COMPUTERIZED EVALUATION OF LIBRARY SERVICE EFFECTIVENESS

by

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ABSTRACT

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Evaluation of library service effectiveness is important in identifying the areas where improvement is most needed, and in justifying library budgets. Traditional methods of service effectiveness evaluation have been too costly and impractical for regular use. However, most of the data required for this evaluation can be collected inexpensively and quickly with automated library systems which many libraries have already started using.

This study reviews traditional methods of library service effectiveness and proposes new methods which take advantage of electronic data processing. The proposed methods are practical and inexpensive so that they can be used routinely.

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Chapter I

INTRODUCTION

1.1 PERSPECTIVE

How effective is a university library? Answers to this seemingly straightforward question are complex. Indeed, measurement of library service effectiveness has been a major preoccupation of librarians and operations research specialists for more than twenty years. Although there has been considerable progress in identifying the basic problems, the present state of the art is still far from resolving them.

Nevertheless, the interest in this topic is high -- especially among library administrators who, in competition for limited funds, need to indicate in some meaningful and measurable way the value of services provided by libraries. The overall, functional significance of such evaluation has long been recognized:

> Evaluation is intrinsic to the library field. It is necessary in assessing the needs for library service, in appraising the library operation and in weighing resources so as to give insight into the significance of libraries; it is necessary for purposes of improving library practices, and to aid in the formulation of objectives[1].

One may consider the opening question and wonder why its answers are so complex. The consensus reached by numerous publications on library effectiveness seems to center on two major reasons: lack of clearly defined short range library objectives, and difficulties encountered in establishing an objective basis for the measurement of the qualitative aspects of library service.

The slow progress, however, has been due to economic reasons rather than to the complexity of the problem. Libraries have never had the financial or technical resources to deal with the massive tasks they are assigned. Typically, they have large backlogs, and because of the lack of resources, they often must forego on some of their desirable functions. Self evaluation always seems to be included in this category. "Effectiveness studies" carried out by library staff under such circumstances have traditionally been geared to give the parent institution what it wants: justification for last year's expenditure and for the new budget. Certainly, the researchers' interests in the subject have been genuine, and, from time to time, libraries with better funding have undertaken extensive evaluation projects, but there have never been enough resources for comprehensive and persistent evaluation to become a regular library function.

Library evaluation is becoming feasible. With the advent of computer technology and the build-up of experience in library automation, computerized library systems are now cheaper, more reliable, and more capable. In fact, their use probably will become an economic necessity for academic libraries by the mid 1980's. Self evaluation can become a routine function of library operation with computerized library systems which can collect, analyze, and report large amounts of data at minimal cost for a variety of purposes.

Even with this powerful and versatile new tool, however, the task is by no means trivial. Computers will need to be programmed to selec-

tively capture a variety of bibliographic, inventory, and operational data and to analyze them so as to provide useful evaluations of how well the library is functioning. While the findings of some of the earlier studies will be useful in providing a basis for the logistics of this programming, others will not apply to the new, computerized library environment. The present study is an attempt to develop some basic principles for the accomplishment of this task.

1.2 PURPOSE AND SCOPE

The objective of this dissertation is to suggest a set of measures for the effectiveness of academic library services. Specifically, the services that will be considered are those with the following goals:

1. Provision of a collection which is shaped to the users' needs,
2. Provision of bibliographic tools to help users locate the items they need from the collection, and
3. Maximization of the the availability of needed items.

There are two factors that distinguish this particular study. First, the emphasis here is in providing library administrators with a tool to monitor library effectiveness continuously, as opposed to establishing the methodology for a costly one-time study. Second, this study assumes that services such as catalog searching and circulation are performed through the use of a computerized library system in real time.

The scope is limited to academic libraries. The measures suggested are for the "output" of the library (the services it provides) and not for its input (budget, personnel, etc.). Further, these measures are not intended to be used for comparison of different libraries; rather, they are intended to be used to compare the effectiveness of a given library at different points in time. This limitation helps to eliminate the effects of various factors that vary from one library to another. And, although one of the reasons for effectiveness measurement is to induce improvement, it is beyond the scope of this study to seek methods to improve or to optimize library operations.

1.3 LIBRARY OBJECTIVES

An academic library has a well defined mission: to provide services for the students and the faculty. These services support assigned reading, background reading, and reference for essays, term papers, and research. This mission is generally represented by the following goals:

1. To provide an appropriate range of library stock,
2. To make this stock accessible and available to the users,
3. To stimulate potential demand, and
4. To provide study areas and other facilities for in-library study and research.

This study will concentrate on measuring progress toward the first two goals. The third goal will not be considered because it is depen-

dent on the first two goals as the user demand generally increases with stronger collection and easier access. Also, this goal is more appropriate to public libraries because the academic library has direct relevance to the prime goal of its clientele, and because the responsibility of promoting the demand for library use rests with the academic departments. The fourth goal, provision of study space and other facilities, is relatively straightforward to measure but somewhat unrelated to the other functions being measured, therefore it will not be considered in this study.[1]

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[1] The effects of and the need for provision of study space have been considered, however, by some researchers. Anderson relates the number of potential library users to library staff, study space, and library costs[2]. Pizer and Cain suggest the use of a random alarm device to measure (among other things) the availability of study space[3]. In their study to determine whether the faculty, graduate students, and undergraduates were homogeneous with respect to their reasons for visiting the library, Rzasa and Moriarty found that over fifty percent of undergraduate users and a significant percentage of graduate users came to the library to do homework with their own books[4]. Mount and Fasana report on a study where one of the twelve surveys conducted was aimed at establishing space allocation for library staff, users, and collections. This was done by analyzing floor plans for each library unit and assigning all space to one of these three purposes[5].

1.4 DESIRABLE QUALITIES FOR SUGGESTED MEASUREMENTS

The objective of this study makes it clear that the suggested methods of measurement are to be used routinely as a part of library operation. Their routine use requires that they be practical and inexpensive. This condition precludes the most widespread method of library evaluation: user surveys.

The evaluation should be comprehensive. There are multiple factors that contribute to effectiveness of library services, and as many of these as possible should be measured to provide a more comprehensive rating of library effectiveness. When these factors are measured, their values should be provided to the library administrators as an array instead of being plugged into a formula which provides an "overall" measure of library effectiveness. This segregation is required because of the intangible nature of the relationships of these factors with one another. Martin has expressed this point well:

> In a multipurpose and a multiprogram agency there is no one and complete measure of performance, and a search for the magic number only compounds the problem. Surely evaluation of an organization involves more than one computation[6].

Chapter II

EVALUATION OF LIBRARY SERVICE EFFECTIVENESS

There are two ways to approach evaluation of library service effectiveness. The first way is by measuring how well the library is equipped to serve, *i.e.*, its capability. This can be done by comparing the library's best potential performance against its stated objectives. The second is by measuring the extent and nature of its actual use. For this latter case, the necessary data must be collected about the library books used, both in-house and by external circulation.

Most library evaluation studies have employed either one or the other of these methods but not both.[2] The dependence of the utilization of a library on its capability (or vice-versa) may seem intuitively clear. But the degree of this dependence has not been shown to be high enough to justify elimination of one of these factors from an evaluation. Library use is a good reflection of the needs of the students and the faculty. Measuring the capability of a library without paying attention to its use is, therefore, an incomplete approach. On the other hand, library use by itself can be a misleading measure since it does not reflect the dissatisfactions of the users. This chapter's analysis of library effectiveness measurement covers both of these approaches.

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[2] A notable exception to this is Kantor's Study [7,8] which is discussed in the next section.

2.1 MEASUREMENT OF LIBRARY CAPABILITY

2.1.1 Strength of the Library Collection

The strength of the library collection is determined by two factors: the quantity and the quality of the collection.

The quantitative criteria suggested for measuring the strength of the library collection include the following:

1. Absolute size of the collection,
2. Size of the collection by subject, date, etc.,
3. Current growth rate of the collection,
4. Expenditure on the collection, and
5. Size of the collection in relation to user population and to the number of books circulated.

The absolute size of the collection usually has been used to establish the minimum number of books below which it is impossible to provide adequate service. Clapp and Jordan have proposed a formula that might be used to assess the adequacy of academic collections[9]. McInnis has since shown that this formula can be written as a weighted sum of several variables[10]:

$$V = 50{,}750 + 100F + 12E + 12H + 335U + 3{,}050M + 24{,}500D$$

where

V = volumes
F = number of faculty
E = total number of students enrolled
H = number of undergraduate honors students
U = number of major undergraduate subjects
M = master's fields offered
D = doctoral fields offered

McInnis tested this formula using regression analysis. He found that although the formula has little bias, it is not empirically verifiable because of the statistical insignificance of the estimated coefficients.

Absolute size of the collection is not a good measure of collection strength because it fails to reflect the effect of obsolescence and the dispersion of the collection among different subjects. The other quantitative measures listed above avoid these objections to some extent but are lacking in other ways. Detailed discussions of the use of these criteria are provided by Bonn[11] and Lancaster[12].

The qualitative methods of measuring collection strength have included inspection of the collection by experts and comparison of the library's holdings against standard lists such as a subject bibliography that is accepted as complete and/or authoritative. Evaluation of the collection by experts is impractical, subjective, and too costly to use routinely. The use of standard lists to evaluate the collection has been a common approach[13]. (See Lancaster[12] for examples of such lists.) This method has been criticized mainly on the following grounds [11,14,15]:

1. Standard lists are not comprehensive enough to assess large research libraries;
2. They become outdated quickly; and
3. Their use does not give the library credit for books that are not in the list but that are in the collection.

Coale has suggested a different approach where he used the citations in recent papers on a given subject to make up a standard list[15]. This particular method is further discussed below, in relation to the "document delivery test."

Some researchers have monitored users to evaluate the strength of the collection by finding the probability that a book needed by a user is in the collection [7,8,16,17,18,19]. This method comes closest to an evaluation in terms of the library's objectives, but it is too impractical to employ frequently. A practical but limited approach involves counting the number of interlibrary requests from users as a measure of "failure" of the collection. (If there is a coordinated collection development activity between libraries, then the joint collection strength of the cooperating libraries may be indicated by the number of interlibrary requests that were not satisfied.) The limitations of this method of measurement are due to the inadequacies of the interlibrary lending services as they exist today. Interlibrary lending traffic is slow (typically 2 to 6 weeks of delivery time) and it deals only with items which are thought to have been uniquely identified, whereas, often the user is pressed for time and can specify only a topic of interest, not particular works. Because of these drawbacks, only a fraction of library users ask for interlibrary loan service while it can be assumed that others simply give up when they fail to find what they need. Therefore the number of interlibrary loan requests does not account for all failures of the collection.

Another qualitative measure for collection strength has been recently suggested by Kantor[20]. It involves the identification of the percentage of "dead" books for which the demand is virtually non-existent. Kantor refers to it as a measure of "vitality" of the collection. This measure is valid and meaningful but it needs to be evaluated in conjunction with other measures. Being based on current demand, by itself, it may yield an inaccurate evaluation, especially for research libraries.

2.1.2 Accessibility of the Library Collection

Access to the library collection can be analyzed in two stages: intellectual and physical access. Intellectual access is establishing the existence of individual documents in the library collection and their relevance to specific inquiries. If the documents are to be used, intellectual access needs to be accompanied by physical access which involves the retrieval of the actual piece.

Accessibility of the collection in each of these stages has two distinct measures:

1. The success rate of users in locating books they need, given that the books are in the collection, and
2. The "convenience" experienced by users searching for books.

The methods for the first measure are discussed below separately for intellectual and physical access. Most studies have avoided the second measure because of the difficulty in its evaluation. Later in this

study, methods are developed to indicate level of convenience at different stages of access.

An important contribution to accessibility is the existence of reference service. The evaluation of this particular service is not attempted in this study.[3]

2.1.2.1 Intellectual Access

Intellectual access is achieved by two basic types of catalog search strategies: known-item searching and subject searching. Known-item searches imply that the user has established the existence (not necessarily in the library) of the required document and can identify it by author, title, or subject. In subject searching, the users have no such prior knowledge. They simply come to the library to find books on a given subject.[4]

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[3] See Rothstein[21] for difficulties encountered in measuring reference service and a review of methods utilized.

[4] Lipetz suggests a more detailed classification[22]: "In a *document search,* (often called a "known-item" search) the catalog user is aware of the existence of some particular book or publication that he wants to locate. In a *subject search,* the catalog user is interested in both identifying and locating one or more documents pertaining to some known topic. In an *author search,* the catalog user is aware of some author, publisher's series, or other source of literature and is interested in identifying and possibly selecting specific documents from that source. In a *bibliographic search,* the catalog user is interested in using the catalog itself to supply or verify bibliographic information regarding a known document; he is not interested in locating and using the document." For purposes of the present analysis, author search can be considered an expedient approach to subject search (more on this below in relation to studies by Lipetz and Krikelas.) Since the physical access is analyzed separately in this analysis bibliographic search is equivalent to known-item search.

Literature on known-item search studies is available but few studies are found on subject searching. Measures for both are obtained through user surveys in most of these studies. Costly as they are, these surveys have problems when studying subject searches. Unlike known-item searches, "success" and "failure" of these searches are difficult to establish. During a subject search, the user may be discouraged by finding too many (or too few) books filed under the heading of his initial choice and may change the strategy slightly to get "better" results. Therefore, the outcome of his search is not easily measurable. Furthermore, a book found in the catalog through subject searching may be misjudged by its title. It may be considered a "success" at the catalog and later turn out to be irrelevant to the user's needs, or it may not be selected by the user when, in fact, it would have been relevant. If a book was located intellectually (through subject searching) and physically and also proved to be useful (and such cases were somehow identifiable by researchers), then there still would be questions such as:

a) Would this book have been used had there been other books on the same topic in the library? (Measure of implicit substitution of what is needed by what is available); and

b) How good, how comprehensive, how up-to-date, and, thus, how "useful" is this book compared to other existing books (not necessarily in the library) on the same topic? (Measure of value or benefit).

In their survey of catalog use at three university libraries and one public library, Tagliacozzo and Kochen have analyzed both known-item and subject searches[23]. They have found that there is a relation between the academic rank of catalog users and the type of search they carry out. (As rank increased, the use of subject searching decreased.) Investigating the user style and strategies of catalog users, they have found (for known-item searches) that when the users had a choice, they chose to use author searching (85.2%) rather than title searching (14.8%); and that almost half the users who failed in their first attempt gave up the search. This particular paper contains useful discussions which provide good insights into various topics related to intellectual access.

A similar but much more extensive survey conducted at Yale University library was reported by Lipetz[16]. For three years, the users were interviewed before and after they used the catalog. One important observation during this study was the following:

> In terms of immediate intent at the time of interview, almost three-fourths of the catalog users are interested in document (known-item) searches. However when these users were asked at the end of their interviews about what they would do in the case of an unsuccesful search, a very substantial number stated that there were other ways to get the information. This indicated clearly that the underlying objective was to find information on a particular topic (that is to perform a subject search), and that looking up a known book on the subject was only an expedient approach. In terms of underlying motivation, about one-third of catalog searches are subject searches, but half of these are sublimated to document searches in using the existing library catalog[16].

The significance of this observation is in its implication that observed behaviour may not represent actual need or intent. Krikelas conducted a study to find more about such disguised searches. In particular, he wrote:

> If known-item searches mask subject approaches, it seems logical to ask "do users make subject searches for specific (*i.e.*, known) documents?" There is evidence that something of that nature does happen and that such procedures may not be uncommon[24].

The findings of his study provide considerable insight about this complex aspect of catalog use[24]:

> 1. Given relatively complete information about the author and title, the majority of users will seek information under author. Nevertheless, a few users persist making title searches even when it would appear that an author approach is more direct and less likely to produce conflicts.
>
> 2. Search strategy is affected not only by the information given but by the perceived complexity of the file to be searched. What influences the individual in making a search choice could not be determined but it seems to be something outside of the observed situation; it is information (or experience) provided by the searcher.
>
> 3. As the amount of information about an author or title becomes less and less distinctive there is a corresponding increase in searches made under "created" title or subjects. Which alternative is selected tends to be related to the perceived uniqueness of the clues; clues that would lead to large files are rejected in favor of others.

Seymour and Schofield surveyed library users to obtain a measure of failure rate in the use of the author catalog[19]. The reader was asked to note details of items not found in the catalog, the source of reference, and his status on query slips. These items were then checked to find the source of failures. A second search was conducted

if the actual bibliographic citation was found to be substantially different from that brought to the catalog by the user. An item verified to exist, but not in the catalog, was checked against records of books on order and books "in process." The users also were interviewed to obtain a reasonable estimate of the proportion of catalog users who completed query slips. This study revealed that many users came to the catalog with incomplete or incorrect author/title information.

Perhaps the most succesful of all library measurement projects is the one undertaken by the Institute for Advancement of Medical Communication.[5] In this study, Orr used a method (referred to as the document delivery test) which involves creating a citation pool and using it to evaluate the probability of an item being available at the time needed. He took a large sample of recently published articles in the medical field and created a bibliography of several thousand sources that were being cited by current writers in medicine by using the references at the end of these articles. He then drew a set of three hundred from this pool and used this set of bibliographic references to test the document delivery capability of medical libraries.

The document delivery test is used to measure collection strength, intellectual access (for known-item searches only) as well as physical access by finding the percentage of the documents in the test bibliog-

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[5] This work is reported in full in a series of articles [3,25,26,27, 28,29] and the statistical material, developmental data and all other detailed documentation has been deposited at the National Library of Medicine.

raphy which are physically available. This method enjoys three significant advantages. First, it is an unobstrusive measure so it does not disrupt services; it does not require user participation; and, more importantly, the measurement itself has no effect on what it is measuring. Second, this measure has a clear justification:[6] If the authors of the selected set of documents had been using the library to write them, what proportion of these resources that they would have needed could the library provide? Third, limited to specific subjects at a time, this test can be used to compare the effectiveness of different libraries in providing documents.

The major disadvantage of the method is the fact that references are not found in machine readable form and so their collection is a costly operation. Further, this method cannot be applied to areas such as fiction where citations do not exist.

Kantor has initiated a long-term survey project which is primarily aimed at determining the range of prevailing values for suggested measures of collection strength, intellectual access, physical access, and library use [7,8]. He has identified eight independently measurable and meaningful parameters, three of which are concerned with access:

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[6] This particular method of creating a test set of publications was first used by Coale to evaluate the collection strength of the Newberry Library in Chicago in Latin American history of the colonial times[15]. The justification stated here was suggested by him.

1. The probability that a book in the collection is not out in circulation,
2. The probability that a book is shelved correctly, and
3. The probability that the user finds an item which is at its correct location.

It must be noted that, unlike other studies, the total measure of effectiveness developed by Kantor rests on library capability as well as on library use. Kantor is presently conducting a large study involving several libraries to obtain values for the parameters he has identified. When completed, this project will provide useful data about the sensitivity of the parameters measured to specific types of libraries, clientele, etc. It also may yield some relatively invariant factors which will not need to be measured frequently.

2.1.2.2 Physical Access

Physical access is more tangible than intellectual access but not that much easier to measure. A list of the main factors that cause "failure" at the physical level includes the following:

1. Book in circulation,
2. Book located at a special location[7] -- this fact being reflected by the catalog,

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[7] Special location, as used here, may be a location such as reserve desk and off-site storage, as well as a status like "at the bindery," "being cataloged," and "missing."

3. Book located at a special location -- this fact not being reflected by the catalog,
4. Book misshelved,
5. Book labeled with a different call number than the one indicated by the catalog,
6. Book recently used or in use in library, and
7. Book in a preshelving area.

The reasons for "failure" at the physical level have been studied by Urquhart and Schofield, who surveyed library users and asked them to record the non-availability of books they were seeking [30,31]. As discussed above, studies by Orr and Kantor cover collection strength and intellectual access as well as physical access. Orr used a randomly selected set of documents from recent citations; Kantor surveyed the library users. Kaske had a third approach in his study of physical access[32]. He sampled the shelves to find the fraction of all volumes which were misshelved and sampled the shelf catalog to measure the rest of the factors that contribute to physical non-availability of books. This particular approach, although practical, has an important drawback: it does not reflect availability of books as experienced by the users. Since there are a considerable number of books in a library which are "very" available because they are hardly ever read, the use of a random sample of the collection (or the collection itself) will yield a

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[8] Kaske's results, when compared with the results of other studies, reflect this fact. See Kantor[8] for the presentation of such a

higher value of availability than what the users experience.[8]

2.2 *MEASUREMENT OF LIBRARY USE*

No doubt by virtue of its tangible nature, measurement of library use has been a popular topic in library research [1,5,33,34,35,36,37, 38,39,40], notably more so among researchers of non-library background. Evaluated in the proper perspective, library use does provide a good indicator of library performance in general. Library use is characterized by (a) circulation and (b) in-library use of books.

2.2.1 *Measurement of Circulation*

Of all library activities, data on circulation is, by far, the easiest to capture, especially in an automated system. It is important to realize, however, that keeping a count of the number of books loaned is of little use by itself. Circulation counts, as well as distributions of circulation period, must be measured by type (*e.g.*, faculty, undergraduate student, graduate student etc.) and background (*i.e.*, academic department) of borrowers, and by subject category and type of items loaned.

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comparison. It is interesting to note that results obtained by Kaske's approach will suggest that the physical availability increases with the proportion of obsolescent books to the rest of the collection.

2.2.2 *Measurement of In-library Use of Books*

Circulation transactions traditionally have been used as an indicator of library use. However, librarians have been conscious of the fact that a great deal of in-library use occurs that is not reflected in circulation records.

For an "open stack" library where users are allowed to browse freely through the stacks, it is a rather difficult task to capture data on in-library use of books. Library researchers have employed various techniques to do this and achieved limited results. A common technique (referred to as the pick-up method) has been to ask the readers not to reshelve used books and then to count them [34,37,38]. Other methods include surveying users [33,35,36]; placing questionnaires in a random sample of books[41]; and placing "hidden slips" in a random sample of books such that any use, no matter how trivial, would be obvious[34].

Fussler and Simon first established a predictable correlation between in-library uses and the number of circulation uses for individual circulating titles[41]. Since then, this correlation has been sought by a number of researchers in terms of the ratio of in-library use of books to the use of books through circulation. Stockard, et al.[in 42] provide a brief survey of such studies and make the following observations:

> There are reports on in-library use to circulation ratios differing as widely as 0.4:1 and 11:1. This wide range is explainable to some degree by differing parameters of type of in-library use being measured, but differences also are attributable to factors such as loan policies and duration of loan periods, ease of access to materials, availability of

> seating, as well as variations in demand characteristics of specific clienteles. With one exception, the published studies were performed in academic libraries; only two found in-library use to exceed circulation use. The methodology used in the studies was predominantly the pick-up method or, less succesfully, a questionnaire.

McGrath conducted a study to establish the presence of a correlation between the subjects of the books used in the library and used through circulation[37]. His findings showed that such a correlation does exist.

Going one step further, Hindle and Buckland found a strong correlation between the uses of a given book in and out of the library[43]. This particular paper includes a comprehensive review and a useful analysis of the topic.

Chapter III

COMPUTERIZED LIBRARY SERVICES: A MODEL

At their outset in the sixties, computerized library systems were designed to perform selected library functions. During the last decade, the scope and depth of library automation has expanded rapidly, stimulated by decreasing computer costs and increasing experience in library systems. Recently, the emphasis has been on integration of all library functions within a single system to avoid proliferation of disparate systems[44,45].

The Virginia Tech Library System(VTLS) is an integrated library system designed to carry out technical service functions such as acquisitions, data entry and modification as well as user services functions such as catalog searching and circulation[45,46]. This chapter describes a simplified model of the catalog access and circulation components of VTLS. Details that are specific to VTLS are kept to a minimum to provide a general model. This model will be used in chapter IV to describe various methods for computerized data collection.

3.1 THE CATALOG

The catalog is an intellectual representation of a library's content. It consists of records -- surrogates of the actual materials -- which are arranged for easy retrieval. One goal of this arrangement is to bring together related works to permit browsing. Another goal is to provide multiple retrieval paths for each record so that it can be accessed by any of the identifiers such as author, title, subject, and bibliographic control numbers. The quality of a library's service is closely related to how well these two goals are met.

The intellectual representation of the collection by the catalog is more complete with computerized systems which also provide status information for each item -- *i.e.*, whether it is available, in circulation, at the bindery, etc. Computerized catalogs offer other significant advantages such as fast response, superior access capabilities, and remote searching.

3.1.1 Database Representation

Figure 3.1 is a simplified[9] diagram describing the catalog portion of the VTLS database layout. The catalog contains three basic types of records: bibliographic, item, and serial holdings records. A bibliographic record is universal information intrinsic to a particular work *e.g.*, author, title, subject, publisher, and standard bibliographic numbers.) An item record contains information specific to a physical

[9] A more detailed diagram is provided in [45].

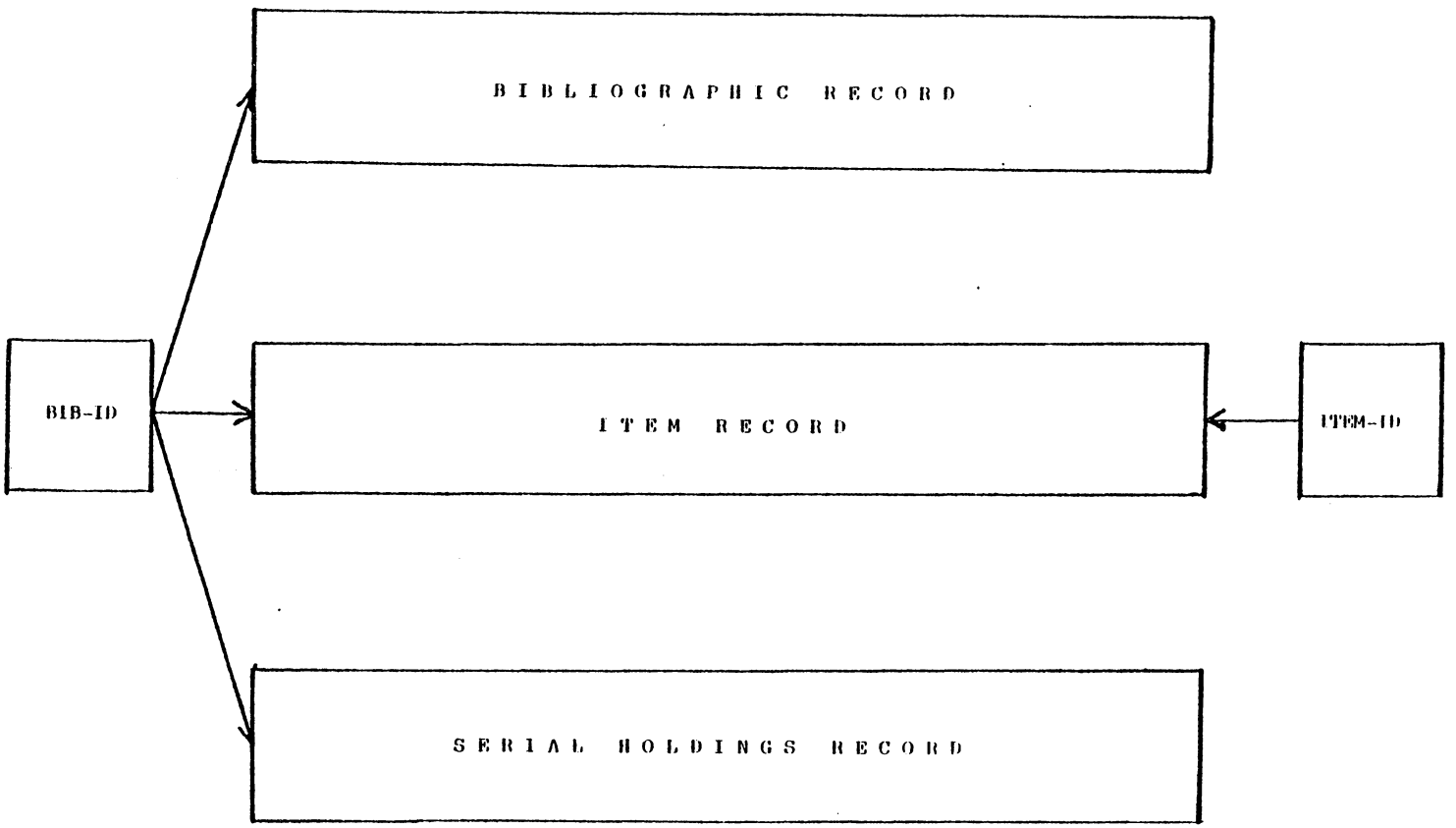

Figure 3.1 - Simplified Database Layout of the VTLS Catalog

piece *e.g.*, ITEM-ID,[10] copy number, circulation period, location, and circulation history.) If, for instance, there were three copies of a book, the catalog would contain one bibliographic record and three item records. Serial holdings records are like item records except they carry information about a range of items, and they exist only for serials. BIB-ID is a local control number assigned by VTLS to each bibliographic record. It is an important key data item which relates the different types of records to one another.

Besides ITEM-ID and BIB-ID, there are various other key data items in the catalog all of which are used to access bibliographic records. They include author-key, title-key, subject-key, international standard book number(ISBN), international standard serial number (ISSN), call number, Library of Congress card number, and Ohio College Library Center(OCLC) number. The following sections illustrate how library users can access the VTLS catalog. Only the first three of the key data items listed above will be considered because the others are normally used only by librarians.

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[10] ITEM-ID is a local number assigned to each physical piece and printed on its machine sensible label.

3.1.2 Search Commands

For each catalog search, the user must specify a minimum number of characters which constitute the search key. The author and subject keys are the first seven characters of the first word or the first word itself of the entry -- whichever is shorter. The title key is formed by concatenating the first three characters of the first word, the first two characters of the second word and the first character of the third word (referred to as the 3,2,1 key).

The first character of a search command indicates the type of search ("A" for author, "T" for title, "S" for subject). All search commands have a "/" as the second character which is followed by the search argument. An author search command and the system response are shown in Figure 3.2. (In the figure, the number immediately preceding each entry indicates the number of publications contained in the system by the corresponding author.) The search argument can include more characters than required by the system to form the author-key. The searcher should enter as much of the entry as possible to avoid retrieval of unwanted entries. Figure 3.3 through 3.6 show various other searches which illustrate this point.

Figures 3.7 through 3.11 illustrate subject searching which is similar to author searching. Searching by title is slightly different because the first three words of the title need to be entered as a minimum and not all of what is entered by the user is always utilized. In addition to the 3,2,1 key which is required, VTLS can also use the fourth and the

SEARCH COMMAND: A/Dickens

SYSTEM RESPONSE:

```
 1.     7 Dickens, Arthur Geoffrey.
 2.     1 Dickens, Bernard Morris.
 3.   113 Dickens, Charles, 1812-1870
 4.     1 Dickens, Frank.
 5.     1 Dickens, Mary.
 6.     2 Dickens, Milton.
 7.     5 Dickens, Monica.
 8.     1 Dickens, Paul De Witt 1896-
 9.     1 Dickens, Peter.
10.     1 Dickens, Roy S.
11.     1 Dickenson, Harry.
12.     1 Dickenson, John P.
13.     1 Dickenson, Richard B.
```

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.2
Searching by Author - Example 1

SEARCH COMMAND: A/Dickens M

SYSTEM RESPONSE:

```
1.     1 Dickens, Mary.
2.     2 Dickens, Milton.
3.     5 Dickens, Monica.
```

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.3
Searching by Author - Example 2

```
SEARCH COMMAND:  A/Dickens Mo

SYSTEM RESPONSE:

 1.      5 Dickens, Monica.

ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 3.4
Searching by Author - Example 3

```
SEARCH COMMAND:  A/Dickenson

SYSTEM RESPONSE:

 1.      1 Dickenson, Harry.
 2.      1 Dickenson, John P.
 3.      1 Dickenson, Richard B.

ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 3.5
Searching by Author - Example 4

SEARCH COMMAND: A/Dickenson Richard

SYSTEM RESPONSE:

1. 1 Dickenson, Richard B.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.6
Searching by Author - Example 5

SEARCH COMMAND: S/Soccer

SYSTEM RESPONSE:

1. 1 Soccer -- Coaching
2. 2 Soccer for women -- Periodicals
3. 1 Soccer -- Great Britain -- History
4. 2 Soccer -- Rules -- Periodicals
5. 1 Soccer -- Social aspects -- Great Britain
6. 1 Soccer -- Training
7. 1 Soccer -- United States -- Periodicals
8. 1 Soccer -- United States -- Records

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.7
Searching by Subject - Example 1

fifth characters of the first word and the first two characters of the fourth and the fifth words. These extra data may be entered by the user to improve search specificity. Title searching is illustrated by Figures 3.12 through 3.14.

```
SEARCH COMMAND:  S/Soccer social

SYSTEM RESPONSE:

 1.      1 Soccer -- Social aspects -- Great Britain

ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 3.8
Searching by Subject - Example 2

```
SEARCH COMMAND:  S/Soccer United States

SYSTEM RESPONSE:

 1.      1 Soccer -- United States -- Periodicals
 2.      1 Soccer -- United States -- Records

ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 3.9
Searching by Subject - Example 3

```
SEARCH COMMAND:  S/Soccer United States Records

SYSTEM RESPONSE:

 1.      1 Soccer -- United States -- Records

ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 3.10
Searching by Subject - Example 4

```
SEARCH COMMAND:  S/Soccer United States History

SYSTEM RESPONSE:

NO EXACT MATCH -- PLEASE BE LESS SPECIFIC
```

Figure 3.11
Searching by Subject - Example 5

SEARCH COMMAND: T/War an p

SYSTEM RESPONSE:

1. War and peace.
2. War and peace : a novel.
3. War and peace aims of the United Nations.
4. War and peace in Europe, 1815-1870.
5. War and peace in Soviet diplomacy.
6. War and peace in the global village.
7. War and peace in the law of islam.
8. War and peace in the space age.
9. War and peace in the Sudan, 1955-1972.
10. War and peace in the world's religions.
11. War and politics.
12. War and politics in Cambodia.
13. War and presidential power.
14. War and prices in Spain, 1651-1800.
15. Wars and population.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.12
Searching by Title - Example 1

SEARCH COMMAND: T/War an p in

SYSTEM RESPONSE:

1. War and peace in Europe, 1815-1870.
2. War and peace in Soviet diplomacy.
3. War and peace in the global village.
4. War and peace in the law of islam.
5. War and peace in the space age.
6. War and peace in the Sudan, 1955-1972.
7. War and peace in the world's religions.
8. War and politics in Cambodia.
9. War and prices in Spain, 1651-1800.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.13
Searching by Title - Example 2

SEARCH COMMAND: T/War and peace in s

SYSTEM RESPONSE:

1. War and peace in Soviet diplomacy.
2. War and prices in Spain, 1651-1800.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.14
Searching by Title - Example 3

SEARCH COMMAND: T/War an p in so

SYSTEM RESPONSE:

1. War and peace in Soviet diplomacy.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.15
Searching by Title - Example 4

SEARCH COMMAND: T/Wars an p

SYSTEM RESPONSE:

1. Wars and population.

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.16
Searching by Title - Example 5

3.1.3 Levels of Catalog Access

A search terminates either when the searcher does not find any entries that are of interest and gives up, or when he retrieves physical status information about a specific item. For the latter, the search needs to go through certain levels of accessing the catalog.

The first level of access is the retrieval of the entries which match a given search argument. Figures 3.2 through 3.15 are all examples of this level which is referred to as the initial menu.

If the searcher "selects" one of the entries from the initial menu by entering its corresponding line number, the system responds by an "intermediate menu" screen which constitutes the second level of access. For author searches, this screen contains all works by the author which has been selected from the initial menu; for subject searches, it contains all works on the selected subject; and for title searches, it contains all works the titles of which are identical to the selected title. (*e.g.*, "Othello" by Verdi and "Othello" by Shakespeare.) Figure 3.17 illustrates the first two levels of a subject search. (The intermediate menu level is automatically skipped by the system if it contains only one entry.)

The third level contains a full description of the bibliographic record which is uniquely determined before this level is reached. Figure 3.18 shows the continuation of the dialogue of Figure 3.17. It illustrates the retrieval of the bibliographic screen.

SEARCH COMMAND: S/New Mexico

SYSTEM RESPONSE:

1. 1 New Mexico.
2. 1 New Mexico -- Antiquities.
3. 1 New Mexico -- Bureau of Mines and Mineral Resources -- History.
4. 3 New Mexico -- Description and travel.
5. 1 New Mexico -- Description and travel -- Addresses, essays, lectures.
6. 1 New Mexico -- History.
7. 1 New Mexico -- History -- Addresses, essays, lectures.

ENTER 'NS' FOR MORE

ENTER NEW COMMAND OR LINE # OF SELECTION

USER SELECTION: 4

SYSTEM RESPONSE:

New Mexico -- Description and travel

1. Santa Fe and the Far West / with a note by Dale L. Morgan.
   Los Angeles: [Printed by W. M. Cheney] for Glen Dawson, 1949.
2. The land of the Pueblos.
   Wallace, Susan Arnold Elston.
   Troy, N.Y. : Nims & Knight, 1889, c1888.
3. The southwestern expedition of Zebulon M. Pike. Edited by Milo Milton Quaife.
   Pike Zebulon Montgomery, 1779-1813
   Freeport, N.Y.,
   Books for Libraries Press [1970].

ENTER NEW COMMAND OR LINE # OF SELECTION

Figure 3.17
Access Levels 1 and 2

USER SELECTION: 2

SYSTEM RESPONSE:

F801 W18 1889

Wallace, Susan Arnold Elston.

The land of the Pueblos.
Troy, N.Y. : Nims & Knight, 1892, c1888.

285 p., [12] leaves of plates : ill.; 20 cm.

NEW MEXICO -- DESCRIPTION AND TRAVEL.
PUEBLO INDIANS

ENTER 'C' FOR CIRCULATION INFORMATION

Figure 3.18
Access Level 3

Note the final system message in Figure 3.18: "ENTER 'C' FOR CIRCULATION INFORMATION" By entering 'C', the searcher can retrieve information about all items that are associated with the particular bibliographic record along with their physical status. This data constitutes the fourth level of access. If there are multiple items, the system displays the "item-menu" screen; otherwise it displays the "item" screen. If the bibliographic record had any holdings records, the system message mentioned above would have been "ENTER 'C' FOR CIRCULATION INFORMATION OR 'H' FOR HOLDINGS." Thus, there are three types of screens at level four: item-menu, item, and holdings screens. Figure 3.19 shows the continuation of the dialogue of Figure 3.18 and an example of the fourth level which, in this case, is the item screen. Figures 3.20 and 3.21 provide examples of item-menu and serial holdings screens respectively.

Sometimes, there may be multiple entries of interest on menu screens. The system can back up to previously displayed screens with the PS (previous screen) command. This makes it possible to retrieve more detailed information on any number of entries that are displayed at different levels.

When the contents of a "screen" do not fit into the terminal screen, the system partitions it into "pages" and displays one page at a time, accompanied with the following message: "ENTER 'NS' FOR MORE" (See Figure 3.17)

(THE SEARCHER ENTERS 'C' IN RESPONSE
TO SYSTEM DISPLAY OF FIGURE 3.18)

SYSTEM RESPONSE:

ITEM: 1000386685
CALL NO.: F801 W18 1889 COPY: 1
UNIT:
AUTHOR: Wallace, Susan Arnold Elston.
TITLE: The land of the Pueblos.
PRICE: $9.00 LOAN PERIOD: 90 CIRC COUNT: 2
PERMANENT LOCATION: Newman
TEMPORARY LOCATION:
STATUS: Checked-out 01/10/81 Due 03/11/81

PLEASE ENTER NEW COMMAND

Figure 3.19
Access Level 4 - The Item Screen

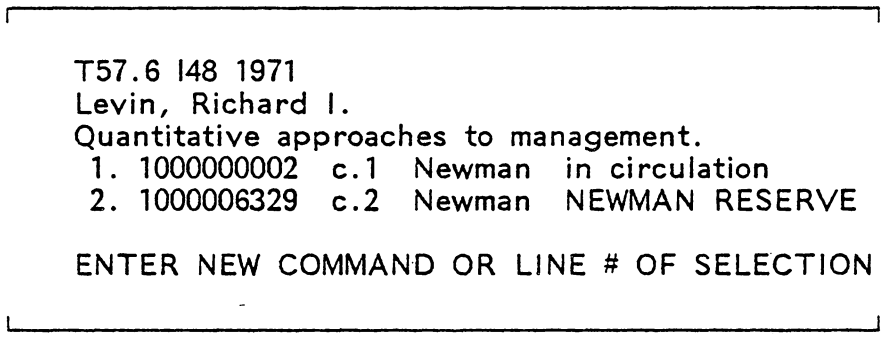

Figure 3.20
Access Level 4 - The Item Menu Screen

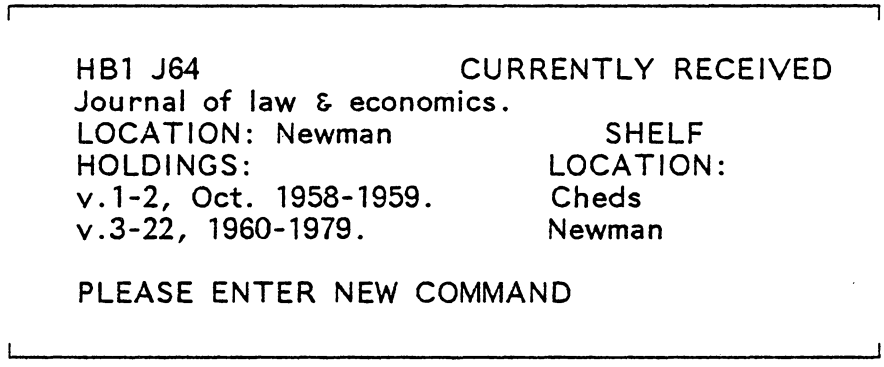

Figure 3.21
Access Level 4 - The Holdings Screen

Figure 3.22 illustrates the four levels of catalog searching with a diagram.

(S E A R C H C O M M A N D)

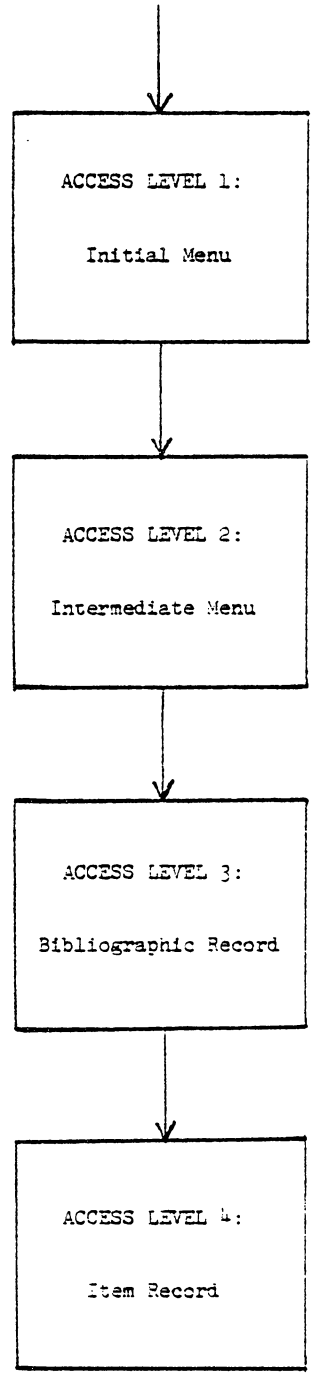

Figure 3.22 - Levels of Catalog Access

3.2 CIRCULATION

Circulation is the most important component of library service. It often has been considered as the only indicator of library use, and it was one of the first library functions to be computerized. A circulation system allows for loaning books to patrons (check-out), for receiving them back (check-in), and for extension of their loan periods (renewal). Its other functions, which are not considered in this study, include processing of overdue fines and control of hold, recall, and reserve activity.

3.2.1 Database Representation

Figure 3.23 shows the VTLS database representation of circulation related data. A circulation record consists of a PATRON-ID[11] and an ITEM-ID along with current-date, due-date, renewal-count and other data to control the correspondence with the borrower about the item. A patron record contains the patron's name, address, PATRON-ID, department, rank, status, etc. Although the patron may not have any books checked-out at all times, his record is kept in the system so as to avoid having to reenter it.

The patron record is accessible by PATRON-ID and patron name. The circulation record can be accessed by ITEM-ID and PATRON-ID. Note that while there can be only one circulation record for a given

---

[11] PATRON-ID is a number which is assigned to each patron to uniquely identify him.

ITEM-ID, there is no such restriction for a PATRON-ID. (In other words, a patron may have multiple books checked-out but a book may not be checked-out to two patrons at the same time.) Using the ITEM-ID access, the system retrieves information about the circulation status of items. (See Figure 3.19) The two different screens that can be retrieved using PATRON-ID access are shown in Figures 3.24 and 3.25.

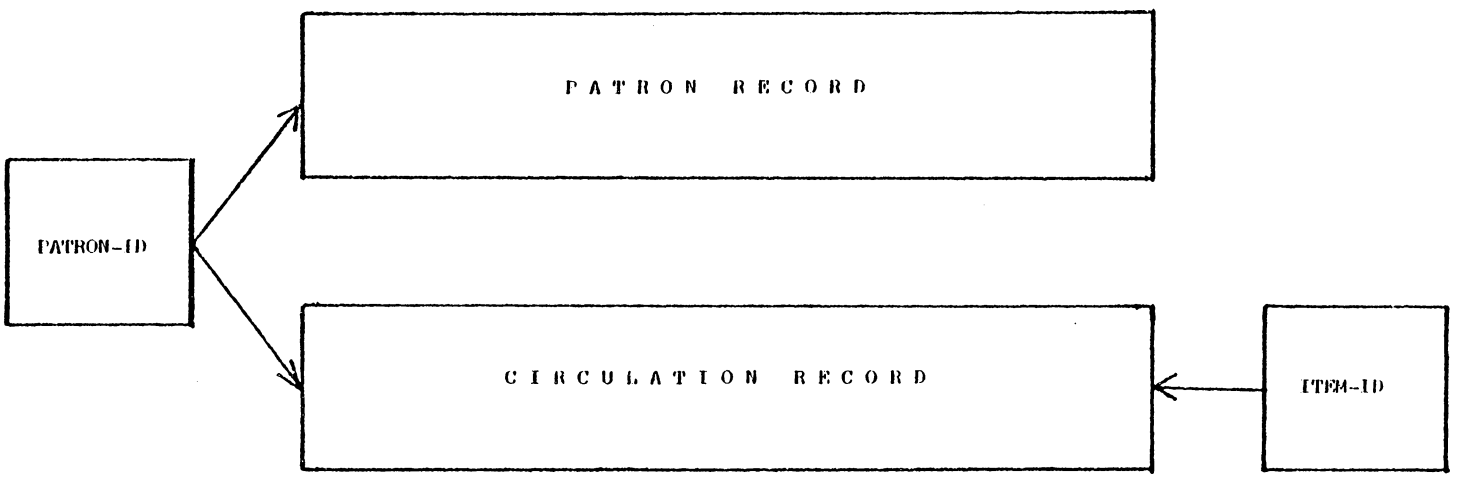

Figure 3.23 - VTLS Database Layout of Circulation Related Data (simplified)

```
PATRON-ID: 2224114982
PATRON INITIALS: TWE
PATRON TYPE: GD
CIRC-PERIOD: GD
DELINQUENCY:
LAST NAME: Espley
FIRST NAME: Thomas
MIDDLE NAME: W.
ADDRESS: 101 E Terrace View
CITY: Blacksburg
STATE: Va.
ZIP: 24060
DEPARTMENT: IEOR
PHONE NUMBER: 703-552-6075
OCCURRENCE: 0
RENEW-DATE: 01/01/80
REMARKS:

 ENTER NEW COMMAND OR UPDATE
```

Figure 3.24
Patron Screen

```
PATRON-ID: 2224114982  PATRON INITIALS: TWE
TYPE: GD  CIRC-PERIOD: GD  DELINQUENCY:

    TITLE                          C.OUT    DUE
 1. Fundamental concepts in the    01/02/81 02/02/81
 2. Patterns in the use of book    01/02/81 02/02/81
 3. Productivity : the measure     03/10/81 04/10/81
 4. Subject approach to informa    03/11/81 04/11/81

PLEASE ENTER NEW COMMAND
```

Figure 3.25
Patron Activity Screen

3.2.2 Circulation Transactions

There are three basic circulation transactions: check-out(/CKOT), renewal(/RNEW), and check-in(/CKIN). (All transaction commands start with a "/".) Figures 3.26 through 3.28 illustrate these transactions.

A circulation record is created by a check-out transaction. The record may then be modified by renewal transactions which increment the renewal-count, update the due-date, and reset correspondence data. It is eventually deleted by a check-in transaction. The system checks a long list of conditions before executing these transactions and displays warnings when necessary. (See Figures 3.26 through 3.28 for examples)

```
TRANSACTION COMMAND: /CKOT

TRANSACTION DIALOGUE:
(OPERATOR RESPONSES ARE INDICATED BY "*")

 ENTER PATRON NUMBER FOR CHECK-OUT
*2123123123
 PATRON #2123123123 NOT ON FILE
 ENTER PATRON NUMBER FOR CHECK-OUT
*2224114982
 INITIALS: TWE
 BOOKS ON LOAN TO PATRON: 9
 ENTER ITEM NUMBER FOR CHECK-OUT
*1034000305
 CHECK-OUT COMPLETED TO PATRON #2224114982
 DUE-DATE: 06/05/81
 ENTER ITEM NUMBER FOR CHECK-OUT
*1123987111
 ITEM #1123987111 NOT ON FILE
 ENTER ITEM NUMBER FOR CHECK-OUT
```

Figure 3.26
Transaction for Checking Items out

```
 TRANSACTION COMMAND: /RNEW

 TRANSACTION DIALOGUE:
 (OPERATOR RESPONSES ARE INDICATED BY "*")

 ENTER ITEM NUMBER FOR RENEWAL
*1123455553
 RENEWAL COMPLETED
 ENTER ITEM NUMBER FOR RENEWAL
*1000000005
 HOLD FOR LOCATION 100 ON BIB-ID
 ITEM CAN NOT BE RENEWED
 ENTER ITEM NUMBER FOR RENEWAL
```

Figure 3.27
Transaction for Renewing Items

```
 TRANSACTION COMMAND: /CKIN

 TRANSACTION DIALOGUE:
 (OPERATOR RESPONSES ARE INDICATED BY "*")

 ENTER ITEM NUMBER FOR CHECK-IN
*1000000005
 HOLD FOR LOCATION 100 ON BIB-ID
 HAVE YOU PLACED THE ITEM ON THE PROPER SHELF?
*Y
 CHECK-IN COMPLETED
 ENTER ITEM NUMBER FOR CHECK-IN
*1123987111
 CHECK-IN COMPLETED
 ENTER ITEM NUMBER FOR CHECK-IN
```

Figure 3.28
Transaction for Checking Items in

Chapter IV

COMPUTERIZED DATA COLLECTION METHODOLOGY

Evaluation of library service effectiveness requires the gathering of two types of data: data that deal with locating the required material and data that deal with the use of the materials when located. This chapter outlines computerized data collection methods for both of these types of data.

Data about users' experiences in locating the books they need are addressed by questions such as: how often do they succeed?; what are the reasons when they fail?; how convenient is the service in terms of speed, intellectual effort, and physical effort required?; etc. Traditionally, this type of data could only be obtained through user surveys which are expensive, disruptive, and thereby impractical to employ regularly. Sections 4.1 through 4.4 of this chapter describe computerized methods to collect such data automatically.

The other type of data that is of interest is about the use of books once they are located: What proportion are read in the library and what proportion are borrowed for external use?; how long are the borrowed books kept?; etc. The computerized methods of collecting this type of data are, in essence, no different from the conventional methods except that they are faster, cheaper, and more accurate. These methods are described in sections 4.5 and 4.6 of this chapter.

The descriptions of the proposed methods consist of identifying and measuring the parameters which are capable of providing useful data about the following determinants of library effectiveness:

1. Success ratio of catalog searches,
2. Precision and speed of record retrieval,
3. Availability of books searched by users,
4. Convenience of book retrieval,
5. Book use through circulation, and
6. In-library book use.

Library materials are not uniform in their supply, demand, and use. For example, circulation period distribution of fiction books may be significantly different from non-fiction books, or the library's collection may be more comprehensive in one subject area than in another. Therefore, to be meaningful and useful, separate measurements of library effectiveness should be used for different categories of materials. These categories need to be defined appropriate to the library's collection, its users' needs, and the intended use of the measurements; they could vary in number and could be based, for example, on subject classification, acquisition fund, physical format, or location. The measures described in this chapter assume a predefined set of item classes which are numbered 1 through n. In cases where the class cannot be determined it is assigned to be 0. Some of the measures are also identified by type of catalog search (author, title, or subject) and by levels of catalog access which were defined in chapter III.

4.1 SUCCESS RATIO OF CATALOG SEARCHES

The identification of the access level at which a catalog search terminates provides information about the success of the search. For example, termination of a search by failing to reach the first level (as in Figure 3.11) may be due to misspelling or entering insufficient data to form the search-key, or it may be due to the absence of the searched record from the system. The likelihood of the latter increases if the search reaches the first level and then terminates. (Search termination is indicated by the entry of a new search command - as opposed to the line number of a selection - in response to a screen such as the one shown in Figure 3.7.) If the search terminates at the second or the third levels, this strongly indicates that the record being searched is not in the system. Finally, if the search reaches the fourth level, this is an indication that the search was succesful. Once the third level has been reached, the class of the accessed record can also be identified and used to approximate the class of the record being searched.

Definitions:

I - type of search (I is equal to 1, 2, or 3 for author, title, or subject search respectively.)

J - record class (J is equal to 0 when class cannot be determined; otherwise it is a number between 1 and n.)

K - level of catalog access (K is a number between 0 and 4.)

S(I,J,K) - number of cases in which a search of type I reaches a record of class J at access level K.

F(I,J,K) - number of cases in which a search of type I terminates after reaching a record of class J at access level K-1.

T(I) - total number of search commands of type I that are entered.

Figure 4.1 shows the possible outcomes of catalog searches. To find the values of S, F, and T, five arrays of counters need to be introduced to the system as indicated in the figure. These arrays are T(I), S(I,0,1), S(I,0,2), S(I,J,3), and S(I,J,4) where each array element is a counter[12] (I = 1,2,3 and J = 0,1,2,...,n). Assuming that catalog searches can only proceed as shown in Figure 4.1:

$$F(I,J,K) = S(I,J,K-1) - S(I,J,K) \qquad 1 < K < 4$$

$$= T(I) - S(I,0,1) \qquad K = 1$$

Thus, the values of F can be determined if the values of S and T are measured. However, the assumption above does not hold when the PS (previous screen) command is used. As described in chapter III, this command makes it possible to go back to lower levels of access during a catalog search. This problem can be overcome by adjusting the incrementation procedure of the counter arrays such that a search with PS

---

[12] Note that since class of the searched item cannot be identified in the first two levels of access, J = 0 when K < 3.

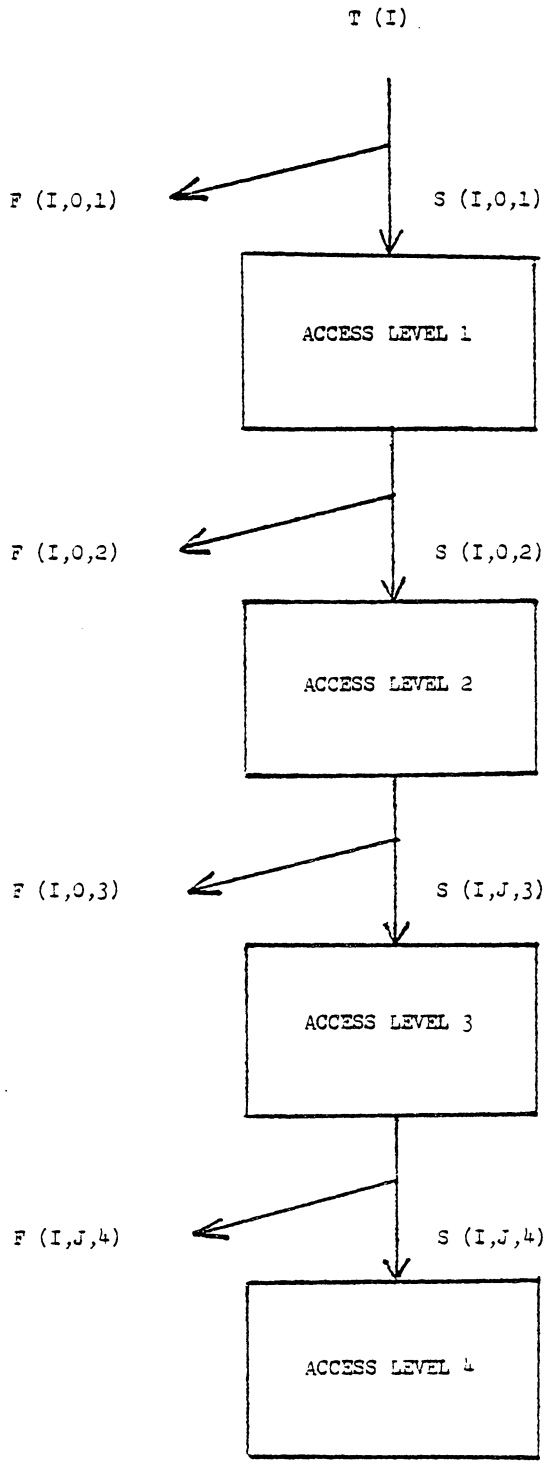

Figure 4.1 - Possible Outcomes of Catalog Searches

commands can be reduced to one or more searches without PS commands. Such an adjustment requires an understanding of the reasons why PS command is used.

PS command is used for two basic reasons. First, the searcher may need to get back to a previous screen having made a wrong selection. This may happen if the searcher is not sure of the complete entry by which he is searching. For instance, he may know the author's last name but may be unsure about his first and middle names. Figure 4.2 illustrates this case. In the figure, the searcher finds the right author in the second try. He then proceeds to the third and the fourth levels (Figure 4.3).

PS commands may also be used when the searcher finds one record and seeks others that can be reached from one of the previous screens. Figure 4.4 continues the dialogue of Figure 4.3 to illustrate this case. In this figure, the searcher goes back to level two and selects a different entry than he had previously selected (top of Figure 4.3) to find detailed information about another record. Figures 4.2 through 4.4 jointly illustrate how these two different uses of the PS command can occur within a single catalog search.

It is not difficult to identify the reason for the use of a particular PS command. It can be assumed that, in general, a PS command entered after reaching the fourth level and any PS commands that immediately follow it (see Figure 4.4) are used to search additional records while all other PS commands are used to go back after making a wrong selection.

```
 (USER RESPONSES ARE INDICATED BY "*")
*A/pryor
 1.      2 Pryor, Karen Wylie
 2.      2 Pryor, Sara Agnes Rice
 3.      2 Pryor, William A.

 ENTER NEW COMMAND OR LINE # OF SELECTION
*2
    Pryor, Sara Agnes Rice

 1. Birth of the nation : Jamestown, 1907.
    Pryor, Sara Agnes Rice
 2. My day; reminiscences of a long life.
    Pryor, Sara Agnes Rice

 ENTER NEW COMMAND OR LINE # OF SELECTION
*PS
 1.      2 Pryor, Karen Wylie
 2.      2 Pryor, Sara Agnes Rice
 3.      2 Pryor, William A.

 ENTER NEW COMMAND OR LINE # OF SELECTION
*3
    Pryor, William A.

 1. Frontiers of free radical chemistry /
    edited by William A. Pryor.
    New York: Academic Press, 1980.
 2. Introduction to free radical chemistry.
    Pryor, William A.
    Prentice-hall, 1966.

 ENTER NEW COMMAND OR LINE # OF SELECTION
```

Figure 4.2
Use of the PS Command - Example 1

```
 (CONTINUING THE DIALOGUE OF FIGURE 4.2)
*1
 QD471 F76

 Frontiers of free radical chemistry /
 edited by William A. Pryor
 New York, Academic Press, 1980.

 xiii, 385 p. : ill.; 24 cm.

 Papers presented at a symposium held at
 Lousiana State University, Apr. 10-11, 1979
 in the 50th anniversary of the Exxon Research
 and Development Laboratory
 Includes bibliographical references and index

 RADICALS (CHEMISTRY) -- CONGRESSES
 Pryor, William A.
 Lousiana State University, Baton Rouge
 Exxon Research and Development Laboratory

 ENTER 'C' FOR CIRCULATION INFORMATION
*C
 ITEM: 1000496184
 CALL NO.: QD471 F76          COPY: 1
 UNIT:
 AUTHOR:
 TITLE: Frontiers of free radical chemistry / ...
 PRICE: $5.00  LOAN PERIOD: 90  CIRC COUNT: 1
 PERMANENT LOCATION: Newman
 TEMPORARY LOCATION:
 STATUS: AVAILABLE

 PLEASE ENTER NEW COMMAND
```

Figure 4.3
Use of the PS Command - Example 1 (cont.)

```
 (CONTINUING THE DIALOGUE OF FIGURE 4.3)
*PS
 QD471 F76

 Frontiers of free radical chemistry /
 edited by William A. Pryor
 New York, Academic Press, 1980.

 xiii, 385 p. : ill.; 24 cm.

 Papers presented at a symposium held at
 Lousiana State University, Apr. 10-11, 1979
 in the 50th anniversary of the Exxon Research
 and Development Laboratory
 Includes bibliographical references and index

 RADICALS (CHEMISTRY) -- CONGRESSES
 Pryor, William A.
 Lousiana State University, Baton Rouge
 Exxon Research and Development Laboratory

 ENTER 'C' FOR CIRCULATION INFORMATION
*PS
    Pryor, William A.

 1. Frontiers of free radical chemistry /
    edited by William A. Pryor.
    New York: Academic Press, 1980.
 2. Introduction to free radical chemistry.
    Pryor, William A.
    Prentice-hall, 1966.

 ENTER NEW COMMAND OR LINE # OF SELECTION
*2

                    .
                    .
                    .
```

Figure 4.4
Use of the PS Command - Example 2

Once the reason for its use is identified, the counters can be adjusted to incorporate the effects of a PS command into the model of Figure 4.1 which only considers "forward searching." If the PS command is used to go back after a wrong selection, the appropriate S counters should be decremented to remove the effect of the inadvertant search step. For example, if a PS command is entered at access level (K = 2) during a subject search (I = 3), then S(3,0,2) must be decremented by one. On the other hand, if the PS command is used to search additional records, the appropriate T and S counters should be incremented to reflect the equivalent of a new search which has instantly progressed to the access level from which the forward search restarts. For example, consider Figure 4.4 where two PS commands are entered in sequence after reaching the fourth level. Noting that this is an author search (I = 1) and that the forward search restarts from level two, the adjustment required here is to increment T(1), S(1,0,1), and S(1,0,2) by one.

In general, the adjustment procedure for a PS command that is entered at level L and during a search of type I can be described by the following steps: (Let J be the record class.)

STEP 1. If L is equal to 4 go to STEP 3; otherwise go to STEP 2.

STEP 2. Subtract 1 from S(I,J,L); go to STEP 6.

STEP 3. Subtract 1 from L; go to STEP 4.

STEP 4. If the next command is PS go to STEP 3; if a selection number is entered go to STEP 5; if the next command

causes the search to terminate go to STEP 6; otherwise repeat STEP 4.

STEP 5. Add 1 to T(I) and S(I,J,K), where K is less than or equal to L; go to STEP 6.

STEP 6. End.

In chapter V, the data collected by the counters will be used to evaluate the "success ratio" of user searches. Important to this evaluation is the realization that the searcher may enter multiple search commands when seeking a single record. This occurs in two ways. First, when he fails to locate a record, the searcher may change the identifier he is using and try again. For example, he may fail to find a record by author and may then try searching by title. The effects of this case will be discussed in chapter V. Second, the searcher may change the search argument and search with the same identifier one more time. This case occurs due to spelling or keying mistakes, or due to uncertainty about the identifier. Figures 4.5 and 4.6 illustrate this case with examples. It is possible to detect some of the occurrences of this type of "duplicate searching" by comparing the search keys of successive search commands. While search keys of successive search commands are very rarely the same for unrelated records, they often are the same when the searches are directed to the same record using the same identifier. To avoid double counting of failures, when such a case is detected, T and S counters should be decremented by one to

avoid counting the previous search. For instance, in the example of Figure 4.6 T(1) and S(1,0,1) need to be decremented by one. To be able to carry out this type of adjustment, the system must remember the access key of the previous search and the level at which it failed -- if it did fail.

```
 (USER RESPONSES ARE INDICATED BY "*")
*A/Kent Allan

 NO EXACT MATCH -- PLEASE BE LESS SPECIFIC
*A/Kent Allen
  1.    6 Kent, Allen

 ENTER NEW COMMAND OR LINE # OF SELECTION
*1

                    .
                    .
                    .
```

Figure 4.5
Searching Mistakes - Example 1

```
 (USER RESPONSES ARE INDICATED BY "*")
*A/Smith Carol
  1.    2 Smith, Carol A.
  2.    1 Smith, Carol E.
  3.    1 Smith, Carol H.
  4.    1 Smith, Carol Sturm

 ENTER NEW COMMAND OR LINE # OF SELECTION
*A/Smith Carroll
  1.    1 Smith, Carroll
  2.    1 Smith, Carroll Newton

 ENTER NEW COMMAND OR LINE # OF SELECTION
*1

                    .
                    .
                    .
```

Figure 4.6
Searching Mistakes - Example 2

4.2 *PRECISION AND SPEED OF RECORD RETRIEVAL*

During a catalog search, one often encounters irrelevant entries at the first two levels of access. These entries retrieved by the system but not relevant may be regarded as "noise." It becomes harder to locate the relevant entry (or entries) as the noise level increases. Therefore, the measurement of the noise level experienced by the searchers indicates the quality of the service provided by the catalog.

In the context of a manual catalog where the first three levels of access are combined, Foskett defines "precision ratio" as follows[47, page 14]:

$$\text{Precision ratio} = \frac{\text{(relevant documents retrieved)}}{\text{(total of documents retrieved)}}$$

In chapter V, a similar ratio is defined for each of the first two levels of access to a computerized catalog in terms of the parameters defined in the last section and the parameters defined below.

Definitions:

Z - search result (Z is equal to 1 if the search reaches the fourth level, and equal to 0 otherwise.)

P(I,K,Z) - number of records inspected at level K (only for K = 1,2) during searches of type I and result Z, before a selection number or a new search command is entered.

To obtain the values of P(I,K,Z), additional arrays of counters need to be introduced to the system at the first two levels. These counters are to be incremented by the number of records inspected at the corresponding levels after the outcome of each search (value of Z) is established. For example, assume that a searcher entered an author search command; inspected two records at the first level; made a selection; inspected three records at the second level; made a selection; and entered "C" at the third level to reach the fourth level. Here Z = 1 and I = 1 since the search was a succesful author search. Then the value of P(1,1,1) must be incremented by two and the value of P(1,2,1) must be incremented by three.

In parallel with the corresponding adjustment of the S counters, when a PS command is entered to go back after a wrong selection, the records inspected at the higher level should be ignored to cancel the effect of the inadvertant search step from P. When the PS command is used to find additional records, the part of the search that precedes it should be treated as a complete succesful search and the rest must be considered a new search which instantly progressed to the level and the record from which the forward search restarts.

Again, in parallel with the adjustment of the S counters, when successive searches have the same key, the appropriate P counters need to be decreased to avoid double counting as discussed in the last section.

Another indication of the quality of the service provided by the catalog is the length of the elapsed time between the entry of a command and the display of the system's response -- often referred to as response time.

Definition:

t(I,K,Z) - response time experienced during searches of type I and result Z in reaching level K.

The adjustments required for the t counters are the same as those described above for the P counters.

4.3 AVAILABILITY OF BOOKS SEARCHED BY USERS

One major area of concern in library service effectiveness is whether books are available at the time they are needed by users. This information can be obtained by observing the status of each item (*e.g.*, available, missing, in-circulation, etc.) for which a catalog search has progressed to level four.

Definitions:

U - item status. (U is a number between 1 and m.)

A(J,U) - number of cases in which item records accessed are of class J and have status U.

Every time the fourth level is reached in a catalog search, an A counter needs to be incremented. The A counters do not need any adjustments.

In case there are multiple copies of the searched book, the status that is most favorable from the point of view of the searcher should be used for U. (*e.g.*, the book that is being searched is considered available even if only one of its multiple copies is available.)

The A array is capable of collecting accurate data about the availability of books which are searched by users. However, it is important to note that this data is based on the system's information and not on actual status of items. The system may, for example, indicate that an item is available when it actually is stolen, misshelved, or being read in the library. Finding the "true" status of a searched item involves independent manual verification. To avoid this costly alternative, the information provided by the system can be used along with a statistical measure of its accuracy.

Definitions:

R(J,U1,U2) - fraction of a random sample of items of class J which are indicated by the system to have status U1 when their actual status is U2. (U1 and U2 are elements of U which is defined above.)

C(J,U) - number of cases in which the accessed items are of class J and have actual status U.

When A and R are known, C can be estimated by the following equation:

$$C(J,U) = \sum_{U1=1}^{m} A(J,U1)\ R(J,U1,U)$$

Values of R need to be obtained periodically to find the current degree of accuracy with which the system reports the status of each item. The "random" sample that is used to obtain R merits some consideration.[13] R is to be used to measure the availability of books which are sought by users. Therefore, the books in the sample must be selected with regard to the probability that they will be needed. Typically, this probability is not uniform for all the books in a library.[14] This probability can be estimated using the circulation history of items.

Definitions:

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[13] At this point, it may be asked why a random sample needs to be generated while the items of interest are identified by user searches. Although items that are actually searched would constitute an ideal sample to evaluate R, their true status cannot be observed since the users who search them are likely to retrieve them subsequently.

[14] The effects of ignoring this fact are discussed in Chapter II, under *physical access*.

X(J) - number of times a book of class J has circulated. (X does not include current circulation.)

Y(J) - probability that a book of class J that has circulated X(J) times is currently in circulation.

To demonstrate the method, a program was written to scan the VTLS database to find:

a. the distribution of X(0) for books that are currently in circulation (Figure 4.7),

b. The distribution of X(0) for all books in the library's collection (Figure 4.8),

and, using these findings, to determine the distribution of Y(0) (Figure 4.9). The data, as outlined in the figures, indicate a correlation between the circulation history of a book and the probability that it is currently in use. This correlation can be used in selecting a random sample of books that are expected to be searched by users.

Definitions:

W(J) - sample size of items in class J.

Q(C,J) - number of items with circulation-count C and class J that are to be included in the sample.

Q(C,J) values are referred to as "sample quotas." For each J, Q(C,J) is calculated by multiplying W(J) by the Y(J) values for corresponding

C and J. A practical computerized procedure to obtain the sample is described below:[15] (For J = 1,2,...,n)

STEP 1. Find the distribution of Y(J).

STEP 2. Determine the values of W(J).

STEP 3. Evaluate Q(C,J) using W(J) and the distribution of Y(J).

STEP 4. Randomly select an item record from the catalog. If the "quota" corresponding to the class and circulation-count of the item has already been filled repeat STEP 4; otherwise go to STEP 5.

STEP 5. Include the item that was selected by STEP 4 in the sample. If there are any unfilled quotas left go to STEP 4; otherwise go to STEP 6.

STEP 6. End.

---

[15] The suggested method is generally called "stratified sampling." In particular, the stratification used here is achieved by way of "random quotas." The theoretical basis of this procedure and the determination of the appropriate sample sizes (STEP 2) are given in various texts on sampling. For example, see chapter 3 in [48].

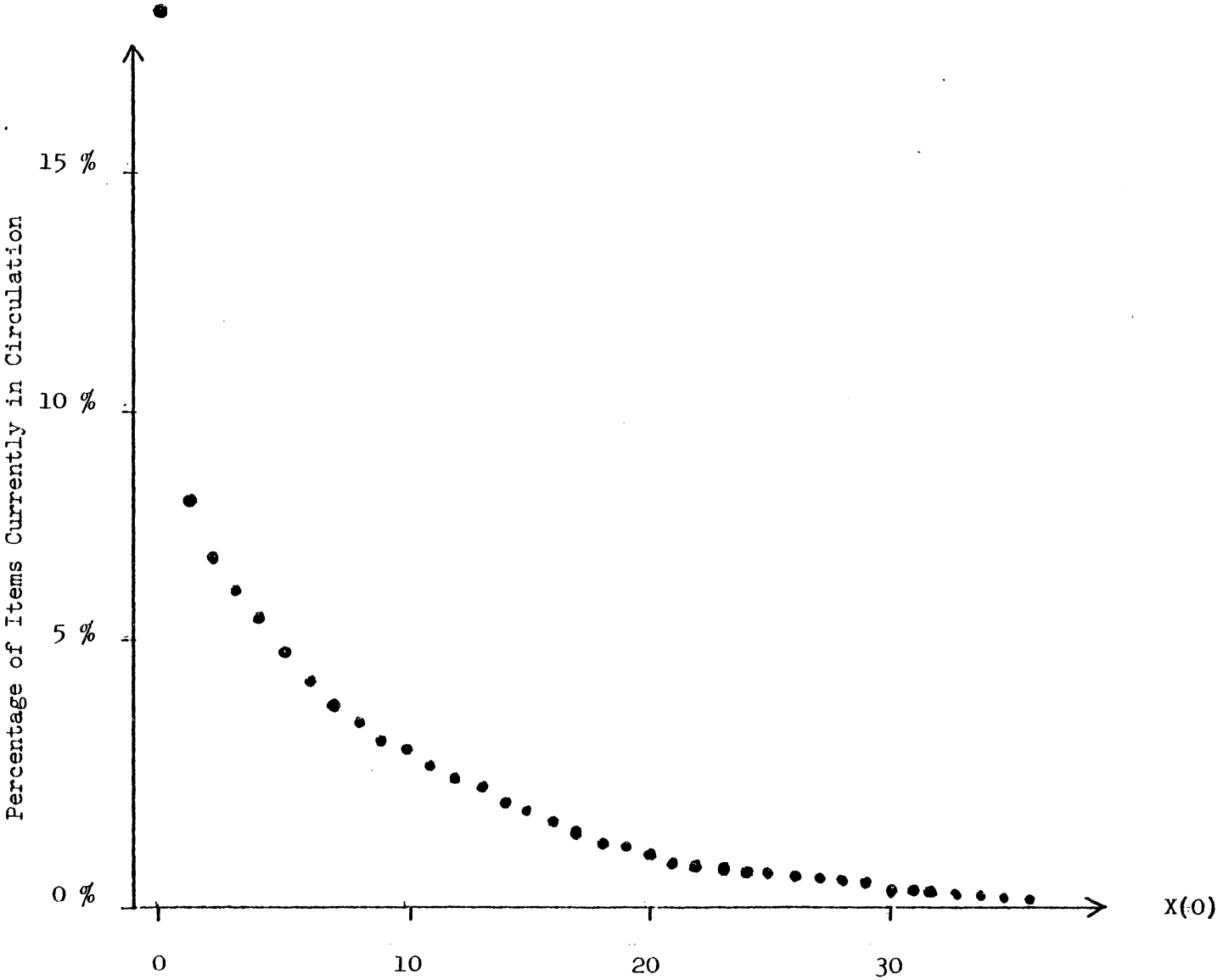

FIGURE 4.7 - Distribution of X(0) for Items in Circulation, March 16, 1981.
(Courtesy of VPI & SU Libraries)

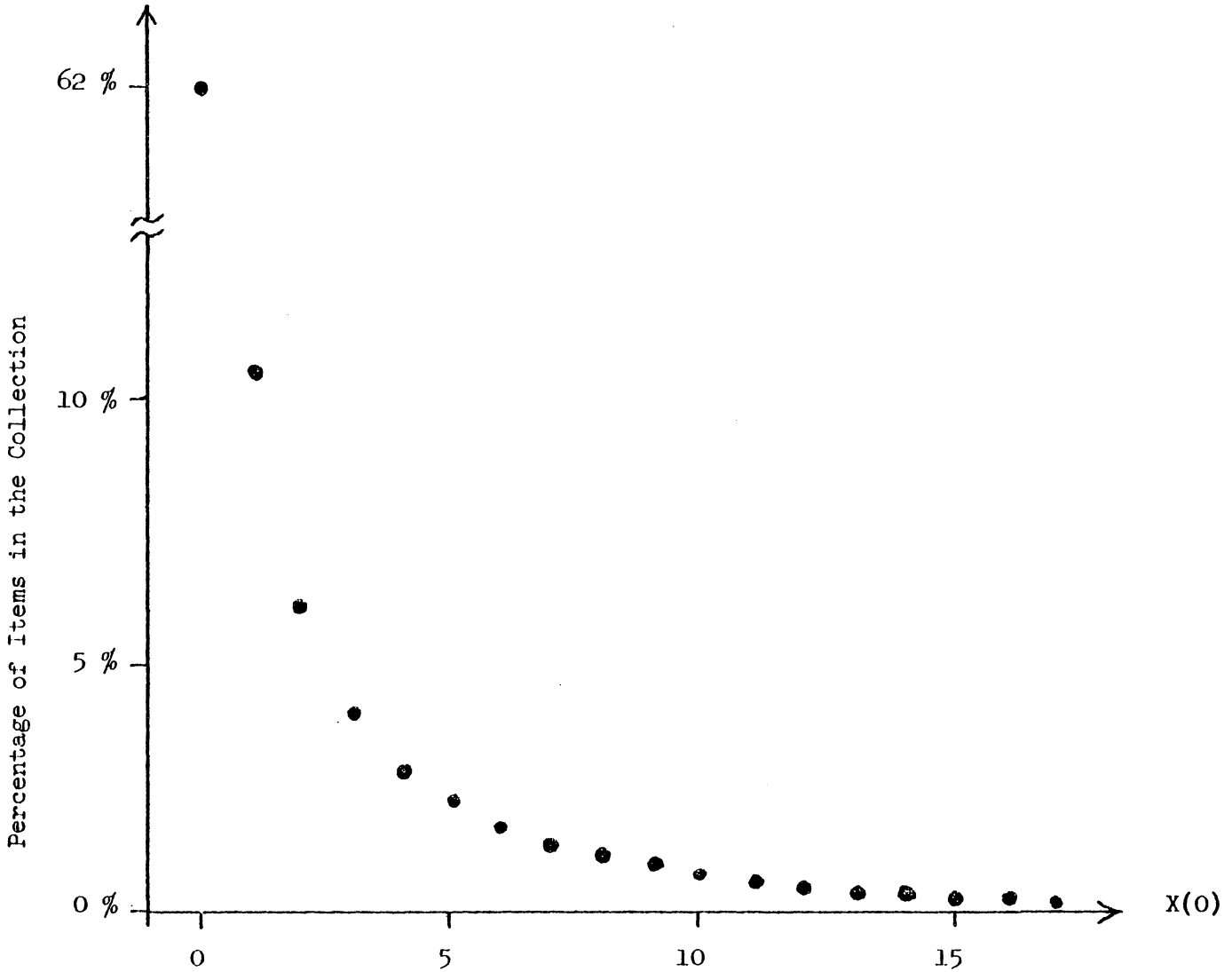

FIGURE 4.8 - Distribution of X(0) for Items in the Collection, March 16, 1981.
(Courtesy of VPI & SU Libraries)

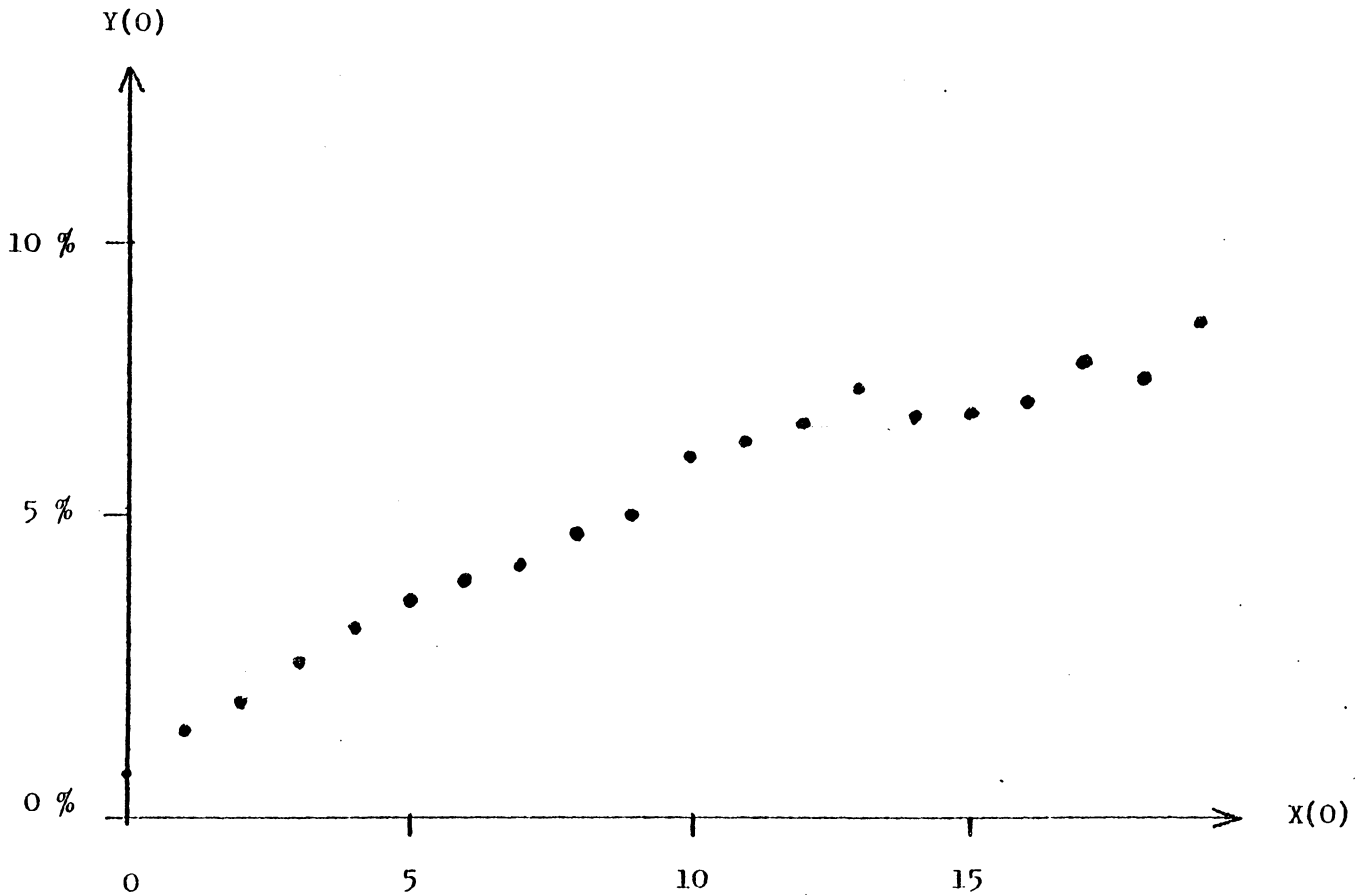

FIGURE 4.9 - Distribution of Y(O) Based on Figures 4.7 and 4.8.

4.4 *CONVENIENCE IN BOOK RETRIEVAL*

A computerized catalog can be accessed from remote locations. This important feature is critical for multi-branch libraries and library networks. Monitoring the use of the catalog, it is possible to measure how far the books are stored from those who need them by comparing the searcher's location with that of the book he is searching. This measure indicates how well the collection is distributed within a group of libraries and their branches in relation to the distribution of the users' library needs by location.

Definitions:

M(L1,L2) - distance from location L1 to location L2.

D(L1,L2,J) - number of cases in which items of class J and location L1 are accessed from location L2.

M can be viewed more generally as a cost matrix the values of which are determined by the library administration. D counters are incremented only when catalog searches reach the fourth level. These counters do not need any adjustments. D and M jointly provide a measure of the distance separating the users from the books they search.

4.5 BOOK USE THROUGH CIRCULATION

By monitoring the circulation transactions, it is possible to collect detailed data concerning the use of books through circulation.

Definitions:

B(J) - number of class J books that are checked out.

H(J) - number of class J books that are renewed.

G(J,N) - number of class J books that are checked in after having been in circulation for N days.

The incrementation of B, H, and G counters are carried out automatically by check-out, check-in, and renewal transactions, respectively. In each case, the class of the item needs to be determined. The G counters require that the circulation period of the item being checked in be also identified. This can be accomplished by subtracting the check-out date (which is included in the circulation record) from the current date.

4.6 IN-LIBRARY BOOK USE

With a computerized system, the "pick-up" method of measuring in-library use of books can be inexpensive and practical. As discussed in Chapter II, this method involves asking the library patrons not to reshelve books after use and collecting data about these books. With a machine readable label on each book, this task simply consists of passing a scanning device over the labels of unshelved books.

Definition:

E(J) - number of class J books which are reshelved (not including items that have been in circulation).

The incrementation of E counters is achieved automatically once the labels are read into the system. This procedure can be thought of as a type of a "check-in" transaction for books that were used in the library.

Chapter V

PROPOSED METHODS OF EVALUATION

The basic factors in library service evaluation were identified and analyzed in Chapter II. The chapter also presented a review of the traditional methods for measuring library service effectiveness. This chapter is a repetition of the same analysis but for a library where catalog access and circulation functions are computerized.

It will be noted that only some components of library service effectiveness can be evaluated satisfactorily by computerized methods. Nevertheless, the methods proposed in this chapter represent a significant advance in the capability for measuring library service effectiveness. Compared to the traditional alternatives, these methods are more comprehensive and accurate; yet they can be applied routinely and at insignificant cost.

The organization of this chapter closely resembles that of Chapter II. This arrangement permits the comparison of the traditional and the proposed methods. The reader may need to refer back to Chapter II for the analysis of particular components of library service, and to Chapter IV for the definitions of the parameters utilized in this chapter.

5.1 MEASUREMENT OF LIBRARY CAPABILITY

5.1.1 Strength of the Library Collection

In this section, several methods are proposed to evaluate collection strength from three complementary views:

1. Size and vitality of the collection,
2. Performance of the collection in response to known-item inquiries, and
3. Quality of the collection.

Collectively, size and vitality measures yield an evaluation of how much benefit is being derived from the investment a library has made in its collection. Measurement of the collection's performance in response to known-item inquiries provides an evaluation of user satisfaction with the collection. The quality of the collection is evaluated objectively, independent of the manifest demand from the library's users. The need for such evaluation is discussed later in this section.

5.1.1.1 Size and Vitality of the Collection

With machine readable data, all traditional quantitative measures of collection strength can be obtained at little cost. In a matter of hours, computer programs can scan a library's database to find the number of items in the collection by subject, format, date, or other groupings. Such quantitative measures need to be complemented with the measure of "vitality" of the collection suggested by Kantor.[16] This particular

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[16] See *Strength of the Library Collection* in Chapter II.

measure can be obtained easily by inspecting the database to find the proportion of items that are active in each class. (For compatibility, the groupings used for vitality of the collection must be the same as those used for the quantitative measures.)

5.1.1.2 Performance of the Collection in Response to Known-item Inquiries

The S counters which were defined in Chapter IV indicate the success rate of users searching the catalog. At this point, it is helpful to restate the following definition:

S(I,J,K) - number of cases in which a search of type I reaches a record of class J at access level K.

The first subscript, I, assumes values of 1, 2, and 3 for author, title, and subject searches respectively. Since known-item searches consist mostly of author or title searches, this section is only concerned with S counters for which I is equal to 1 or 2. The second subscript, J, indicates the "class" of the item being searched by the user. (The classes are identified by the library and numbered 1 through n. In cases where the class cannot be identified, J is assigned the value of 0.) The last subscript, K, indicates the level of access[17] which was reached.

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[17] See *Levels of Catalog Access* in Chapter III.

Methods for obtaining the values of S counters were described in Chapter IV. These values are not accurate in representing how many searches were conducted, and how many of them failed. Their inaccuracy is due to the difficulty in assessing the reason for the termination of a "forward" search sequence. Some of the inaccuracies can be removed by "adjusting" the values of the counters based on the following searches. In Chapter IV, several methods were suggested to adjust the values of S and T counters. These adjustments aim at eliminating the bias the following cases may introduce to the values of S and T:

1. The user sometimes makes a spelling mistake when he initially enters a search command. He may then enter the same command with the correct spelling. Often, this case can be recognized by the system since the searches are similar and they tend to generate the same search key. The adjustment suggested in Chapter IV has the effect of ignoring the former search command;
2. In searching for a single record, the user, using PS commands, can go back and forth between access levels 1 and 3, examining the various records under an author or a title. The effect of the suggested adjustment for this case is to reflect that it was, in fact, a single search; and
3. Using PS commands, the user may search for multiple records without entering a new search command for each one. In this

case, the suggested adjustment has the effect of counting each of the searches that occurred as a separate search.

The assumptions made in recognizing these cases were given in Chapter IV. In general, these assumptions are expected to hold, although sometimes they will fail.

There are other cases which will introduce bias to the values of S and T. The automatic recognition of these cases is either very difficult or simply not possible. They are the following:

1. Failing to find a record by one identifier (*e.g.*, author), the user may search it by another identifier (*e.g.*, title, or another author). If he fails the second time, the counters will indicate that two separate failures have occured. If he is successful the second time, then the counters will indicate two searches, one of which has failed;
2. Sometimes the searcher may use a record to reach other records on the same subject. He does this by searching the record and reaching access level 3 to find out what its call number is. Then, he proceeds to the stacks, to examine the other items that have similar call numbers. Although the search is successful, the system will assume this case a failure since the fourth level of access is not reached; and
3. Often, the user may not be able to find the record he is seeking although it is in the catalog. This may happen in a varie-

ty of ways: He may be misspelling an identifier; he may not know the correct form of the identifiers; the record may be cataloged or entered into the system incorrectly, etc. Since the collection is not really failing in these cases, the value of the corresponding S counter will be mistakenly deflated in relation to the value of the corresponding T counter.

These three cases do not exhaust all the different ways S and T can be biased. There are other, less frequently occuring cases which can introduce additional bias (*e.g.*, using the system incorrectly, transmission errors, etc.). It follows then that the counters cannot be used directly to yield the success (or failure) ratios indicating the proportion of user requests that were satisfied by the collection.

It should be noted that the bias introduced by each one of the cases mentioned above is always in the direction of making the performance of the collection appear worse than it really is. Therefore, it can be stated that the success rate of the collection in satisfying user requests is greater than the following ratio:

$$\frac{\sum_{J=1}^{n} S(I,J,4)}{T(I)}, \qquad I = 1,2$$

It is reasonable to assume that the percentage of bias in the values of S and T counters stays constant for a given library. With this assumption, these counters can be used to compare the performance of a library's collection at different points in time. Four sets of measures which utilize S and T are proposed below. It is important to note that, because of the bias in the values of S and T, these measures can be used for *relative* rather than *absolute* evaluations of collection performance.

a) $$\frac{\sum_{J=1}^{n} S(I,J,4)}{T(I)}, \qquad I = 1,2$$

b) $$\frac{\sum_{J=1}^{n} S(I,J,4)}{S(I,0,1)}, \qquad I = 1,2$$

c) $$\frac{\sum_{J=1}^{n} S(I,J,4)}{S(I,0,2)}, \qquad I = 1,2$$

d) $$\frac{S(I,J,4)}{S(I,J,3)}, \qquad I = 1,2; \quad J = 1,2, \ldots ,n$$

Measures in *a* through *d* approximate the probability that a searcher will succeed in his search, given that he is at access level 0, 1, 2, and 3, respectively. Each of these probabilities is expected to increase with an improvement in the performance of the collection in response to known-item searches of users. Only the last group, *d*, which comprises 2n independent measures, provides an evaluation of the collection performance by item classes.

As library systems become connected to one another to form library system networks, it will be possible to keep track of interlibrary loan requests automatically and efficiently. The system can arrange these requests by item classes and provide them to library management in periodic reports. These reports can be extremely helpful in identifying the weaknesses in the collection as evaluated in light of the current needs of the library users.

5.1.1.3 Quality of the Collection

Evaluation of collection strength solely based on manifest demand by users has the following shortcomings:

1. It does not give credit to the collection for important items that are used infrequently. This is a significant concern for research libraries;
2. It may overemphasize transient topics of interest; and

3. It does not provide a measure of performance of the collection in response to user inquiries by subject. (See section on intellectual access in Chapter II for a discussion of why monitoring user searches is not very effective in measuring collection strength in the case of subject searches.)

For these reasons, it is important to complement the measures proposed previously with an objective measure of quality of the collection which can be obtained by using standard lists -- much like the ones that have been traditionally used in the past. However, in the presence of computerized library systems, these lists, once put into machine readable form, can be matched against a library's collection at little cost and effort. Professional societies and library associations need to cooperate to produce such standard lists periodically and make them available in machine readable form.

5.1.2 Accessibility of the Library Collection

In this section, methods of evaluation of the following components will be described, separately, for intellectual and physical access:

1. The success rate of users in locating items they need, given that the items are in the collection, and
2. The "convenience" experienced by users in searching for items.

5.1.2.1 Intellectual Access

The success rate of users at the intellectual level (*i.e.* the probability that a user will find the record of an item in the catalog, given that it is in the catalog) is difficult to evaluate automatically. Methods need to be devised to ask the user what he is looking for and then monitor his search to see whether he finds it or not. In the cases when he fails, the library staff need to conduct additional searches to determine if the searched record is in fact in the catalog. One way of accomplishing this is by having the system "survey" the users. The system can randomly ask some users to enter all they know about the records they are searching in a free-text form and then keep records of a few screens that are accessed immediately after. Library staff can review these data later and evaluate the success rate at the intellectual level. This method does not need to be used frequently. A reevaluation of the success rate of users is necessary only when there is a change in the following factors:

1. Searching capabilities of the system (*e.g.*, the existence or the lack of the capability for boolean searching),
2. Users' understanding of cataloging practice and the computer system, and
3. Cataloging rules and conventions used by the library, and the degree of accuracy with which they have been applied.

The "convenience" experienced by users at the intellectual level can be measured automatically by S, P, and t counters which were defined in Chapter IV. Similar to the success rate which was discussed above, this component of intellectual accessibility is not expected to change quickly, and the same three factors effect its change. Of course, t is also affected by a change in the system's speed in searching the catalog. The following measures are proposed for use in monitoring the convenience experienced by users at the intellectual level:

$$a) \quad \frac{P(I,K,Z)}{S(I,0,K)}, \qquad I= 1,2,3;\ K= 1,2;\ Z= 0,1$$

$$b) \quad \frac{t(I,K,Z)}{S(I,0,K)}, \qquad I= 1,2,3;\ K= 1,2,3,4;\ Z= 0,1$$

The first set of measures, *a*, show the average number of records inspected at each of the first two levels of access during a catalog search. The second set of measures, *b*, show the average time it takes the system to reach access level K from access level K-1. Distinct values for these measures are provided by search type and search result in order to indicate the problem areas more clearly.

5.1.2.2 Physical Access

Two conditions are assumed in evaluating the success rate of users (physically) locating the items that they need:

1. The item sought is in the collection; and
2. The user has successfully accessed the corresponding record at the intellectual level.

In Chapter IV, the methodology was described to evaluate the following set of indicators accurately and inexpensively:

C(J,U) - number of cases in which items that are accessed at the fourth level are in class J and have actual status U.

The values of the following set of measures provide a rather powerful tool to library administration in evaluating the availability of items:

$$\frac{C(J,U)}{\sum_{I=1}^{3} S(I,J,4)}, \qquad U= 1,2, \ldots ,m; \quad J= 1,2, \ldots ,n$$

These measures can indicate specific problem areas since they are distinct for items of different class and status. A good indicator of the level of user "convenience" at the physical level is D which was defined in Chapter IV:

D(L1,L2,J) - number of cases in which items of class J and location L1 are accessed from location L2.

The average convenience experienced at the physical level is represented by the following set of measures:

$$\frac{D(L1,L2,J)}{\sum_{I=1}^{3} S(I,J,4)}, \quad L1= 1,2, \ldots ,m; \quad J= 1,2, \ldots ,n; \quad L2= 1,2, \ldots ,m$$

In general, increasing values of these measures indicate that the items are stored further from those who need them. They are evaluated separately for each class, and storage and searching location combination. This way, they can point out to particular problems in the distribution of items between the branches of a library and/or between the libraries which participate in a network.

5.2 MEASUREMENT OF LIBRARY USE

As noted earlier, measurement of the use of a library is simpler than evaluating its potential capability to serve. The following indicators which were defined in Chapter IV provide a precise tool to measure library use both by circulation and by in-library reading:

B(J) - number of class J items that are checked out.

H(J) - number of class J items that are renewed.

E(J) - number of class J items which are reshelved.

G(J,N) - number of class J items that are checked in after having been in circulation for N days.

The system can provide the values of these indicators for any given time range. (This can be useful to the administration in other ways than measuring the volume of use. For example, B and H, plotted for hours of the day, and for days of the week, will show the distribution of the circulation workload.) Quarterly or annual values of B, H, and E yield strong indications as to the level of library use.

The interpretation of G is somewhat more difficult; it requires that the relationship of the actual use of an item and the length of time it stays on loan[18] be known. Without such knowledge, a change in the average borrowing time period may be evaluated based only on intuition.

It should be noted that although B, H, E, and G have a high degree of precision, their accuracy is based on the assumption that an item which is loaned for circulation or removed from its location in the library is *used*, and furthermore, that each such use provides the same amount of benefit. Although one may be discouraged thinking how misleading such an assumption may be, it may help to remember that libraries have evaluated their performances based solely on rough *approximations* of B and H for decades, and most still do.

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[18] This is as yet an unresearched area. Metz has expressed the need to investigate this relationship and has suggested a methodology that can be followed in such a study[49].

Chapter VI

SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

The objective of this study was to develop methods for the evaluation of library service effectiveness in the presence of an automated library system. A requirement was that these methods be practical and inexpensive so that they could be employed routinely.

In Chapter II, an analysis of library service was presented along with the traditional methods of measuring library service effectiveness. In Chapter III, an automated library system model was described. This model was used as a basis for the various methods of measurement developed in Chapter IV. In chapter V, the proposed evaluation methods were presented in the framework of Chapter II, and based on the measures obtained in Chapter IV.

It is interesting to note that library service effectiveness measurements which once were so cumbersome, slow, and costly are now not only practical and fast to obtain, but virtually free. This is because they come as a "by-product" of automated systems which many libraries need to keep their operations running efficiently.

The evaluation methods developed in this study take advantage of the presence of an automated library system in the following ways:

1. By having the system monitor the catalog searches and record data about the "convenience" and the success rate of users;
2. By having the system "survey" the users, randomly asking them questions and accepting free-text responses from them;
3. By having the system monitor interlibrary loan activity, and collect related data;
4. By having the system collect circulation statistics as items are checked-out, renewed, and checked-in;
5. By having the system collect in-library use data as items that have been removed from the stacks are "checked-in;"
6. By having the system collect circulation history data on each item, and use this data to generate stratified random samples from the catalog;
7. By having computer programs scan the system's database to collect quantitative, as well as circulation history data, and report them by item classes; and
8. By having computer programs read (standard) bibliographic lists, compare them with the library's collection, and prepare reports.

6.2 RECOMMENDATIONS

Undoubtedly, in the future, the methods of evaluation described in this study will be replaced by more sophisticated ones. As automated systems become more capable and experience with these proposed methods grows, library service evaluation will become more efficient, precise, and complete. It is important to note that data collection is no longer the difficult part of the evaluation. The difficulty now lies in data interpretation. Therefore, research directed to answer the following questions will have profound contributions to the evaluation of library service effectiveness:

1. How much "benefit" is obtained from an item when it is borrowed, or when it is read in the library;
2. How does the amount of this benefit depend on who the user is, what the item is, and how long it stays on loan? Conversely, how much "loss" is incurred when a needed item cannot be located, or when it cannot be located immediately;
3. How does the amount of this loss depend on who the user is, what the item is, and how long he has to wait for it; and
4. Are the costs and benefits that are incurred by users always relevant to the library's purposes?

This general area dealing with the measurement of benefit to users needs to be researched and the results need to be integrated into the evaluation methodology. This is of major concern for two reasons:

1. If the "benefit" of each use was measurable, it could be incorporated into the evaluation to "weight" each use of the collection. This would make the evaluation more accurate.
2. As noted in Chapter I, the purpose of performance evaluation is to induce improvement. Improvements generally require various resources which have well defined costs. Also, it will help the library administration to know how much "benefit" a certain improvement will bring about, and how much "loss" is incurred without it. Otherwise, the management of the library budget will always remain an art.

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