items borrowed, frequency of use of library, types of materials borrowed, etc.
16. On-line terminals for user reference to bibliographic file and circulation subsystem.
17. Ease of handling borrower priorities, and limitations on circulation of different types of materials.
18. A central circulation file which can be addressed to determine availability of an item in any library tied to the system.
19. Borrower does not have to fill out charge slips.

Circulation systems can be categorized into four major groups based on the mode of operation: manual, semi-automated (non-computer), data collection (batch), and on-line. Fry (1961) was able to describe and compare 28 systems most of which were variations of two basic types, the Newark self-charge system which originated around 1900 and based on a book card system, and the transaction card system. Essentially these systems are uni-dimensional or single file systems. Modifications to these systems include the use of embossed printers to imprint the borrowers' ID number on the charge card (Gaylord system) or the entire borrower's name and address (Demco system) to eliminate the need to refer to the registration file for sending overdues. Another modification was the use of photocharging equipment for the transaction card systems.

In the book card systems, the borrower's name or ID is entered on a book card found in the book pocket. This card contains the book's ID. The book card and borrower's card are stamped with the due date, and the book card is later filed in the circulation file. This file is arranged either by book ID or by date due and then book ID. To reserve a book, the borrower completes a post card or other record which is then filed by book ID in a reserve file. When a book is returned the circulation file must be cleared, the book card replaced in the book, and then the book is checked against the reserve file. In some cases the reserve file is checked against the books in the stacks, but it is possible a book on reserve will circulate again before the reserve check is taken. To send overdues, the circulation file must be searched, as well as the borrowers' file for addresses.

The transaction card system was first introduced in the late 1930's in an attempt to provide a system which would reduce manual charging and discharging time. In its initial form or design the transaction card system required the borrower to enter the book ID and borrower ID and pre-

numbered transaction card with a paper slip attached. The paper slip was separated from the card, stamped with the due date and inserted in the book. The transaction card was stamped and filed by transaction card number -- a numeric file. To discharge a book, the paper slip was removed from the book pocket and used to clear the transaction card file. The book was ready for shelving. Overdues were easy to spot because of the numerical order of the file. Reserves on the other hand remained a problem as in the book card charge system.

According to Fry (1961) the basic self-charge transaction card system is cheaper to operate than a book charge file system. Since the burden of filling out the transaction card is on the borrower, he estimates that in a public library, for 1,000 circulations, 5.3 man hours are required compared to 8.6 man hours for a book card charge system. These figures include registration, charging, discharging, overdues and reserve operations. However, Fry does not attempt to evaluate the effect of reduced benefit to the borrower and the library since the transaction card system does not provide information on the location of an item in circulation. If the book is not on the shelf, one assumes it is charged out. In this regard it is significant to note that none of the college and university libraries surveyed by Fry used the transaction card system. These libraries must know where their books are at all times.

Both systems fail to provide any meaningful statistical data to the total library system. Since the principal purpose of a library is to disseminate information found in documents, and one of the instruments for doing this is the circulation system, it is obvious the circulation system should not be treated as a purely mechanical operation which does not require statistical analysis and feedback. As indicated in the list of benefits from the model circulation system, statistical data from circulation activity can be used to influence the purchase of duplicate copies and

weeding decisions. It can also assist management in analyzing the various circulation operations, reveal weaknesses in the collection, and provide data on user reading habits, etc.

In an effort to reduce circulation costs, particularly labor costs, and to provide more meaningful statistical data and faster turn around time, libraries turned toward data processing equipment. Becker (1964) points out that mechanized circulation control started in the 1930's when edge-notched cards were used. The advantage of the edge-notched files was to permit a library to maintain its circulation charges by call number, and at the same time, by use of notches to represent the due date, the file could be searched quickly for overdue operations. With the introduction of punched cards in place of edge-notched cards, circulation systems were able to use card sorters to maintain their circulation files and to assist in locating overdue items. However, the discharge operation continued to be a manual procedure, and the reserve file was still a separate function.

Many of the early punched card circulation systems were based on keypunching the book's ID data onto a card and inserting the due date at the time of circulation. The borrower's ID was entered (usually in writing) on the card and when the book was returned the punched book card was stamped "returned" and inserted in the book pocket to be used at a later circulation to reproduce a new keypunch record.

To compare the manual and semi-automated systems against the model is relatively simple. The manual, transaction card and edge-notched card systems are very dependent on manual manipulation of the charge and discharge operations. In all cases overdue notices are manually prepared and no meaningful statistics about circulation activity can be developed. They are essentially single file systems and do not permit fast manipulation of data nor duplication of data.

The primary benefit from these systems is a low operating cost, but only if the circulation activity is small, and there are no variations in

circulation policy based on user priorities, date due policies, etc. The manual systems tend to break down when the annual circulation approaches 100,000 or more, although there is very little in the literature which clearly demonstrates the effectiveness of the different circulation systems at varying levels of activity. Bell Laboratories (Kennedy 1968) and Brooklyn College (Cox 1963) have stated their experience with manual systems and their increasing inefficiency with growing circulation activity. Flannery and Mack (1966) reported the Lehigh University manual system was ineffective when the annual circulation reached 150,000; McCoy (1965) reported the Southern Illinois University system broke down at 1000 circulations per day. James Cox (1963) compared three systems at UCLA and concluded that the total annual operating costs for a semi-automated system (keysort) were the lowest at \$23,000, the manual system was costed at \$26,000 and a fully automated circulation system at \$31,000. With improvements planned in 1963, UCLA hoped to have this latter figure down to \$29,000. However, the labor costs were lowest with the automated system, and highest for the manual system. Considering the continued growth in the student body and thus library circulation, the costs for the automated system should remain constant or decrease, while the labor costs for the manual and semi-automated systems will necessarily increase.

Neither the manual nor semi-automated systems provides the opportunity to reduce the tedious labor associated with circulation systems, and they continue to be operated in an isolated mode with little interaction with other library units. The introduction of punched cards however, did provide an opportunity to gather historical data on circulation activity, and did pave the way for the concept of single input of data and an integrated library.

According to Becker (1964) the concept of a machine-readable book card and borrower's card was introduced in the 1940's by IBM when it designed "Punching Judy" for the Montclair Public Library. In this system

the IBM book card and borrower's card were inserted in a "record control unit" machine which had a slave keypunch which reproduced on a punch card the data collected from the inserted records. The slave keypunch also punched date due information, and a serial transaction number. This then became the circulation record, and the original book card was replaced in the book. When the book was returned, the book card was inserted in the "record control unit" where the slave keypunch produced a "return" card for matching against the circulation cards. A match purged the "cleared" circulation card from the active file. This charging and discharging was a mechanized procedure. The circulation file was machine-sorted to perform overdue operations, but the reserve procedures were still external to the file.

In 1959 IBM introduced the 357 Data Collection System for circulation control. This was a logical progression from the introduction of punched cards. The components of a 357 system include a computer, a 357 input station, a 358 control unit, and a keypunch. The control unit acts as liaison between the input station and the keypunch. A 374 cartridge reader is optional depending on whether the library has variable date due information and prefers not to have to enter the date-due as it would if the 372 manual entry keyboard is used.

The 357 system requires a plastic borrower's card (similar to a credit card) and a plastic book ID card. The charging and discharging system are similar to the "Punching Judy" system except the cards created by the Slave keypunch are fed to a computer which creates a magnetic tape circulation file. This tape can be processed daily and with appropriate programs can handle not only the charging and discharging operations, but also reserves, renewals and overdues. It can also print out multiple copies of the circulation record and in varying formats: by book call number, by borrower, by due date, etc. It can also compute overdue fines and send out overdue

notices. It accepts reserve information, shows this in the circulation printout, and prints a notice that the book is reserved and should not circulate again. The 357 system because it is tied to a computer can provide a full array of statistical data. For discussions of data collection systems installed see Auld (1968), Brown (1967), Cammack (1965), Campbell (1969), Flannery (1966), McCoy (1965), Parker (1967), Payne (1966), and Stockton (1967).

The IBM 357 and other data collection systems offered an advance in the state of the art of circulation systems, and it wasn't long before additional improvements were made. As originally implemented the data collection systems provided speed in charging and discharging, improved accuracy, and increased statistical and analytical reporting. However, because they were operated in a batch mode, the data collection systems did not provide real-time information and automatic, timely follow-up on reserves, nor were the computer programs operated against the entire shelf list inventory, but rather they processed only the active circulation records. These capabilities could be designed into a data collection system hooked to a computer operating the circulation system in an on-line mode, or designed into an on-line system utilizing a keyboard terminal as the input device.

Heineke (1969) at Midwestern University, and Hamilton (1968) at the Illinois State Library describe data collection systems operating with on-line circulation systems. In both libraries the reserve problem is resolved because on-line updating of the file permits the system to alert the circulation attendant that a document being discharged is on reserve. However, both systems operate against the active circulation file, rather than against the entire shelf list inventory. Another on-line system utilizing a keyboard terminal as the input device was designed without the complete library holdings as the master file at the State University of New York at Buffalo. (Lazorick, 1967). It wasn't until the Bellrel system (Kennedy 1968) was

designed and implemented that an on-line real-time circulation system with the shelf list inventory as the master circulation file became a reality. (Unstead, 1967 describes such a system, but there is no indication it is operational.) It is not clear however, if the Bellrel system is an integrated system accepting its input as a by-product of the catalog system or as duplicate input from cataloging. The latter appears to be the current design, although there are plans to implement a fully integrated circulation system. Of course the obvious advantages of a shelf list circulation system is the additional information library management will have in determining the circulation usage of its holdings, the strengths and weaknesses of the collection, additional input for weeding decisions, etc.

A wholly integrated circulation system which is a subsystem of a cataloging input is within the state of the art. What is lacking is an appreciation for, and more important, an evaluation of the cost effectiveness of the various circulation systems in terms of the total collection, size of the circulation file, annual circulation activity, number of borrowers, the loan policy, the type of library (public, special or academic), the conversion and equipment costs, the equipment downtime and costs for back-up systems, labor costs and the benefits of these systems. As indicated earlier, there is very little in the literature about the cost effectiveness of these systems particularly the automated systems. Some cost studies have been attempted (Fry 1961; Library Technology Project, 1965, 1967; Kimber, 1968) but they are incomplete and provide very little insight into cost trade-offs that must be made in converting from a manual or semi-automated system to an automated batch or on-line system. Only Fry and the Library Technology Reports have attempted any analysis of the different systems. Unfortunately these studies are of little value since they attempted to measure and compare the systems at one point in time only, and also attempted to cover too much ground. The circulation requirements in a public, academic or special library differ and it is unfair to compare these systems as operated by the

different libraries. One also wonders if Fry's prejudices against mechanization didn't interfere with some of his conclusions. Ruecking (1964) attempted to develop some equations which could be used to project circulation and staffing requirements over a period of time to justify automation, but his equations are based on a circulation volume which is constantly increasing. There is no attempt to provide some fundamental understanding of all aspects of circulation, such as the reserve or overdue volume which can be critical even when total circulation volume is relatively stable. Perhaps circulation systems are unique to their institution? And yet this belies the latest activity in the design of circulation systems.

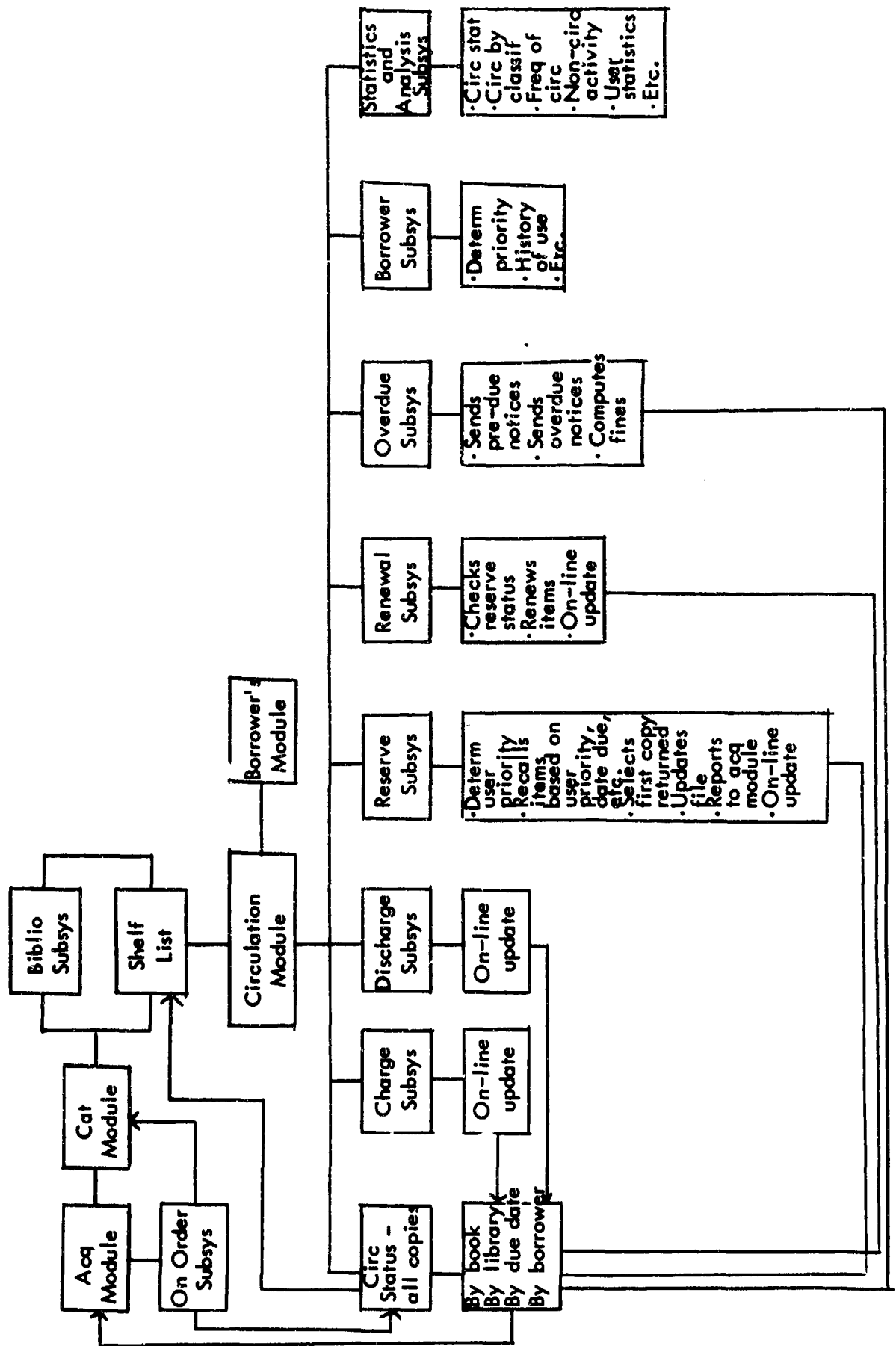
The software package designed as a general purpose system has been introduced to the library automation field. Organizations such as System Development Corporation and Computer Real Time Systems have designed general purpose circulation systems which can be implemented in any library having access to a computer, or capable of purchasing or renting a terminal to be linked to a computer. The System Development Corporation design is on-line and connects the library to the SDC computer via a teletype terminal. The actual file updating is done overnight however. The CRTS approach depends upon the library providing the computer. The system may be batch or on-line and is independent of input device. Both systems can operate against the entire shelf list as the master circulation file or just the active circulation file. The questions raised by these systems are 1) can a library operate an effective circulation system by using someone else's computer? 2) what compromises are made to install a general purpose software package?

Another area that requires study is the "big brother" aspect of circulation analysis. While much circulation data will be useful to library management in terms of acquisition, weeding, circulation desk manpower requirements, etc., and while circulation data can provide valuable insights into student and faculty use of the library, correlation between library use and academic

achievement, etc., it is also possible this data could be misused to threaten or invade the privacy of library users. For instance a chairman of a department may show unusual interest in the reading habits of his faculty; or an instructor might want to know which of his students have actually read the books he assigned; or a legislator might ask a public library to provide a list of books borrowed by "questionable" citizens, etc. Some computerized circulation systems are now using the borrower's social security number as his identification key. Thus there is no reason why a dossier on an individual couldn't be built to include reading habits and fed to some national data bank. These may appear as far-fetched fancies, but it can happen!

In summary, the advances in circulation systems will be made via automation and the integration of the circulation system with the acquisition and cataloging systems. Additional work must be carried on in the area of cost benefit analysis of various systems and volume of activity.

CIRCULATION SUBSYSTEM



Annotated References

Auld, L. Automated book order and circulation control procedures at the Oakland University Library. *Journal of Library Automation*, Vol. 1, June 1968, p.93-109.

The circulation system described utilizes an IBM 357 data control unit with modifications on controlling the various operations by using "trigger cards." Such cards are used to control the type of borrower, to indicate the kind of operation: charge, discharge, reserve, missing, at bindery, etc. The circulation file is updated overnight by the 1620 computer system.

The system as designed has a maximum file capacity of 9000 charges at one time and can handle a total of 115,000 transactions per year. No indication is given of the replaced system and the reasons for automation.

Becker, J. Circulation and the computer. *ALA Bulletin*, Vol. 58, December 1964, p.1007-1010.

Presents a brief history of the development of circulation systems and discusses in more detail an IBM batch processing circulation system using the 1401 with input via punch book cards which are a by-product of the shelf list. The system requires the borrower to enter his own ID data on the punch book card. This is later keypunched to produce a circulation record which is put on computer magnetic tape for processing.

Blau, E. J. An automated circulation system and master book file for a medium-sized scientific library. *ASIS Proceedings*, October 1966, p.21-38.

Describes a system which operates in a batch mode on the 360/91 with card input and disk storage. The file is random access with the accession number serving as the record key. Direct access is used for file maintenance and update; but for report generation the file is searched sequentially.

An improvement over most circulation systems is the fact the entire book collection record is used for the circulation file, instead of just those items in circulation: however, the creation of this record is not an integral part of the cataloging system, but an additional input. In addition, any circulation transaction requires that a transaction sheet be prepared by the circulation desk with the appropriate codes and data elements! These sheets are later keypunched and provide the input to the system. This would appear to be a serious delay factor and one which is error prone at that!

Booz, Allen. Applied Research Inc. Mechanization Study of the U.S. Army. Picatinny Arsenal, Dover, N.J. Booz, Allen. September 1966, 24p.

Describes in more detail, the system originally written up by Haznedari and Voos in 1964. The author concludes the system is more efficient than the replaced manual system. It is unfortunate the authors did not attempt to compare the punch card system against a more fully automated circulation system.

Brown, W. L. A computer controlled charging system at Essendon Public Library. Australian Library Journal, Vol. 16, December 1967, p.221-9.

Describes a data collection system similar to the IBM 357 system, but employing Olivetti equipment. The circulation system is supported by a computer program which operates against the entire shelf list and borrower's file. The data collection system captures the transaction information which is batched for input to the computer.

Cammack, F. M. Remote-control circulation. College and Research Libraries, Vol. 26, May 1965, p. 213-218.

Describes the circulation system designed for the University of Hawaii library, which utilizes an IBM 1001 data collection system. The 1001 uses telephone lines connected to a slave keypunch; the 357 uses cable. The 1001 system described operates pretty much like the 357 except the amount of data transmitted is limited to borrower's ID and book call number, collection code and loan period code. The title and author cannot be transmitted.

Cammack, F. and Mann, D. Institutional implications of an automated circulation study. College and Research Libraries, Vol. 28, March 1967, p.129-132.

The Oakland University Library utilizes an IBM 357 data collection system with a 1620 computer. The authors describe data that can be collected and analyzed to assist library management. The data includes charging activity patterns to assist in manpower scheduling; heaviest used portion of the collection; student and faculty usage; students and fields of study correlations; grades and library usage, etc.

Although this data can help the library to react to the needs of the users, one wonders if there are invasions of privacy lurking in the corners?

Campbell, G. R. The circulation system of the McPherson Library, University of Victoria. LARC Reports 2 (1), March 1969, p.26-43.

Discusses a system designed for operation on the IBM 360/44 utilizing punched book cards produced from the shelf list, and an IBM 1030 data collection system. There are no unusual features in this system. It is unfortunate that the designers did not include use of the shelf list against which circulation activity could be posted.

Cox, J. R. (Communication) In circulation activities. College and Research Libraries, Vol. 24, November 1963, p.492-495.

A very informative communication which provides some comparisons in operating costs between manual, semi-automated and fully automated circulation systems. Concludes that the manual and semi-automated systems cannot handle the loads in large university libraries, and although the fully automated systems are more expensive, they provide increased services, and in the long run will operate more efficiently and economically.

Flannery, A. and Mack, J. Mechanized circulation system, Lehigh University Library. Library systems analysis report no. 4. Center for the Information Sciences, Lehigh University, 1966, 17p.

Describes an IBM 357 data collection system installed at Lehigh University for circulation control. The system is tied to a GE 225 computer and a daily printout of the circulation file is kept at the loan desk. The 357 system designed is not unique, and therefore no comments will be made regarding this design. However, instead of preparing keypunch book cards for the entire collection of 450,000 volumes, cards were prepared for only the most active books in the collection, and all new books, in advance of installation. The less active books would have book cards punched at the time of circulation. This does appear to be an economical way of adjusting the system to avoid unnecessary costs.

Interestingly enough, the authors conclude that there is no arithmetical formula to be derived from current circulation volume to indicate mechanization is required. Growth trends and the level of control desired are principal guides.

Fry, G., and Associates, Inc. Study of circulation control systems. Chicago, Ill., 1961, 138p.

Analyzes the components of circulation systems and attempts to provide cost comparisons. The systems studied included book card file systems, charge card file systems, and transaction card systems. The libraries surveyed included public, academic and special libraries.

This study is very useful to someone wishing to learn of the highlights of various manual systems. The cost comparisons are also useful, although not beyond question. For example, is filing time constant whether the file consists of 5,000 or 50,000 items?

Geer, H. T. Charging Systems. Chicago, Ill., 1955, 177p.

A guide to the selection for charging systems. Describes each system, the routines involved in charging, discharging, handling renewals and reserves, and sending overdues.

Hamilton, R. F. "The Illinois State Library on-line evaluation control system," in Proceedings of the 1968 Clinic on Library Applications of Data Processing.

Discusses an on-line circulation system which operates on an IBM 1710 system using IBM 1031 terminals for input. To charge a book the system requires a punch book card and a borrower's badge. Input through the 1031 activates a computer check of the borrower's ID card status. The computer automatically updates the borrower's record, circulation record, and related statistics reports. It is significant to note the book ID cards were generated from the shelf list which is also on punch cards, but no attempt was made to use the shelf list as the basic record against which all circulation activity could be posted. This system provides many of the features found in batch data collection systems, except it is updating the file on-line. It does however automatically notify the circulation desk of an on-reserve status of any discharged book facilitating the control of reserved books.

Harris, M. H. The 357 data collection system for circulation control. College and Research Libraries, Vol. 26, March 1965, p.119-120, 158.

From questionnaires sent to 60 medium-sized academic libraries, the author concludes that 30 of the 47 libraries queried could feasibly make use of the IBM 357 data collection system based on his premise that any library spending more than \$2500 a year on filing, card pulling and overdue notices can justify the new system. There is no justification provided for this assumption except the fact that the 357 system rents for about \$2500 per year! The author assumes a computer is available for library use.

Haznedari, I. and Voos, H. Automated circulation at a government R&D installation. *Special Libraries*, February 1964, p.77-81.

Describes a system using IBM punch cards as input to a 1401 for up-date of the circulation file, including a daily print-out of the circulation file and reserve listings, and monthly overdue notices and borrower's active charge statements. The punch cards are prepared at the time of circulation from request cards filled out by the borrower. A duplicate punch card is inserted in the borrowed item, later to be used as a "return" card.

The system takes advantage of the use of punch cards and computers, but as the authors indicate, in a very limited way. They do plan to enter the shelf list file as the circulation record, thereby expanding the circulation services and providing library management with more meaningful data for book purchases and weeding.

Heineke, C. D. and Boyer, C. J. Automated circulation system at Midwestern University. *ALA Bulletin*, October 1969, p.1249-1254. Also Boyer, C. J. Online library circulation control system at Midwestern University. *LARC report 2 (1)*, March 1969, p.44-58.

Describes a circulation system operated in an on-line mode on an IBM 1401 coupled with an IBM 1031 data collection system. The 1401 is shared by other departments at the University; it is not a dedicated computer. Batch programs are interrupted by the on-line systems as required. To charge an item, the book card and borrower's badge are inserted in the data collection system. The program interrupts the background processing in the computer until the borrower's file is checked and the clearance to charge the book is ascertained (less than 1/2 second of CPU time; a total of 10 seconds). The 1033 printer prints a book slip which is inserted in the charged out book.

This system appears to be efficient, but it lacks the sophistication of circulation systems tied to the entire shelf list. Also, one wonders what the maximum limit is on circulation records? However, the system does prevent reserve books from circulating, provides borrower status information, date due and fine computations, statistical records and a daily printout of the circulation file.

Kennedy, R. A. Bell Laboratories' Library real-time system (BELLREL). Journal of Library Automation. June 1968, p.128-146.

Describes an on-line system consisting of terminals in three different locations, linked by Dataphone to the 360/40 computer. Direct access disk files provide information on the total collection (shelf list) and circulation activity against it. The system has a union list of all three libraries and can indicate the current status of any item in the system, even indicating the item is on the shelf and ready for circulation.

Each library has 2 terminals with keyboard, printer, and card read facilities. There are 22 transactions covering charging, discharging, reserves, and queries. Daily loan lists, pre-due and overdue notices, high-demand lists, statistics, etc. are batch processed. The system can handle over 300,000 transactions per year.

Although this system is perhaps the most sophisticated circulation system providing on-line up-date to the file, including reserve data, it does not appear to be integrated with the catalog system. This last sentence is vague because the article is vague about how the circulation file, which is the shelf list file, is produced. It appears it is duplicate input from the catalog system, and not created as an integrated file from the catalog system, although this is a stated objective of the system. In addition, the time it takes to complete a loan transaction is 23 seconds. This is longer than the manual system it replaced, and the 357 data collection system.

Kimber, R. T. Studies at the Queen's University of Belfast on real-time computer control of book circulation. Journal of Documentation, June 1966, p.116-122.

Presents the plans for circulation control at Queen's University of Belfast which includes on-line interrogation of the loan file which includes the complete shelf list as the master file against which all circulation transactions are made. Not much detail is given regarding the system design, but it appears the author is considering an integrated library when the shelf list data is generated by the cataloging function and input to the circulation system.

Kimber, R. T. An operational computerized circulation system with on-line capability. Program, no. 3, October 1968, p.75-79.

Describes a generalized processing system called TERPS used in a circulation system at the West Sussex County Library. The circulation system is operated in a batch mode with input via a data collection system using edge-punched cards. Interrogation of the system is via typewriter consoles in an on-line mode.

Perhaps the only unique feature of this system is the use of a general file maintenance system adapted to circulation use, and the on-line query system. There has been no attempt to broaden the circulation function and to integrate it with the shelf list file.

Kimber, R. T. The cost of an on-line circulation system. Programs, no. 3, October 1968, p.81-95.

Compares the cost of a normal system in operation at the Queen's University of Belfast with estimates of the cost of an on-line computerized system. Concludes that the on-line system will effect a 45% reduction in the manpower devoted to circulation activities, although it will be 15% more expensive.

Lazorick, G. J. and Herling, J. P. A real-time library circulation system without pre-punched cards. Proceedings of the American Documentation Institute, Vol. 4, 1967, p.202-206.

Describes a real-time circulation system using an IBM 2741 typewriter terminal and the CDC 6400 computer. To charge an item the borrower's ID and book call number are entered via the terminal. The typed record is inserted in the book and the transaction completed. The program includes batch automatic processing for overdue notices, save notices and circulation statistics. The books do not require book cards of any sort. The computer can be addressed via the terminal for circulation status of any item. The charge time is 20 seconds.

This on-line system handles transactions numbering over 300,000 per year at the State University of New York at Buffalo. Branch libraries are hooked into the system, but the master circulation file consists only of charged materials not the shelf list or record of complete library holdings.

Library Technology Reports. The use of data processing equipment in circulation control. Library Technology Reports, July 1965, 24p.

Describes three machine systems for circulation control, and analyzes their costs. The cost of operating a circulation control system was divided into four categories; staff time; cost of purchasing or renting equipment; supplies; installation costs.

Concludes that justification for mechanization of circulation systems "must be other than economic." Cautions librarians to thoroughly analyze their manual systems and even consider additional costs of increased labor force vs mechanization. The conclusions are based on rather incomplete cost analyses.

Apparently the authors of this LTP do not consider the increased speed and accuracy of the three mechanized systems, as well as other benefits from mechanization, unique results available only through mechanization. They contend a manual system can do the same. Considering the three systems they have analyzed, and having the advantages of five years of continued progress, some of their conclusions seem justified! The systems they analyzed appear to be quite cumbersome and certainly don't take advantage of mechanization as much as they should. Except for the IBM system, none use computers, and only the IBM system uses data created from the shelf list.

Library Technology Reports. The Remington Rand and Walkenhorst photo-charging machines. Library Technology Project, March 1966, 6p.

Describes two book charging systems based on the photo-charge method. The authors conclude these German made machines offer no advantage over American made products.

Library Technology Reports. Three systems of circulation control. Library Technology Reports, May 1967, 40p.

Discusses the advantages and disadvantages of three systems used for circulation control: the Demco charging system; the IBM 357 circulation control system (one card); and the IBM 357 circulation control system using two cards.

The authors conclude these systems are superior to three mechanized systems they analyzed in 1965. However they still reveal their prejudices for manual systems concluding that operating costs will increase, but not indicating the increased speed and benefits from the 357 systems, computer manipulation of circulation data, and the possibilities of integrated library systems. The authors feel libraries should install 357 systems only if their manual systems are breaking down, they want to provide special services to different classes of users, and can have access to a computer. They do not feel the 2-card 357 system justifies the additional costs.

McCoy, R. E. Computerized circulation work: A case study of the 357 Data Collection System. Library Resources and Technical Services, Vol. 9, Winter 1965, p.59-65.

Describes the 357 system with a 1401 computer installed at Southern Illinois University, the reasons for its adoption, the steps taken to prepare for its installation, some costs, and the benefits. The author states the Key-sort and Gaylord charging system failed when the circulation activity reached 1,000 daily.

Nolan, K. P., Cardinelli, F. A., and Kozumplik, W. A. Mechanized circulation controls. *Special Libraries*, January 1968, p.47-49.

Describes a simple EAM system using keypunched book cards on which are entered the borrower's ID at the time of circulation and later keypunched. These charge cards are duplicated and two files are kept, one by book ID and one by borrower ID. The overdue process is handled by searching the borrower's file and duplicating all overdue items. These duplicate punch cards are then run through a card reader/printer to produce overdue notices. The authors contend the system saves about \$38,000 annually. Still if the system does handle over 177,000 transactions per year, one wonders how well the punch cards hold up, and what difficulties the machine room operators experience.

Parker, R. H. Not a shared system. *Library Journal*, November 1, 1967, p.3967-3970.

Briefly describes a computerized circulation system using the IBM 357 for data input and operated in a batch mode. The major portion of this article exhorts libraries to automate.

Payne, L. M., Small, L., and Divett, R. T. Mechanization in a new medical school library. *Medical Library Association Bulletin*, Vol. 54, October 1966, p.337-350.

Describes the serials and circulation phases of the data processing system at the University of New Mexico Library of the Medical Sciences. The circulation system uses an IBM 357 data collection system and EAM equipment. It appears the use of EAM equipment is considered economical compared to the use of a computer, but this may be because the library has a collection of 5,000 volumes.

Pizer, I., Anderson, I. T., and Brodman, E. Mechanization of library procedures in the medium-sized medical library. *Medical Library Association Bulletin*, Vol. 52, April 1964, p.370-385.

Describes a circulation system which is a variation of the Bookmatic system. It utilizes plastic book and borrowers' cards which are run through an addressograph machine to imprint the embossed data on an IBM charge card. This card is then keypunched with the "imprinted" data and filed in the circulation file. EAM equipment is used to produce overdue notices.

Since the system described is for a library whose total circulation file is only 3,000 cards, the system seems adequate, although it may prove feasible to use a computer in place of the continued sorting of cards by EAM equipment.

Pizer, I. H. A mechanized circulation system. College and Research Libraries, Vol. 27, January 1966, p.5-12.

A variation of an earlier system described by Pizer, et al. (1964).

Describes a circulation system which uses an Addressograph Class 9500 Optical Code Reader and an IBM 1440 computer. Items are charged out by inserting an embossed borrower's card and plastic book card in a data recorder which imprints the embossed information from the borrower's card and book card onto an IBM punch card. The punch card is batched with others and run through the Optical Code Reader which automatically punches the borrower's information in the appropriate columns. The book ID is then manually keypunched into the card. This charge card is now ready to be manually filed in the circulation file. The 1440 is used to produce overdue notices after EAM equipment does the sorting for the circulation file.

This seems to be a cumbersome system utilizing a lot of equipment. Why couldn't they design the system utilizing EAM equipment only?

Radford, N. A. and Barry J. E. IBM punched card circulation at Sydney University Library. Australian Library Journal, December 1966, pp.228-234.

Describes a mechanized circulation system based on that developed by the Library of Brooklyn College in N.Y. The system utilizes two types of cards: an 80 - column loan card to be filled out by the borrower, and a 51 column card used as a transaction card. The system requires the entire loan file to be processed each day. The annual circulation is as high as 320,000 loans.

Ruby, H. V. Computerized circulation at Illinois State Library. Illinois Libraries, Vol. 50, February 1968, pp.159-162.

Discusses in general terms how the on-line system operates. Charging takes 4 to 9 seconds, discharging 2 to 5 seconds depending on whether a reserve notice is printed out by the computer. The system operates with IBM punched book cards duplicated from the shelf list. However, the circulation activity is not against the shelf list. No information is given regarding the type of equipment used for data input, nor the computer used. Apparently the input is captured "on-line" although the file up-date is done over-night in batch mode.

Ruecking, F., Jr. Selecting a circulation-control system: a mathematical approach. College and Research Libraries, September 1964, pp.385-390.

Develops a series of equations which the author believes were helpful in analyzing the circulation system at Rice University and which contributed to the decision to install an IBM 357 data collection.

There is very little data available to compare the effectiveness of different circulation systems. The equations offered do not satisfactorily solve the problem, and the author is aware of this when he indicates that six criteria were selected to provide a common ground for comparing effectiveness.

The author is also aware of the limitations of the comparisons made by Fry and Associates (1961) and has attempted to provide more accurate means for comparison.

Stockton, P. A. An IBM 357 circulation procedure. College and Research Libraries, Vol. 28, January 1967, pp.35-40.

Describes an IBM data collection system used in a medium sized library. The chief weakness of the data collection systems is that they cannot provide complete control over reserves or "holds." Thus it is possible a reserved item can circulate again before it is noticed the item is on reserve for a borrower. However, this is a weakness true of most manual systems and one which is corrected only when a circulation system has its discharge transaction on-line and the file includes on-line up-date or reserve data.

Trueswell, R. W. Two characteristics of circulation and their effect on the implementation of mechanized circulation control systems. College and Research Libraries, Vol. 25, July 1964, pp.285-291.

Attempts to evaluate the need to prepare punched book cards for all volumes in a library based on two factors: the length the item has been in the library; the last previous circulation date. Indicates it is cheaper to punch a book card at time of circulation rather than in advance, although it may be possible to punch book cards in advance for all new acquisitions.

An especially useful paper for a librarian attempting to convert from a manual system to a data collection system where IBM book cards are required for machine input.

Unstead, C. R., et al. Compatible automated library circulation control systems. Redstone Arsenal, April 1967, 174p.

Describes five systems ranging from a manual circulation control to a fully automated on-line system with the shelf list as the master circulation file. The systems were designed so that they are compatible, and it is possible to develop from the manual system to the punch card EAM system to the "small scale control system" to the on-line system.