DOCUMENT RESUME

ED 057 813   LI 003 302

AUTHOR   Evans, G. Edward; Borko, Harold
TITLE   Effectiveness Criteria for Medical Libraries. Final
                Report.
INSTITUTION   California Univ., Los Angeles. Inst. of Library
                Research.
SPONS AGENCY   National Library of Medicine (DHEW), Bethesda, Md.
PUB DATE   Apr 70
NOTE   67p.; (90 References)

EDRS PRICE   MF-$0.65 HC-$3.29
DESCRIPTORS   *Cost Effectiveness; *Evaluation Criteria; *Library
                Services; Library Surveys; *Medical Libraries; *Use
                Studies

ABSTRACT
        The objectives of this study undertaken for the
National Library of Medicine were to develop a list of issues and
criteria that relate to the problem of measurement of medical library
effectiveness. The procedure employed was to review the literature on
the subject of library evaluation. Each criterion or measure of
evaluation encountered was placed on a list of criteria and examined
in terms of its potential significance and validity for measuring
library performance. The first section of this report contains a
discussion of some of the factors involved in measuring library
performance and an outline of existing evaluation methods. The second
section is devoted to discussing individual studies and the
evaluation criteria that were used. In the third section areas in
which it is believed additional research will produce sound method(s)
of evaluating total library performance are discussed. The final
section is devoted to the analysis data from the University City
Science Center's "Final Report - National Survey of Medical School
Libraries." (Author/NH)

EFFECTIVENESS CRITERIA FOR MEDICAL LIBRARIES

By

G. Edward Evans

and

Harold Borko

FINAL REPORT

Proposed under a grant from the National Library of
Medicine and the Southwest Regional Medical Library
(UCLA Biomedical Library).

(1 GO4-LM 00718-01)

April 1970

Institute of Library Research
University of California
Los Angeles, California

1

TABLE OF CONTENTS

ACKNOWLEDGMENT

EFFECTIVENESS CRITERIA AND MEDICAL LIBRARIES

1.0 INTRODUCTION

Today, as always, libraries of all types are confronted with a number of problems involving an assessment of their performance. Some of the problems relate to the evaluation of services or functions for which there are no reliable methods of measuring the quality of service or function. One fundamental problem is that none of the current evaluation methods seem to consider total library performance as critical to making a valid evaluation. Another problem is that most of the present evaluation methods are not completely acceptable to either librarians or non-librarians because none of the methods seem to be sufficiently sensitive to both quanitative and qualitative factors of library service.

This is a report on a study undertaken for the National Library of Medicine*; the study objectives were to develop a list of issues and criteria that relate to the problem of measurement of medical library effectiveness. To the extent it was deemed appropriate other types of libraries were considered as there exists a rather broad common bond between all types of libraries. The procedure employed was to review the literature on the subject of library evaluation. Each criterion or measure of evaluation that was encountered was placed on a list of criteria and was examined in terms of

---

its potential significance and validity for measuring library performance.
The purpose of the listing and examination was to aid in the process of
defining areas of needed research and to recommend areas where work could be
conducted with some expectation of good results and high returns. In
addition, the study conducted an analysis of a recently completed medical
school library evaluation project carried out for the National Library of
Medicine by the University City Science Center. This work involved some
additional statistical analysis of the UCSC data.

In the first section of this report, we discuss some of the factors
involved in measuring library performance and outline existing evaluation
methods. The second section is devoted to discussing individual studies
and the evaluation criteria that were used. In the third section we discuss
areas in which we believe additional research will produce sound method(s)
of evaluating total library performance. This third section is without
doubt highly subjective and open to question; however, if these suggestions
generate some debate and some work, they will have served a useful purpose.
The final section is devoted to the analysis data from the University
City Science Center's Final Report - National Survey of Medical School Libraries.

1.1 Factors in the Evaluation of Medical Libraries

In order to accomplish the objectives set forth in the proposal to the
National Library of Medicine, the authors examined over five hundred articles,
books and abstracts relating to the evaluation of libraries. Perhaps the
most surprising aspect of the literature review was an apparent lack of
concern with the how or the why of the evaluation process. It would seem to
be self-evident that any discussion of library performance should be prefaced

by a discussion about what aspects are to be evaluated, how they were selected and why they are to be evaluated. There are a surprising number of reports and studies on the subject of evaluation that fail to make it clear just what the intended purpose was, and as a result, confusion arises over the interpretation of the results.

Another rather surprising finding was the lack of concern about the total service program of a library. Most of the studies, with presumably sound reasons (although seldom spelled out) confine themselves to one or two evaluation criterion as applied to one or two service functions. While no single study can cover all services, some attention should, in our opinion, be given to the matter of how the services studied or evaluated fit into the total service program of a given library or type of library. In general this total service concept was lacking, and so it was difficult to determine whether the criterion was appropriately selected and employed.

It was also notable that those few studies that did concern themselves with the full range of services all failed to consider one rather basic function of all libraries. In the very broadest sense the library's main function is that of dissemination; however, in terms of usual considerations the library has two functions: immediate dissemination and conservation for later dissemination. None of the studies examined concerned themselves with the question of conservation. While it may be true that only the large teaching-research-regional medical library may need to be significantly concerned with conservation, all libraries must have some concern about the matter. In general all the material acquired by the library, even the small special library, is housed in the library because there is some expectation

-3-

6

that the material will be used and used by a number of different people over a period of time. If this were not so, the material would simply be given to the person requiring the information in much the same manner that a good deal of the inter-library loan materials (photocopies) are now handled. The point being made is that many methods of evaluation place a high premium on the performance of a service or function that is or may be detrimental to the conservation of the materials--an equally important library function.

Perhaps the clearest example of the above problem is in terms of reader accessibility to materials. Most libraries assume open stacks are important in allowing the greatest possible use of the materials. Open stacks store books in an environment that is most comfortable for people (a 65-70° temperature with 50-60% humidity and ample natural or artificial light) and most detrimental to the documents. In a closed stack situation the materials could be stored in conditions that would slow down the chemical and bacterial action that destroys most of the present day papers. It is also possible that such a move would not change the performance of a library, especially if the performance were evaluated in terms of response time. An example of this would be the Document Delivery Test (DDT) of the UCSC study. In this test, a premium is placed on response time and any document not on the shelf at the time the test is given lowers the library's performance score. In a closed stack situation fewer items would be misshelved or in use with no record of who is using it or where it is being used. Items in the categories "missing" or "can't locate" are given a long response time score in the Document Delivery Test, thus in this case, a high DDT score is positively correlated with conservation. There are a number of questions

about the usefulness of such a test and some of these are discussed in a
later section (4.0).

One of the most comprehensive projects on library evaluation was
conducted for the Army Technical Libraries by the John I. Thompson Company
during 1966, 1967, and 1968.* This project conducted an extensive literature
search up to 1967. The ATLIS investigators came to the conclusion that
most studies had focused on one or two factors and ignored the implications
for the total system. Our work carrying the literature search up to
January 1970 indicated that the situation has not changed. However, even
the ATLIS studies, though they are rather comprehensive, do not consider
the conservation aspect of the problem. Admittedly the special-technical
library is the least likely to have to consider this problem. We will
return to this matter later in the section on needed research.

Our literature search revealed that most studies of library performance
concentrated on one or two service functions. Only a very few studies
attempted to review the entire scope of library services and those that did
ignored one or two areas of concern. (It also indicated that no study
examined the question of conservation as an issue, or factor, in library
performance.)

2.0 STUDIES OF LIBRARY PERFORMANCE

Shortly after starting the literature review it became apparent that
if we tried to set up a separate category for each slightly different method
of evaluation, we would need one category for each study examined. In

---

* Wessel, C. J. Criteria for Evaluating the Effectiveness of Library
Operations and Services. Atlis reports 10, 19, 21. Washington, D. C.
John I. Thompson and Company, 1967, 1968, 1969.

order to provide the reviewers with a framework to organize their work a
list of about sixteen measures was developed. After the review was finished,
it became rather clear from the material covered that there was still a high
degree of overlap. Because of the overlap we decided to further reduce
the list by considering only the methods of analysis that were employed.
By this means, we drew up a list of six "basic" criterion of library
performance or effectiveness. The list given below represents the order
in which we will present the discussion of the individual studies.

Basic Criterion for Evaluation Library Performance

I.   Accessibility*

II.   Cost

III. Use

IV.   User Satisfaction

V.   Response Time

VI.   Cost-Benefit

In the ensuing pages we will discuss some of the studies that have
either used or suggested using one or more of the above measures as a method
of evaluating library performance. A research study is considered under
as many topics as necessary. At the end of each unit there will be a
discussion of the measures listed in that section and some indication of
their research potential. The discussions are not intended to summarize the
results of the reported study or its methodology. Our only purpose is
to analyze the problems and potential utility of the various measures that

---

* See section 3.0 for discussion of specific measures included under each
  basic heading.

have been suggested. The use of citations to specific studies is merely to document the sources for measures discussed.

Evaluation studies of library services are generally concerned with reader services rather than technical services. Studies of technical services seem to be considered matters of internal concern. Nevertheless, there have been a number of studies conducted on various aspects of technical service work. In many ways technical service studies point up a basic weakness noted for all evaluation studies; that is, they are not concerned with the question of what will happen to reader services as a result of changes in technical services (i.e., they are not concerned with the total library operation). Studies evaluating services may be considered as being one of two types; a) how efficient the organizational pattern is in terms of the various operations required to carry out the library objectives, and b) how efficient or effective the staff is in providing the services or performing the required tasks to meet the library objectives. It should be noted that almost without exception none of the studies seem to be concerned with determining what the goals or objectives are and how important each one is or the degree to which a specific service achieves a specified goal. The ATLIS studies are an outstanding exception to the above generalization; however, even in that instance there is no attempt to determine the relative weight each service has in terms of achieving the library's goals. Specific studies of technical service operations will be discussed below as part of the detailed discussion of evaluation methods.

2.1 Accessibility

Accessibility to the library and its contents is without a doubt one of the most difficult criteria to measure. Of the criterion discussed, accessibility factors are the least often considered. There are two aspects to the question of access: (a) physical access to the library and its materials, that is the ease with which one may determine if a particular document is in a collection and where it is located, and (b) to what class of user is a given service available. To a large extent studies of the organization and form of the public catalog are accessibility studies, although they are seldom considered in this light. In order to measure physical accessibility in a quantitative manner, it becomes necessary to consider response time, but as will be noted most studies that discuss this problem fail to take this variable into account. At the same time most studies that deal with problems of response time fail to consider the problem of who has access to the service. A total approach to even one segment of the problem of evaluation of library performance seems to be the exception rather than the rule.

The problem of location and availability of materials has been explored by Bush and Morse (1956) by gathering data on cases of failure to meet demands for material held by the library. A ratio of materials used to materials demanded was the criterion employed to determine effectiveness. The information on failure to meet demands was strongly influenced by the location of the materials and the length of the loan period. In essence the study was concerned with accessibility of the materials collection. There was also some consideration of the time delay in gaining access to the materials and as such was one of a notable

-8-

11

exception in that they did consider the problems of response time. As with all the criteria discussed there is an overlap, in this case there is a very clear element of user satisfaction that should be considered. Again, this points out the need for a total approach to the problem of performance evaluation.

In discussing accessibility, Fussler (1961) calls frequency of use the major factor in producing increased efficiency in the organization and housing of materials. Fussler (1951) considers accessibility essential and suggests a better understanding of readers' needs and working methods is the only manner by which a library will be able to improve user access. In other studies the criterion for evaluation is the ratio of the number of books to the size of the user population. This method was proposed for use by the U. S. Office of Education in choosing academic libraries to receive grants in aid. Clapp (1965) argues that minimum adequacy of academic libraries can be measured by the number of volumes, and, considering such variables as student body size and composition, faculty size, cirriculum and campus location, he develops formulas for estimating the number of books required. In an article on college libraries, Weber (1957) suggests that ease of access and the number of successes achieved is more important for evaluation purposes than the volume count. The underlying assumption in studies of this type is that each user should have access to a minimum number of documents. Weber points out the problem of employing this concept is that the number of successes is more relevant for evaluation than mere volume counts. Of equal importance or perhaps even greater is the question of quality and relevancy. Access to a million volumes will

be of no use to a patron if the million volumes are not of interest to that person, even if he can receive any one of the million documents in a fraction of a second.

Another factor of importance to the above discussion is the class of user who is given access to the documents or services being evaluated. Very few studies have made any attempt to explore this problem area. One study that concerned itself with this, and a wide range of other services, and the patron groups that received these services, was the Orr, et.al. (1968c) study. This is one of the few studies that relates specifically to the medical library situation. Their measure of effectiveness is called the "Standardized Inventory of Library Services". An attempt is made to create a scale that will allow the library to assess its services in terms of what the official policy is and to provide a means of comparing the results between institutions. The method suggested for scoring the inventory is based upon having a number of people allocate points on the basis of personal opinion as to the value of a given service. User satisfaction would seem to be the criterion of evaluation that is being suggested in this study. Yet what the study reveals is the degree to which various user classes are given service. Until such time as the full text of the ILS is published, one must withhold any true evaluation of their technique (see Section 4.5 for a discussion of the ILS as reported in the UCSC Final Report).

It seems very clear that there is need to consider the question of accessibility in the process of evaluating any library. To ignore the matter as so many studies have done is to bury one's head in the sand.

Rapid response times, low costs, high use rates, good cost-benefit ratios, and great user satisfaction may not be a reflection of the ideal library performance goal. A situation such as just described could probably be achieved today in more than 99% of the existing libraries without an increase in their budgets. Obviously there is a missing element in the above formulation and that is the matter of accessibility and who and what is to be serviced. Libraries could achieve rapid response time, for example, at the expense of cutting back on services to "marginal" users and for "marginal" materials. There has always been the problem of determining potential and marginal users and most libraries do very little in this area. Therefore any system of performance evaluation that ignores the question of accessibility, or at least availability, will only compound the problem by encouraging program administration to concentrate upon the achievement of the optimum performance for the known factors, and thus in fact sub-optimize the total system performance.

2.2 Costs

There has always been a concern with the problems of cost control in the library. Yet throughout most of the history of library development, librarians have approached the problem of cost analysis in a most elementary and timid manner. Much of the reluctance can no doubt be attributed to a lack of training in cost analysis on the librarian's part and a lack of concern over the level and significance of dollars being expended on the part of library control boards and the general public. It is only recently, when the level of expenditure rose sharply, that any real concern was demonstrated on anyone's part about unit costs and cost control. The

question of cost control and library performance evaluation are clearly connected. Fortunately, most cost factors are relatively easy to identify and quantify.

The literature contains a great many general cost studies and most of them cannot be employed directly in evaluating the performance of the library. The studies discussed are merely samples of the material that is available. In general the smaller and more standardized the analyzed unit is, the more suitable it is for use in evaluating the performance of the library through time or for comparing the performance of a particular task between libraries.

In order to determine more accurately the basic unit costs of technical services, Brutcher (1964) recommends using cost accounting techniques. Library functions are divided into cost centers for such services as ordering, cataloging, book selection, etc., with derivative figures showing the cost of having a book on the shelf is equal to the average purchase price plus the average cost per book processed. Risk (1956) outlines the means of applying cost accounting methods to the library and recommends measuring the total cost to determine what the output should be in terms of activities and personnel and using the standard work hour measure. While these cost figures cannot be used to evaluate a library, they are useful in determining the efficiency of some operations and when used in combination with other criterion can begin to provide some insight into library performance.

Bouman (1951) points out that the value of a company library, or any other library, should not be based on production costs alone, but

rather on the replacement value. To establish the cost of internal
operations and provide a basis for future budgeting the Technical Services
Division of the University of Denver Library was studied by Wynar (1963).
In his summary of the results, time and cost factors on a per book basis
are given for the order department, cataloging department, and mechanical
preparations, with the total cost of preparing a new non-fiction title
averaging $4.33. Relating book funds to users, the Knox (1959) study found
that an average of $30 per professional user (in this case chemists) was
spent each year on materials. Niland (1967) attempts to develop a method
for evaluating budget proposals of libraries. Using multiple regression
methods he attempted to set up some standards of evaluating proposed
budgets and develop realistic requests. Again none of these approaches
will completely solve the problem of evaluation; however, each one does
have some merit and in conjunction with each other can provide a reasonably
clear picture of the cost factor in library operations.

Another aspect of the cost picture that is often ignored is the
personnel requirements, especially when dealing with public services.
There seems to be a great reticence and reluctance to put a "price tag"
or unit cost figure on public service activities. Admittedly the "value"
of the service is difficult to measure, and the unit cost figure may be
high which may create some problem in "demonstrating" the desirability
of such a service. However, other variables, such as the quality of a
collection, are studied and occasionally even from a cost point of view.
In any case, any method of evaluation or standards of service that specify
or suggest certain skills, abilities, training, etc., carry with them some
basic cost factors that should not be ignored.

Many studies have focused on the number of staff required and the qualifications, special training or skills needed to perform a service adequately. It is generally recognized that an arbitrary number of staff members cannot be set but must depend on the kind and scope of service provided, the content of the collection, and the size of the organization served. The ALA College Library Standards prescribe a minimum number of professional librarians with additional hiring determined by size of population served, type of library organization, size and character of the collection, prevailing community interests, number of hours the library is open and arrangement of the building. In 1964 the Special Libraries Association suggested a ratio of 2-3 non-professionals to every professional library staff member. In a criticism of the SLA standards, Randall (1965) recommends a ratio of one staff member for every 100 potential or 75 actual library users. In considering the qualifications of library staff, there is agreement on such requirements as graduation from a library school for professionals and suc'. generalities as loyalty, modesty, and the ability to work with people. Brophy (1960) summarizes two personality studies and discusses the attributes of a model librarian. He suggests the creation of work situations to fit individual abilities. Others have defined staff qualifications as the skills necessary for performing out-lined responsobilities. The duties of a reference librarian are listed in Hufford (1950) who suggests that continued schooling and active member-ship in professional organizations as a means of improving skills. This approach requires giving time off from regular duties and thus increases costs. Sass (1950) presents definite qualifications in what he calls a

realistic approach to special librarianship. These include expert

knowledge of the sources of information and reference tools, training in

administration, a year course in acquisitions and cataloging, a subject

specialization and working knowledge of French and German. Other studies

have discussed the qualifications of the non-professional staff and .

suggested in-library training through the use of staff manuals. As

can be seen very little hard research has been conducted in the area

of the number and kind of personnel needed to perform a library service,

nor in the area of the type of skills and knowledge that lead to better

performance. Decisions are made on the basis of educated guesses.

In general the approach to evaluating performance in terms of cost

carries with it the assumption that the lowest cost figure represents

the ideal provided all other things are equal. To be perfectly blunt,

the rather primitive state at which the investigation of library services

now finds itself in does not provide a feeling that any investigator

can show that "all other things" are in fact equal. Cost analysis and

unit costs are valuable management tools and can, if used alone and

with available data, be used to evaluate a small segment of a given

process. The writers believe that the more effective way of using the

cost criterion for evaluating overall library performance is as part of

a comprehensive weighted system employing all the evaluation criterion

in the form of a thorough cost-benefit analysis or its equivalent.

2.3 Use

Utility has been employed as a measure of library performance for

some time. The level of sophistication in the nature of the units of

use considered up until recently has been very low. Normally the unit employed is the number of documents circulated. Occasionally the number of registered borrowers has been used. As the number of circulations or borrowers increase, the level of performance is assumed to also raise. Recently a number of new approaches have been employed that represent a great improvement in evaluating the validity of the use criterion.

One approach to measuring library performance is through examining the use it receives. A library with materials and services designed to meet the users' needs (there are some that are primarily archival-museum collections) is not effective unless it is used. Use studies have been conducted in a number of areas and for a number of purposes. In evaluating utility, per capita circulation is often mentioned as an indicator of the effectiveness of the library system. A study of circulation patterns at Arnold Engineering Development Center (Randall 1956) showed a ratio of one actual user to four potential users and a direct correlation between job complexity and library use. An elaborate five-year survey of a technical library (Strain 1965) serving 4,000 people yielded a ratio of one actual user to two potential users, as well as the months of high and low circulation points, circulation-collection ratios and the average number of books on loan at any one time, all indicators of utility. Although intended for other purposes Steig's study (1942) and Trueswell's (1965) work have been used by some people to evaluate overall performance. Both studies are concerned with the degree and frequency of book collection use.

Looking to the future, Morse's (1964, 1968) study of the MIT Science
Library attempts to predict through circulation figures, the amount of use
the library will receive. The major work (1968) is a very detailed study
relating to library effectiveness and use. An operations research
orientation is employed throughout the book and so many librarians will
have difficulty in applying the very useful evaluation-decision-making
models that are supplied.

In a criticism of the 1964 SLA standards, Randall (1965) proposes
that the ratio of circulation to acquisition should be six to one, and
that the circulation figures should be equal to 90% of the total collection
and there should be a yearly circulation rate of 20-30 items per user.
In evaluating with circulation figures, it should be remembered that
in-house use of the materials is not usually included. A good summary of
work in the methodology that may be employed in conducting use studies
can be found in the Lehigh University (1965) report. The Middle States
Association of Colleges and Secondary Schools (1958) in an article on
what criteria should be considered in evaluating libraries says that the
use of the library is the ultimate test of its effectiveness.

Use of the individual collections has also been employed to determine
the relevance of the collection to a user needs. This in turn is considered
as a measure of the library performance capability. Evaluation of materials
on the basis of use has been applied to the problem of weeding by Trueswell
(1964, 1965, 1966, 1969). Using quantitative methods, Trueswell has
considered the last circulation date as an indication of circulation
requirements and shown that holdings might be reduced by 60 to 70% and

still satisfy over 99% of the users' requirements. The assumption is a
smaller active collection would be easier to use and cost less to
maintain (better performance).

In a description of a special library's weeding policy, Bedsole (1958)
lists circulation data as one of the criteria to be used. In this study
he describes a policy of weeding out any book not borrowed in the last
seven years. Several others have employed the last data used approach;
Fussler (1961), Lister (1967), Trueswell (1965), and Jain (1965). In the
Bush (1956) study, the measure of effectiveness chosen was the ratio of
material used to material demanded. Material used was material borrowed
plus material consulted in the reading room and material demanded was
material used plus material unavailable. The library was found to be
89% effective by this measure. Two factors must be considered when
evaluating this approach: a) a large number of requests are the result
of a very few users, and b) at best this reflects only successful search-
use patterns and does not reflect users who failed in their search.
Again, as we pointed out earlier, it is relatively easy to reduce cost
or increase use, but in so doing, will the library still be able to provide
the full range of library services?

Another approach to partially evaluating the collection and the
library on the basis of use is described by Cole (1958). This method
employs an analysis of the reference questions asked including both those
answered and unanswered. Such an approach will clearly define the active
users' needs and can be used as a partial guide to collection development.
One would need to be extremely cautious about evaluating the library's

performance from these data. There would always be an element of doubt

in that only active user needs would be apparent and even these

users may only ask some of their information questions of the library.

There are several other studies relating to use that should be noted.

Of these the Meier (1961) study is most interesting. Unfortunately, the

published article fails to provide enough data to make a completely

adequate evaluation of his method. It seems likely that a good deal of

the basic input for the University City Science Center's Document Delivery

Test was drawn from this source. In his study, Meier approaches the

problem of use from a more total library evaluation point of view than do

most other studies encountered. In addition, Meier recommends inter-

library comparisons with the use of his item-use-day unit. His explanation

of this unit of measure shows that it is operational, has minimal ambiguities,

can be agreed upon by similar institutions and can therefore be used for

comparison. Another unit of measure proposed by Ohlman (1965), although

not suggested for comparisons, is the activity ratio obtained by dividing

the number of potential transactions completed during one month by the

number of potential transactions available at the end of that month.

Schutze (1952) also suggests using circulation figures and user classification

by type as a basis for new book selection or duplication.

There are a number of problems that arise from the employment of the

use criterion to measure library performance:

a) it fails to differentiate between types of use (significant and
   non-significant)

b) it does not include "in house" use, for such data cannot be
   collected without employing expensive data collection methods.

c)   it is susceptible to radical variations as a result of a
     change in use patterns of a small percentage of the total
     user population if this group is in the very active user category.

d)   it fails to reflect any information about the potential users
     who have either not attempted to use the library or who have
     given up as a result of repeated failures to satisfy information
     needs.

With all its drawbacks, the use criterion is the only criterion that

begins to provide a completely objective measure of the total performance

situation. Costs are objective, but they fail to relate the relevance of

the performance to even a portion of the user population. Cost-benefit

analysis appears to be rigerous and objective, but is frequently forced

to use subjective benefit factors such as a user satisfaction criterion.

Response time is also an objective measure but like cost analysis, it

fails to provide the evaluator with information on relevance. Thus

use, while not terribly satisfactory, can be considered at least a partial

index of relevance and of a library's ability to provide needed services

to some portion of total potential user population.

2.4 User Satisfaction

As indicated above, measuring user satisfaction is a highly personal

process. Because of the subjective nature of such a criterion, one must

be very careful about drawing conclusions about the performance of one

or several libraries that are too sweeping in scope. Within the broad

heading of user satisfaction, there are two distinct sub-groups to be

considered: (a) user satisfaction with existing services and materials,

and (b) attempts to determine user needs for services and materials not

presently available.

Libraries have always attempted to evaluate their document collections
in some manner; we have already noted the efforts to determine unit costs
for materials and the studies that evaluate the collection in terms of
use. Another method that has always had wide currency has been in terms
of comparing a particular library's holdings to some "ideal" value or
list. We decided to place this type of study under the broader category
of user satisfaction rather than accessibility primarily because of the
manner in which the results of such studies are most frequently used.
That is the results are usually made known to the patrons and they are often
asked to note items on the list that were not held but which should be
purchased. It is possible, although it seldom happens, that some of the
items that were not held are not desired. In this way the users, or at
least some of the users, are able to indicate their satisfaction or lack
of satisfaction with the library's holdings.

A survey article by Hirsch (1959) describes four methods of evaluating
a collection: 1.) the impressionistic method usually done by scholars,
2) the checklist method, 3) on the basis of circulation and use data,
4) comparison of expenditures for materials with expenditures of other
institutions. A common technique is the comparison of library holdings
with a list of "ideal" holdings in a certain field. Examples of this
approach are Emerson (1957) and Downs (1942, 1965, 1966); although these
studies were undertaken for different purposes, the method was the same.
The evaluation of the collection was made in terms of the percentage of
items held when a bibliography is checked against the catalog. The
publication source, language distribution and time span of the citations

may also be analyzed and the library holdings are checked against the list as a measure of adequacy. Similarly, Maizell (1960) recommends as a measure of the quality of the technical library collection, a comparison with published lists of key literature or citations in the most used journals, as well as a record of unfilled requests received by the library.

Impressionistic evaluation is seen in Anderson's (1965) study of a multi-level file structure where subject specialists examined a random sample of documents drawn from a larger number to determine the reliability of the file, i.e., the collection. Many studies have been done on the relevance of the retrieved documents to the user of an information system; for example, Cleverdon (1958, 1959, 1962, 1964), Bornstein (1961), Cuadra (1964). The value of these studies lies in testing the efficiency of the indexing system, although the same methods can be used in the evaluation of materials. However, several fundamental questions remain unanswered. Foremost among these is what is relevant, and does that definition adequately serve all users? We, too, leave these questions unanswered.

Determining user requirements is most important as an aid to selection, weeding and evaluation of materials. Scientists' attitudes and methods of gathering information were examined through questionnaires and surveys by Allen (1966), Atherton (1962), Bare (1966), Bourne (1961), Lehigh University (1965), and Tomlinson (1965). All studies in this group were oriented towards basing a collection on demonstrated user needs. Bach (1957) also analyzed the information needs of scientists by noting

the number of journals required, the age and language of journals. He
also differentiated between pure and applied scientists. In these studies
the question to be answered is how well are the known needs being met?

Classifying users by type is another approach toward identification
of the potential collection requirements and for meeting user needs.
Bernal (1960) describes this method, considering user function as the
determining factor; he distinguishes between the researcher, the practical
user, the user writing articles, the science historian and the chance
reader, each type requiring a different kind of material. Slater (1963)
does the same for an industrial library, noting the research methods
used. General criteria for judging the value of a piece of information
in technical library materials selection were delineated by Mayo-Wells
(1964). These included currency, authenticity, reliability, assimilability,
credibility, completeness, all subjective assessments made by the staff.
Although none of these studies provide specific criterion for the evaluation
of library performance, they do provide some indication of how one may
begin to isolate user groups and define user needs.

The effectiveness of the service or work performed by professional
and non-professional personnel can be measured in terms of goal achieve-
ment and user satisfaction. The degree and types of services provided by
the library should be chosen because they achieve a given goal or level
of user satisfaction most effectively. A special library will naturally
offer more bibliographic services such as literature searches, preparation
of abstracts and bibliographies and translations than is possible for a
public or college library with a much larger and more general clientele.

Most recommendations for the amount and kind of services are based on
user needs and wants; problems often arise first in determining wants
and needs and then publicizing the availability of services when they are
provided. Pundsack (1955) suggests a library committee of users to
improve communications and suggest improvements along with talks and
brochures by librarians. Such a system would at least provide a formal
channel for determining wants and needs. A typical study is the one done
by Shank (1959) where members of the academic research staffs at Columbia
University were surveyed as to their opinions on the location of technical
reports and the provision of current awareness services. The various
user requirement studies mentioned have also been used to determine levels
of service.

There must also be ways of measuring the effectiveness of the services
offered in order to give the staff some feedback. Bare (1966) suggests
a neutral survey team and to ensure wide participation the survey questions
should be capable of being answered with yes or no responses, request
demographic data, and include some personal interviews. A computer
operated system (SURF - Support of User Records and Files) is described
by Wallace (1966) as a means of identifying current user requirements and
providing feedback in a technical library. In a proposal by Hattery (1963),
continuous feedback relating to user satisfaction is suggested as the
ultimate criterion for planning. By extension then the ultimate criterion
of library performance would be the degree to which user needs are met.
Conversely, Taube (1959) claims that the effectiveness of a scientific
information service cannot be measured by consumer acceptance since the

service is professional rather than consumer oriented. He reviews the
literature on use studies, both qualitative and quantitative and concludes
that none of them provide any prescriptive criteria.

Employment of the user satisfaction criterion to measure library
performance creates certain fundamental problems that cannot be completely
avoided.

(a) There is always a strong subjective element in such an evaluation,

(b) There can be very few if any comparative studies done employing
user satisfaction criteria unless very expensive testing is
first conducted on the test instrument, because individuals
may interpret the scale or values used to indicate degree of
satisfaction in different ways,

(c) There is always a question of defining what is relevant and
the universality of such a definition,

(d) There is always a problem in getting a representative sample
of actual and potential user to respond to any survey questionnaire.

Nevertheless, user satisfaction must be considered one of the primary
measures of library evaluation. There is a great deal of consensus that
the ultimate test for any library is user reaction and satisfaction, and
regardless of any other measures, if the users reject the services and
materials offered, the library must be considered a failure. User
satisfaction is an adequate criterion of effectiveness only when it is
employed with a full understanding of its limitations and in conjunction
with other criterion.

2.5 Response Time

The use of response time as a measure of library performance is a
relatively new development. Its use is increasing as many investigators

view this as one of the more objective measures and one that is subject
to easy quantification. While response time can be measured, there is a
great deal of room in which to vary the points at which to make the time
measurement and for that matter whether or not to use real, elapsed,
or some "average" time for different situations. As with the other
criterion it is possible to use this measure in several different ways:

(a) To measure the time required to secure a copy of a specific
document,

(b) To measure the time required to secure a specific piece of
information or have a given service performed.

In a fairly comprehensive study, Monroe (1962) indicates that methods
of evaluation should be based upon a determination of a) library objectives,
b) services rendered, and c) the procedures employed in providing the
services. In order to evaluate any service in terms of the above, Monroe
suggests using the response time of the operations involved as the best
measure. As with so many studies or suggestions for studies this idea
has some merit but will not do the entire job. One must question whether
response time is equally important to the performance of each operation
and to what extent other factors enter into consideration?

In the case of journals, a shorter response time and increased
circulation has been recorded in special libraries by Kopkin (1955) and
Randall (1954) by first routing the tables of contents, then the requested
magazines. The delay in response time caused by the circulation process
has been discussed by Elvers (1962), the time lag in book returns being
mentioned as one of the problem areas. Circulation service would seem
to be an area in which response time would be of primary interest for

evaluation purposes. Mathieu (1959) observed with a stop watch some operations in a newly established documentation center, then compared the times for filing, classifying, abstracting, etc., with other documentation centers. In this case, time was a criterion for the performance of a manual task rather than overall library performance. In the case of current awareness service being measured in terms of response time, we see a not infrequent occurence in evaluation of library performance. That is, a valid criterion of performance is employed, but no consideration is given to the question of how important that particular criterion is to the service performed. The problem is that for the above examples there is really a question as to whether performance and service has been increased by decreasing response time. Circulating a list of titles of articles rather than journals will no doubt reduce the time factor but as anyone with even limited experience knows, the titles of articles are not always indicative of the content which would cause more requests for items to examine the content. Is that really a step forward in improving current awareness? Response time is important but if all the criterion of performance were applied to that service, it seems likely that in a weighted value system, response time would receive one of the lower weights.

Another approach considers response time versus utility, services or hodlings as a measure of library effectiveness. Anderson (1965) and others have used simulation techniques allowing manipulation of the operating variables of a system to measure performance. In defining elements which can be measured in a simulation model, Blunt (1966)

includes the time lapse between the statement of information and reception of output as a measurable indication of the system's effectiveness. This is basically what is involved in the Orr (1968 b) study and in the Wessel (1969) proposal to use document delivery time and elapse response time as a measure of performance.

Data gathered by Bush (1956) in cases of failure to meet demands for materials provides information on the suitability of the loan period, the efficiency of the internal processing required for each item, and the extent to which the distribution of library materials among branch libraries causes a response time delay. The basic assumption is that a delay is undesirable and reflects poor performance. There would be reason to question such an assumption in some cases, i.e., delay for one class of user may result in greater accessibility for another class of user, again reflecting the need for a means of applying all the relevant criterion employing some weighting system that reflects the criterion's importance to achieving a specific goal.

Thompson (1962) argues that the real value of information lies in its availability to the user when he needs it. He expresses the value of the information as a function of time, e.g., as a ratio of the time required to make the information available to the total time it would be of value after a need occurs. While this idea has a very basic appeal, one must be careful about accepting it too readily. The primary flaw is that in reality, the system is concerned with user satisfaction although everything is based on a time factor. The only way to determine the length of time the information is of value is to ask the user. An experienced user would

not be willing to commit himself too strongly on the time factor unless
(1) he is very certain he has to have the information, in which case
access and not time is the critical factor; or (2) he is fairly certain
that the information will not cause him to undertake radical changes.
In all other cases, which would be true most of the time, the user would
wish to see the information or document first before deciding on the time
value. What is likely to occur is that the information or document that
turns out to be not quite what was expected will be given a short time
value ("If I had known how poor it was I would not have asked for it. I
wasted a lot of time waiting for nothing."). By the same token, the "good"
information is worth waiting for in most peoples' eyes--if they cannot
have immediate access to everything.

While response time is a quantitative criterion of library performance
and has a high degree of objectivity when certain perameters are agreed
upon, it tends to be over evaluated as the measure of performance.
Although there is no evidence to support this suggestion, it seems quite
reasonable that most users would prefer to have access to more materials
than to reduce the number accessible and increase the response time for
those that are available. In theory, all medical libraries have access
to all the national medical resources and it is simply a question of how
long does it take to receive the material. In reality most people will
admit that this is not quite the case. Until such time that theory and
preactice are identical, to suggest that response time is the criterion
of library performance is to be unrealistic. There are other factors
that must be considered. User satisfaction may fall off even if response

time is improved if the system allows too many error factors to become operative. Costs would rise and could skyrocket to the point that the service would become uneconomical. Can a system based on response time alone be operative for all users, for all needs; it seems likely it could not because of the cost and the overloading that could occur in areas of high demand. As with the other criteria, response time is best considered as part of the total system of evaluation, with a weight assigned to the time factor comensurate with its value in achieving a specific goal or service objective.

2.6 Cost-Benefit

The final criterion to be discussed is a relative newcomer to the field of librarianship. Only a very few studies have been completed that have applied the term cost-benefit analysis to their procedures and have followed the procedures developed in business and government in applying this method. There have, in addition, been a number of less sophisticated studies of the type that can be considered cost-benefit analysis. Since these represent older studies, they will be discussed first. The section will conclude with a discussion of some of the more thorough cost-benefit studies.

Purdue University investigated the costs of providing library services to university researchers sponsored by outside organizations. Quatman (1962) estimated a ratio of costs for sponsored research to costs for undergraduate library service, then checked the figures in a 20-day survey period. The aim of the study was to determine if library allocations to user classes were equitable. This is at best a very

elementary cost-benefit analysis but it does attempt to examine costs

in terms of the service provided. A ratio of expenditures to users and

service has also been used to determine effectiveness. A cost study of

an industrial library (Taylor 1961) revealed that 32.6% of staff time was

spent dealing with inquiries and providing information - this accounted

for 28.1% of the library's total expenditures. Another approach to

library budgeting is based on services, by dividing the calculated costs

of all services into fixed and variable groups, Maybury (1961) claims that

an accurate picture of the library's needs will result. Performance

budgeting was instituted by the Washington, D. C. Public Library as

reported by Budington (1959); he believes that this method of concentrating

on the character of the work performed by each functional division has

more merit than simply listing costs under categories of materials and

services purchased. This method of budgeting requires a thorough knowledge

of the services to be performed and the amount of use that each service

receives.

Many researchers have attempted to approach library evaluation

through combining two or more of the measures. Recognizing that libraries

have very different specific missions, this approach does not in general

allow one to compare institutions but rather relates one aspect of

service in a particular library to another service in the same library.

This approach can be seen most clearly in the studies relating cost to

benefit. Comparisons between institutions are possible only when each

library employs identical systems which is seldom the case. However,

cost-benefit can provide some indication of the relative performance of

different libraries. Thorne (1955) evaluates a retrieval system in terms
of cost-benefit, where efficiency in the number of successful searches
is the benefit and a superior system is one which operates at the lowest
cost with the greatest benefit. However, there is no general agreement
on the definition of a successful search, a problem noted earlier.
While the method was used in a special retrieval system, it is of course
applicable to the library situation. In another study investigating the
value of a retrieval system, Mueller (1959) felt a library should strive
to achieve a minimum of a 1:1 ratio of man hour costs saved to the cost
of retrieving documents. He also compared retrieval costs with staff
consultation, another way of obtaining needed information.

Goffman (1964) measures performance in terms of effectiveness
divided by cost. Formulas are provided in order to show effectiveness
as a function of cost and time. For an indication of past purchasing
effectiveness, Hodgson (1959) presents a formula based on cost which
shows that too much material was borrowed on inter-library loan when it
would have been cheaper to purchase the requested items.

Other studies have compared the costs of two comparable methods of
operation. The benefit in such cases is a lower cost. An example of
this approach is Linder's (1965) comparison of document indexing and
book cataloging. Factors contributing to the greater cost of cataloging
are noted and the different functions of the two systems described.
In the same manner, the Library School at Rutgers State University (1966)
compared the operating conditions of three systems of information
retrieval; a punched card file, a handbook reproduced from that file,

and conventional cataloging-reference approaches to the same material. Cost was one of the criteria and was found to be much higher in terms of input and cost per use for a mechanized system.

A recent book by Raffel and Shishko (1969) is the most complete study of cost-benefit in an academic library setting that was encountered in the literature search. They start with a program budget for an academic library and then move through a series of different cost-benefit analyses for each of their basic programs. Clearly, there is much to he gained by using this method.

Cost-benefit analysis could be considered at least in theory, as the criterion of library performance. This would be possible, however, only if a large number of different benefits were considered (for example, cost-accessibility, cost-use, cost-user satisfaction, cost-response time). Within each such division there would have to be a number of sub-analyses in order to cover various situations. While cost-benefit seems to have a great deal of promise, it cannot get away from the subjective, imprecise, inconsistent, difficult to measure factors that create problems for most of the other criterion that have been discussed. The benefit can be almost anything--which in itself provides a great deal of room for the variation and slight modifications that make comparisons difficult if not impossible to make. For all of the potential difficulties, cost-benefit seems to be a very important criterion for measuring library performance.

3.0 SUMMARY OF LITERATURE SEARCH: MEASURES OF LIBRARY EFFECTIVENESS

During our literature review we encountered a variety of measures
that were employed in attempts to evaluate library performance. Most
of the measures we considered to be slight modifications of one of the
six criterion that we employed to organize our presentation. The complete
list that follows, indicates the variant and specific measures that have
been included under our more general heading.

I. ACCESSIBILITY

    1. Number of services and degree of services provided various
classes of users.

    2. Ratio of services requested to services available.

    3. Ratio of holdings to total user population (actual and
potential).

II. COSTS

    1. Staff size.

    2. Staff skill and characteristics.

    3. Unit cost.

    4. Ratio of book budget to users.

III. USE

    1. Gross use of services (reference questions answered,
bibliographies completed, etc.).

    2. Ratio of actual users to potential users.

    3. Total library use.

    4. Ratio of service use to total number of users.

    5. Ratio of total use to total number of services.

    6. Percentage of materials used (by type) and by class of
users (student, teacher, researcher, etc.).

7. Ratio of documents circulated to various classes of users.

8. Ratio of documents circulated to active users.

9. Ratio of total use to total holdings.

10. Item-use-day.

IV. USER SATISFACTION

1. User satisfaction.

2. User activities (purpose) in library.

3. Percentage of items in collection as listed in some checklist.

4. Percentage of items in collection by type of material (books, serials, reports, etc.).

5. Percentage of items in collection by type of material compared to various classes of users.

6. Quality-value of items in collection based on expert opinion.

7. Ratio of documents used to materials requested.

V. RESPONSE TIME

1. Speed of service.

2. Ratio of number of services offered to average response time for all services.

3. Ratio of response time (to secure document) to total time document is of value.

4. Ratio of holdings to response time.

VI. COST-BENEFIT

1. Ratio of services to cost.

2. Ratio of total service expenditures to users (actual and/or potential).

3. Cost-benefit.

4. Cost-response time.

Several studies have made an effort to include all possible factors pertinent to library effectiveness in their evaluations. An example is an on-site study of mechanization in DOD libraries (1966) where the list of measures covers all those discussed here. Carnovsky (1955) discusses the accumulation of data that has been used to evaluate public libraries and warns that they cannot be applied arbitrarily. Each librarian must decide on his library's goals, based on potential readers, their needs and desires, and evaluate on the basis of those goals, not on the goals of other libraries. An old article by Purdy (1942) summarizes many of the basic problems in evaluation of libraries. Wilson and Tauber (1956) summarize the past methods used in over-all university library evaluation, showing that the principal technique has been comparison. Four approaches which have been taken are comparing the present condition of the library with that of past years, comparing the library to other aspects of the university, comparing the library with other similar libraries, and comparing the library with certain standards. They feel that true evaluation of a library can only be determined by the extent to which the users achieve their purposes, not by comparative techniques.

3.1 Areas of Research

The purpose of the literature review was to look at what work had been carried out in the area of evaluating library performance in order to make recommendations regarding areas in which further work might be productive. The summaries at the end of the discussion of each basic criterion reflect the authors' general thoughts on these criteria.

The primary result of the literature search was that it indicates that a great many variations on a few basic approaches to measuring library performance have been tried; but of all the studies examined, only one attempted to look at the problem of evaluation from the point of view of the total library (Wessel, 1967, 1968, 1969). Most of the studies concentrated on one or two measures of one or two services. One completes the review still wondering what measures can be employed in the hope of achieving valid results. Are all the measures, even the six "basic" criterion equally important in measuring all services? If not, how can they be weighted to reflect this relative importance both to the evaluation of a specific service and to the total library program?

Research that would aid in answering the questions in the above paragraph would seem to be of primary importance. Medical libraries, like other libraries, perform multiple services and therefore it seems unlikely that any single criterion can be considered completely valid as the measure of library performance. When it is possible to apply several different criteria, the question of weighting each one becomes important. In order to determine what the weighting factor should be, it is clear that one needs to know how important each criterion is in achieving a specific library function. As was noted above, the literature in general reflects an absence of consideration of a) the total service program, and b) the importance of any one criterion in meeting the needs of even one service function. Without such consideration it would seem to be impossible to arrive at a valid evaluation of the performance of the library.

In light of this, it is suggested that one area of needed research should be to develop a technique or instrument to aid in determining with a reasonable degree of accuracy what a given library's services are and their relative importance in terms of the total library program. A second phase of this problem would be to determine which criteria were appropriate to measure the performance of the services and the weight that should be assigned to each criterion. For example, does it seem valid to give the same weight to response time when considering such services as translation and information-reference? While response time would be a valid criterion in both cases it seems quite likely that most people would rather see a slower response time (less weight) and say more accessibility (more weight) when evaluating a translation service. However, until there are instruments or techniques to aid in determining this, the matter is subject to debate and opinion.

Another area that ought to be investigated, if total library performance is to be considered, is that of conservation. No studies were encountered in the literature search that even discussed conservation as an aspect of library performance. Some techniques should be developed for evaluating the losses that the library incurs in terms of conservation when the library attempts to increase its performance in terms of users.

In general, it would seem from a review of the literature, that perhaps the time has come when less effort should be devoted to developing variations in the criteria of performance evaluation in terms of one or two services. Rather that efforts be directed toward unifying the work that has been done in order to evaluate the entire library and perhaps arrive at the point at which intelligent comparisons between libraries may be made.

4.0 UNIVERSITY CITY SCIENCE CENTER STUDY

In addition to reviewing the literature relating to the measurement of library effectiveness, and preparing a summary list of measures that have been employed as indicators of library performance, the investigators also carried out some additional statistical analysis based upon data available from the National Survey of Medical School Libraries (PH 43-68-94). That survey was prepared for the National Library of Medicine by the University City Science Center (UCSC) of Philadelphia. In the course of their research a great deal of statistical data was gathered. As is always the case, data lends itself to many more types of analysis than need be done in any one study. We proposed to re-examine the data from some different points of view, and through the cooperation of NLM and UCSC the computer tape file of the data was made available.*

The UCSC study is in many ways typical of all studies of library evaluation. It focuses on only one or two aspects of library service, it applies a single criterion of evaluation to a service with no attempt to justify the significance or validity of the criterion measured for that service, and the study does not consider the relation of the service studied to the overall purpose and function of the library, in this case medical school libraries. These are, however, as indicated in the report on the literature review rather common failings, and perhaps a failing only when considered from a much broader perspective than most studies assume. However, it would seem

---

* The investigators wish to express their appreciation to UCSC for their cooperation which, indeed, consisted of more than simply supplying a tape. They patiently answered questions and helped us make efficient use of their material. This kind of scientific sharing is still far from common, and is all the more appreciated.

-39-

that any study that does not at least note the relationship between the problem under investigation and the total system of which the problem is part, would have a rather limited value.

The objective of the UCSC study was "to determine, analyze and report the service capability and performance of all active medical school (training toward the M.D.) libraries in the United States."[*] In order to accomplish this objective, the study undertook "to administer a Document Delivery Test (DDT) appropriate to academic medical libraries to 92 medical school libraries and 3 reservoirs."[**] (reservoir libraries). It is important to note that the DDT was <u>not</u> ready for operational use, but was still an experimental technique that required further testing.

4.1 The Validity of the DDT

The DDT essentially consists of a list of 305 document (304 for the reservoir libraries) references. Effectiveness in this test is determined in terms of the speed at which the library can deliver the documents to a requester. The references are taken from the field of medical research and <u>not</u> medical education. The two subjects are related, but they are not identical and there is no reason to assume a priori that the performance of a medical school library can be fully and adequately measured by how fast it can deliver a few hundred research reports. Surely a medical school library serves a broader spectrum of needs than just research. No

---

[*] University City Science Center. <u>Final Report - National Survey of Medical School Libraries.</u> University City Science Center, Philadelphia, 1968. P. 2.

[**] Ibid. P. 2.

justification or even suggestions are made regarding the validity of the
sample in either the final report or the published articles, with only one
small exception. The exception states, "because researchers' needs for
primary source documents pose one of the most severe demands on a library's
capability, we do not consider this limitation a critical weakness for a
test of the document delivery capability of academic biomedical libraries."*
As a test of research document delivery capability the DDT may be valid;
however, in terms of meeting the study's objective "to determine, analyze
and report the service capability and performance" the test does not appear
to have even surface validity. In order to validate the DDT in terms of
research, documents would require drawing and testing a new sample at the
same libraries. This has not been done.

In addition to the validity of the test itself, the validity of using
response time, or document delivery time, as a measure of the total service
and performance capability of medical school libraries is certainly
questionable. Surely there is more to the performance of medical school
libraries than the speed at which documents are supplied to users. Granting
the premise that speed is an important factor, as indicated in the literature
survey section, this factor can be used to study the performance of a wide
range of services, not just the document delivery. In addition the UCSC
investigators make no attempt to justify the DDT as the sole measure of

* Orr, Richard H., Pings, Vern M., Pizer, Irwin H., Olson, Edwin E., and
   Spencer, Carol C. "Development of Methodologic Tools for Planning and
   Managing Library Services: II. Measuring a Library's Capability of
   Providing Documents," Bulletin of the Medical Library Association 56,
   (July 1968) p. 257.

performance and service capability. In any case the entire question of the validity of concept needs to be re-evaluated.

4.2 Data Analysis - DDT Reliability

Aside from the validity, the reliability of the DDT had not been reported. However, a split-half reliability could be determined by reanalysis of the raw data, and this was one of the tasks undertaken by the present study. The sample of 305 documents employed in the test were split into two groups. The method of splitting was based upon the number assigned to the term, all even numbered items in one group (152 documents) and the odd number in the other (153 documents). The performance index (PI) for each institution was recomputed for each option for each of the samples. We employed the UCSC method of computing the PI as reported in the UCSC progress reports ($PI = \frac{5-m.s.}{4}$). (PI = performance Index, 5 = the number of possible delivery speeds, m.s. = the mean speed for all documents at an institution, and 4 = a constant employed to insure a decimal PI. One problem encountered was a lack of specific information in the final UCSC report about the procedures used, so that we could be certain we were working from the same base.) The institutions were then ranked according to their PI on option 1 and 4 for the odd and even samples. These rankings were compared to one another and to the PI as computed by UCSC based on the total sample.

The results of correlation coefficient analysis are as follows.

CORRELATION COEFFICIENTS FOR DDT RELIABILITY SPLIT HALF

	Options						
	1	2	3	4	5	6	mean
Regular (odd-even)	.93	.93	.94	.94	.92	.94	.93
Reservoir (odd-even)	.96	.97	.95	.95			.96

RANK CORRELATION COEFFICIENTS FOR DDT RELIABILITY SPLIT HALF

	Options						
	1	2	3	4	5	6	mean
Regular (odd-even)	.91	.92	.90	.92	.89	.90	.91
Reservoir (odd-even)	.90	.90	.93	.94			.92

As can be seen from the figures the degree of association is extremely high. In the case of rank correlation coefficient, we simply ranked the institution in terms of its PI for each option using only the even numbered documents and then only the odd numbered documents. We then checked to determine how closely the two halves came to ranking the institution in the same order. Again from a statistical point of view it would seem to make little difference which half were used if they would produce very similar results. These results may be interpreted as indicating that the original sample is reasonably consistent and uniform, containing no measurable bias.

4.3 Data Analysis - DDT and Categories

A second analysis was undertaken to determine whether or not twenty-three status categories were necessary in order to record scoring information for the DDT. The UCSC study employed 23 different categories for recording the status of a given document (see below for a list of these categories). It seemed probable that a reduction in the number of categories would (1) produce results of equal or greater relevance for scoring the DDT, and (2) produce a format which would be easier to use in the field, reduce possible variations in scoring due to different interpretations of a situation, and make scoring easier. Six categories were used in this analysis. They were:

(1) On shelf* - On shelf, to be shelved and on shelf-second search.

(2) Not in collection - Not in collection, interlibrary loan, missing, can't locate.

(3) In storage or special location - Off premises, in storage, special location-mediated, special location-not mediated, other known status, other - second search.

(4) In circulation - Reserve loan, faculty loan with recall, faculty loan without recall, student loan with recall, student loan without recall, other loan with recall, other loan without recall.

(5) In Bindery - In binding.

(6) In process - In process not available, in process available.

The categories were given speed codes that differed slightly from those assigned in the UCSC study. This was necessary because the UCSC study occasionally used different speed codes for categories that we placed under one

---

* Covering the following UCSC categories.

heading. However, the scoring concepts were kept consistent with the UCSC study. For the regular libraries we used the following speed codes for option 1.

Our Code		UCSC Code
On shelf	1	1,2,3
Not in collection	ILT*	ILT, 5, ILT, ILT
In storage or special location	2	EDT**, 2,1,2, EDT, editor's opinion
In circulation	4	EDT, $4\frac{LP***}{2}$, 4, $\frac{LP}{2}$, $4\frac{LP}{2}$
In bindery	2	EDT
In process	EDT	2, EDT

Using the new speed codes the PI for each library was recalculated and compared to the UCSC PI for each section, with the following correlation coefficient results.

CORRELATION COEFFICIENTS FOR UCSC PI AND "NEW" PI

	Options						
	1	2	3	4	5	6	mean
Regular libraries	.99	.99	.97	.97	.04	.91	.96
Reservoir libraries	1.00	1.00	1.00	1.00			1.00

These results may be interpreted as indicating that using the simplified method of scoring one would achieve practically the same results as by using the more complex method.

---

*   Inter library loan time
**   Estimated delivery time
*** Loan period

Several hypotheses were checked against the data. Each of the following hypotheses was checked against the data by employing a rank correlation analysis.

1) There is a very high positive correlation between the number of documents on the shelf and the overall performance index.

2) There is a very high negative correlation between the number of items not in the collection and the overall performance index.

3) There is a high negative correlation between the number of documents in storage or special locations and the overall performance index.

4) There is a moderate negative correlation between the number of documents in use and the overall performance index.

5) There is a moderate positive correlation between the number of documents in process and the overall performance index.

6) There is a moderate negative correlation between the number of documents in the bindery and the overall performance index.

We decided to use only Option 1 of UCSC for testing the hypotheses (see section 4.4 for detailed discussion of scoring options). The rank correlation coefficient was calculated for the Option 1 PI as determined by the UCSC method and each of six hypotheses on the basis of the number of documents in each category. The data indicates for regular libraries that hypothesis one was correct (+.902). We suggested that there would be a high positive correlation between the number of documents on the shelf and the PI.

In hypothesis two the high negative relationship between the PI and the number of documents not in the collection was found to hold (-.858). Again we employed the method of PI to the number of documents in the appropriate category, in this case not in the collection. The hypothesized relationship (high negative), suggested in hypothesis three, between the PI and the number of documents in special locations did not exist (-.104). A moderate negative

-46-

relationship was predicted to exist between the PI and the number of documents in use in hypothesis four. This was not the case; the correlation coefficient value was .067. In the case of hypothesis five a moderate positive correlation was anticipated between the PI and the number of documents in process. Again the hypothesis was not supported by the analysis (-.007). Finally the relationship posited in hypothesis six (moderate negative) between the PI and the number of documents in the bindery did not exist (.006). The evidence for the regular libraries clearly indicates the only significant relationship is between "on the shelf" and "not in the collection" and the PI. This would seem to indicate the DDT and PI are relatively insensitive to the other status categories.

HYPOTHESIS	PREDICTED CORRELATION	REGULAR LIBRARIES	RESERVOIR LIBRARIES
1	++	.902	.635
2	--	-.858	-.982
3	--	-.104	-.035
4	+	.067	-.235
5	+	-.007	.117
6	-	.006	-.225

++ = high positive.
 + = moderate positive.
-- = high negative.
 - = moderate negative.

The same basic pattern was encountered in the reservoir libraries although the lack of correlation is not as high. The most surprising feature of this analysis was the lack of a high positive relationship for hypothesis one. Hypothesis one was rejected because the relationship at best can only be considered moderate (.635); hypothesis two was supported (-.582); hypothesis three was rejected (-.035); hypothesis four was rejected (-.235); hypothesis five was rejected (.117); and hypothesis six was rejected (-.225).

In part these results may be a reflection of the fact that documents on the shelf or not in the collection represented almost 92% of the total sample for the regular libraries and 89.2% for the reservoir libraries. As a result the influence of the other status category documents on the PI was at best very slight.

What this means is that in essence the DDT measures how many documents are or are not in the collection and very little else. Since the correlation of books on the shelf and the PI for regular libraries is $r = .9$, $r^2 = .81$, measuring the 81% of the total variance of the PI score is accounted for by this one variable. In view of the questions that exist about the suitability and validity of the DDT documents for testing medical school libraries, we feel that this instrument is of limited use. That is, any standard medical bibliography could be used to check the holdings of any medical school library and the percentage of documents held by that library would provide as much information about the "service capability and performance" of that library as the DDT results.

4.4 Data Analysis - DDT and Scoring Options

Throughout the UCSC study there is an emphasis upon scoring option four as the significant option to be considered. "Option 4 - score with both short-term and long-term activity controlled, representing what the performance would have been if all test documents in use within the library and on loan were instead 'on shelf'."* "In looking up a library's score, Option 4 is the one most indicative of the institution's capabilities, as it represents performance with short and long term activity controlled . . . Option 4 is the one used in all subsequent graphs and in comparisons with other variables."** No evidence is given to support these statements, and since Option 1 represents the "raw score"*** for the test, and is thus easiest to calculate, it seemed desirable to check on the significance or variation, if any, that exists between the various options.

The null hypothesis (that no significant differences exist between any of the scoring options) was checked by means of correlation coefficients for the PI and by rank correlation coefficients. The results of these analyses are:

CORRELATION COEFFICIENT FOR SCORING OPTIONS - REGULAR LIBRARIES

	1	2	3	4	5	6
1		.998	.973	.971	.955	.918
2			.974	.974	.958	.925
3				.998	.942	.956
4					.994	.961
5						.974
6						

*   Ibid., p. 23
**   Ibid., p. 24
***   Ibid., p. 23

RANK CORRELATION COEFFICIENT FOR SCORING OPTIONS - REGULAR LIBRARIES

	1	2	3	4	5	6
1		.996	.961	.954	.954	.892
2			.959	.959	.958	.903
3				.995	.926	.945
4					.926	.956
5						.948
6						

CORRELATION COEFFICIENTS FOR SCORING OPTIONS - RESERVOIR LIBRARIES

	1	2	3	4
1		.999	.997	.996
2			.996	.997
3				.999
4				

RANK CORRELATION COEFFICIENTS FOR SCORING OPTIONS - RESERVOIR LIBRARIES

	1	2	3	4
1		.996	.992	.992
2			.989	.989
3				1.000
4				

Clearly these data indicate that no significant differences exist and that
all the options, or scoring methods, are highly correlated with one another.
Therefore the suggestion that Option 4 is "most indicative of the

institution's capabilities" in terms of performance is not substantiated.

It is no more and no less indicative of the service capability than any

of the other options. The reason for this result was suggested above; the

DDT is relatively insensitive to any status category except "on shelf" and

"not in collection". In view of this finding it would seem to be unnecessary

to go to the trouble of calculating nything but the raw score (Option 1).

The Orr, et al (1968 a, b, c) articles provide some reasons for using all

of the options; however, these reasons appear to be based upon the assumption

that the PI would be much more sensitive to variations in the twenty-three

status categories. On the basis of the data collected from the 92 "regular"

and 15 "reservoir" medical school libraries, this assumption did not hold.

4.5 Summary - DDT

In summary, the PI and DDT, as applied in the UCSC study, does not yet

appear to be a totally satisfactory method of assessing medical library

service capability. The reasons for this statement are:

1) There is no evidence to support the idea that response time is
   the best measure of service capability much less the sole measure.

2) The sample of documents employed in the DDT does not adequately
   reflect the information needs of the total user population served
   by a medical school library (only the "author-researcher" needs
   are represented).

3) The scoring method (PI) is not sensitive enough (at least for the
   reported libraries) to the various status categories set up by
   the UCSC study. This makes the test cumbersome to use and in
   fact the effort is wasted because the results will vary only
   slightly for having done the extra work.

4) The DDT, because of this lack of sensitivity, is not any more useful
   for determining the service capability than the results of checking
   a standard medical bibliography against the holdings of a library.
   The latter operation could also be completed more quickly and
   cheaply.

-51-

This is not to say that the method is without value. There are a number of
areas within which refinements could make it a very valuable tool of evalu-
ation. Some areas where additional work could produce a more valuable
technique are:

1) A sample drawn in a manner that would be more reflective of all
patrons' needs is essential to valid employment of the DDT as a
measure of a library's ability to provide a wide range of users
with the documents they need.

2) A reduction in the number of status categories would make the test
easier to use and would produce results as accurately as the present
method.

3) An increase in the values assigned to documents in status categories
other than "on shelf" and "not in collection" should make the PI
more sensitive to variations in those other categories.

4) A reduction in the number of scoring options to one (the raw score)
would also seem to be appropriate and would reduce the time
required to calculate the results. Although if there were an
increase in the sensitivity of the status categories, additional
scoring options might be of some value.

4.6 Data Analysis - Inventory of Library Services

All the reviewers of the UCSC final report commented on the surprising
lack of correlation between the PI and ILS score. It would seem reasonable
that a moderate positive correlation should exist between the two factors
since both measures took into account circulation and inter-library loan
activity. The proposal we submitted to the National Library of Medicine
indicated we would attempt several analyses of these data in an effort to
determine the factors that created the lack of correlation.

Some time was devoted to attempting to determine how the ILS score was
calculated by UCSC staff. Since neither the final report, the published
articles (Orr, et al 1968 c), nor the progress reports submitted to NLM by

UCSC gave adequate information about the ILS scoring techniques and our own efforts did not produce satisfactory results, we contacted the UCSC staff. After some time, we received written confirmation of the following points (see Appendix A).

1) The ILS score for an institution is not a composite score based upon the responses given to all questions for all five user categories. Rather, the score is the highest score achieved in one of the user categories. Thus if the house staff at an institution received the greatest service score, that score represented the ILS "score" for that institution.

2) The rationale for the above approach is that since the library is capable of giving that level of service to one category of user, it should be given that score as the measure of its service capability.

3) The scores for two institutions (003 and 026) represent scores achieved on the basis of services rendered, a sixth category of user (State Health Officers) that is not mentioned in the final report nor its appendices.

4) The appendix listing the data from the ILS test contains a number of incorrect listings making it impossible to duplicate the same results as reported in the UCSC study, if the appendix data are used. The original data were not available for use.

5) The published discussion of the ILS and scoring of that test has no relationship to the manner in which this aspect of the study was handled in the final report.

Because of these findings no further attempts to work with the ILS material were undertaken. In view of the unusual manner in which these data were handled, it is not too surprising to find they did not correlate with the DDT results. The rather questionable rationale about the highest score for one class of user representing the total service capability of a library cannot be accepted. The assumption that services given to a limited number of patrons can be given to all patrons is simply unrealistic. Perhaps the reworked analysis of the ILS mentioned in Appendix A will remedy many of these problems.

4.7 Summary - UCSC Final Report

In summary, the UCSC study, while having a number of questionable factors included in its methodology, appears to have started toward developing one valid technique for measuring one aspect of the problem of library service performance. The DDT is a useful experimental device, but more work needs to be done before it can be put to operational use. More importantly, additional instruments need to be developed to measure the full range of library services.

January 20, 1970

Mr. G. Edward Evans
School of Library Science
University of California
Los Angeles, California

Dear Mr. Evans:

This is to confirm our telephone conversation regarding the scoring
and reporting of the ILS data. I apologize for the lateness of this
letter, but I hope that it will be of use to you anyway.

Your understanding of the procedures as stated in your letter of
November 7, 1969, to Mr. Bagley is correct. The ILS score for each
institution is not a composite score, but is the score of the user
category receiving the highest degree of service. Thus, the score
represents the maximum service capability of the institution at the
time of testing.

As might be expected, this user category was most often the faculty,
with but a few exceptions. In two of these, 002 and 026, the highest
degree of service was accorded a category of user for which there
is not a summary sheet breakdown in the appendix of the report, as
so few institutions mentioned it at all. These two scores were, I
believe, given to you by telephone.

I checked with Dr. Orr concerning the published discussion of the
ILS, and he confirmed that it was concerned with the projected method
of weighting and scoring answers and answer categories. This method
was not developed at the time of our study and is thus not the one
used in our report to NLM. However, I understand that this weighting
and scoring has subsequently been accomplished and that the results
thereof are to be published shortly. This method should provide an
excellent "in depth" manner of evaluating each institution's service
capability.

Best wishes on the progress of your report; I hope you have not
had further difficulties with it since I talked with you last.

Sincerely,

(Mrs.) Dana Close

BIBLIOGRAPHY

1. Allen, T.J., & others   1966   Time allocation among three technical
                                            information channels by R & D engineers.
                                            (Research Program on the Management of
                                            Science and Technology) Working Paper.
                                            (Cambridge: MIT, Alfred B. Sloan School
                                            of Management)

2. Andersen, Arthur & Co.   1962   Research study of criteria and procedures
                                            for evaluating scientific information
                                            retrieval systems.   (Washington: NSF,
                                            Office of Science Information Service)

3. Anderson, A.A.   1965   Multi-level file structure as a frame of
                                            reference for measuring user interest.
                                            Presented at the International Advanced
                                            Study Institute on the Evaluation of
                                            Information Retrieval Systems at the
                                            Hague, Netherlands.

4. Aro, B., Gripton, J. &   1965   Cost analysis study: technical services
        Strashem, C., Eds.   division University of Denver library.
                                            Studies in Librarianship, No. 4   (Denver:
                                            Univ. of Denver)

5. Atherton, P.   1962   "Indexing requirements of physicists."
                                            In The literature of nuclear science: its
                                            management and use.   (Oak Ridge: U.S.
                                            Atomic Energy Commission, Division of
                                            Technical Information Extension)
                                            p. 215-18.

6. Bach, H.   1957   "Scientific literature use: a survey."
                                            Special Libraries 48: 466.

7. Bare, C.E.   1966   "Conducting user requirement studies in
                                            special libraries." Special Libraries
                                            57: 103-06.

8. Bedsole, D.T.   1958   "Formulating a weeding policy for books
                                            in a special library." Special Libraries
                                            49: 205-09.

9. Bernal, J.D.   1960   "Scientific information and its users."
                                            Aslib Proceedings 12: 432-38.

10. Blunt, C.R. & others   1966   A general model for simulating information
                                            storage and retrieval systems.   (State
                                            College, Pa.: HRB-Singer, Inc.)

11. Booz-Allen Applied   1966   Study of mechanization in DOD libraries
    Research   and information centers. (Cameron
                                      Station, Va.: Defense Supply Agency,
                                      Defense Documentation Center)

12. Bornstein, H.A.   1961   "A paradigm for a retrieval effectiveness
                                     experiment." American Documentation
                                     12: 254-59.

13. Bouman, G.P.   1951   "Cost analysis in company libraries."
                                     Biblioteekleven 36: 281-90.

14. Bourne, C.P. & others   1961   Requirements, criteria and measures of
                                     performance of information storage and
                                     retrieval systems. (Washington: NSF)

15. Brophy, A.L. & Gazda,   1960   "Handling the problem staff member."
    A.M.   Illinois Libraries 43: 750-63.

16. Brutcher, C., Gessford,   1964   "Cost accounting for the library."
    G. & Rixford, E.   Library Resources and Technical Services
                                     8: 413-31.

17. Budington, W.S.   1959   "Cost of information service." In The
                                     Library as a community information center.
                                     (Champaign: Univ. of Illinois) p. 51-66.

18. Bush, G.C., Galliher,   1956   "Attendance and use of the science li-
    H.P. & Morse, P.M.   brary at MIT." American Documentation
                                     7: 87-109.

19. Carnovsky, L.   1959   "Evaluation of library services." Unesco
                                     Bulletin for Libraries 13: 221.

20. Clapp, V.W. & Jordan,   1965   "Quantitative criteria for adequacy of
    R.T.   academic library collections." College &
                                     Research Libraries 26: 371-80.

21. Cleverdon, C.W.   1958   "An investigation into the comparative
                                     efficiency of information retrieval
                                     systems." Unesco Bulletin for Libraries
                                     12: 267-70.

                             1959   "The evaluation of systems used in infor-
                                     mation retrieval." International confer-
                                     ence on scientific information, 1958.
                                     (Washington: National Academy of Science)
                                     p. 687-98.

-57-

21. Cleverdon, C.W.   1962 <u>Report on the testing and analysis of an</u>
                                          <u>investigation into the comparative</u>
                                          <u>efficiency of indexing systems</u>. (Aslib-
                                          Cranfield Research Project, Cranfield)

22. Cleverdon, C.W.,   1964 "Uncovering some facts of life in infor-
       Lancaster, F.W. &   mation retrieval." <u>Special Libraries</u>
       Mills, J.   55: 86-91.

23. Cole, P.F.   1958 "Analysis of reference question records
                                          as a guide to the information require-
                                          ments of scientists." <u>Journal of</u>
                                          <u>Documentation</u> 14: 197-207.

24. Cuadra, C.A.   1964 <u>On the utility of the relevance concept</u>.
                                          (Santa Monica: System Development Corp.)

25. Downs, R.D.   1942 <u>Resources of New York City libraries</u>.
                                          (Chicago, Ill.: American Library
                                          Association)

                                    1965 <u>Resources of North Carolina libraries</u>.
                                          (Raleigh, N.C.: Governor's Commission on
                                          Library Resources)

                                    1966 <u>Resources of Missouri libraries</u>.
                                          (Jefferson City, Mo.: Missouri State
                                          Library)

26. Elvers, D.A., & Armour,   1962 <u>An analysis of   d recommendations for</u>
       G.C.   <u>the main libra circulation department</u>
                                          <u>of Indiana Uni rsity</u>. (Bloomington:
                                          Indiana Univer ity Libraries)

27. Emerson, W.L.   1957 "Adequacy of engineering resources for
                                          doctoral research in a university
                                          library." <u>College & Research Libraries</u>
                                          18: 455-60.

28. Fisher, E.L.   1966 <u>Checklist for organization, operation and</u>
                                          <u>evaluation of a company library</u>. (New
                                          York: Special Library Ass.)

29. Fussler, H.A.   1951 "The problems of physical accessibility."
                                          In J.H. Shera & M.E. Egan, Eds., <u>Biblio-</u>
                                          <u>graphic organization</u>. (Chicago: Univ. of
                                          Chicago Press) p. 163-86.

30. Fussler, H.A. & Simon,   1961 <u>Patterns in the use of books in large</u>
       S.L.   <u>research libraries</u>. (Chicago: Univ. of
                                          Chicago Library)

31. Goffman, W. & Newill, V.A. 1964 "Methodology for test and evaluation of information retrieval systems." Comparative systems laboratory technical report no. 2. (Cleveland: Western Reserve Univ., Center for Documentation and Communication Research)

32. Hattery, L.H. 1963 "Organization for a science information service." In Paul W. Howerton, Ed., Information handling: first principles. (Washington: Spartan Books) p. 171-81.

33. Hirsch, R. 1959 "Evaluation of book collections." In Wayne S. Yenawine, Library evaluation (Frontiers of Librarianship, no. 2) (Syracuse: Syracuse Univ.) p. 7-20.

34. Hodgson, J.G. 1959 "The literature of library standards." Third military librarians' workshop. (Monterey: U.S. Navy Postgraduate School)

35. Hufford, J.H. 1950 "Principles to be considered in planning and operating a functional technical reference library." Special Libraries 41: 9-13.

36. Jain, A.K., et al 1967 A statistical study of book use. (Lafayette, Ind.: Purdue Univ., Library Operations Research Project)

37. Knox, W.T. 1959 "Administration of technical information groups." Industrial and Engineering Chemistry 51: 48a-61a.

38. Kopkin, T.J. 1955 "Circulating the table of contents of magazines." Special Libraries 46:211-12.

39. Lancaster, F.W. 1968 Information retrieval systems. (New York: Wiley)

40. Lehigh Univ. Center for Information Sciences 1965 Studies in the methodology of measuring information requirements and use patterns (Bethlehem, Pa.: Lehigh Univ.)

1966 Studies in the man-system interface in libraries (Report no. 2). The application of psychometric techniques to determine the attitudes of individuals toward information seeking. (Bethlehem, Pa.: Lehigh Univ.)

41. Linder, L.H.   1965   "Comparative costs of document indexing
                                  and book cataloging." Special Libraries
                                  56: 724-26.

42. Lister, W.C.   1967   Least cost decision rules for the
                                  selection of library materials for
                                  compact storage. (Lafayette, Ind. M.S.
                                  thesis)

43. Logsdon, R.H.   1954   "Time and motion studies in libraries."
                                  Library Trends 2: 401-09.

44. Maizell, R.E.   1960   "Standards for measuring effectiveness
                                  of technical library performance." IRE
                                  Transactions on Engineering Management.
                                  EM-7(2): 69-72.

45. Mathieu, J. &   1959   Guiding principles for time and cost in
      Barlen, S.   documentation work. (Germany: Technical
                                  Information and Library Services,
                                  Ministry of Supply)

46. Maybury, C.   1961   "Performance budgeting for the library."
                                  ALA Bulletin 55: 46-55.

47. Mayo-Wells, W.J.   1964   Organization of a national scientific and
                                  technical information center. (Alexan-
                                  dria, Va.: Defense Documentation Center
                                  for Scientific and Technical Information)

48. Meier, R.L.   1961   "Efficiency criteria for the operation
                                  of large libraries." Library Quarterly
                                  31: 215-34.

49. Middle States Ass. of 1958   "What to consider in evaluating the
      Colleges & Secondary   library." Library Journal 83: 1656-58.
      Schools

50. Monroe, M.E.   1962   "Standards--criteria for service or
                                  goals for the future." ALA Bulletin
                                  56: 818-20.

51. Morse, P.M.   1964   Probabilistic models for library opera-
                                  tions. Presented at annual meeting of
                                  Ass. of Research Libraries.

                          1968   A systems approach to library effective-
                                  ness. (Cambridge, Mass.: MIT Press)

52. Mueller, M.W.   1959   "Time cost and value factors in infor-
mation retrieval." General information
manual. (IBM Information Retrieval
Systems conference, Poughkeepsie)

53. Niland, P.   1967   "Developing standards for library expen-
ditures." Management Science 13:
777-808.

54. Ohlman, H.   1965   "The activity spectrum: a tool for
analyzing information systems." In L.B.
Heilprin, B.E. Markuson & F.L. Goodman,
Eds., Proceedings of the symposium on
education for information services.
(American Documentation Institute)
(Washington: Spartan Books) p. 155-66.

55. Orr, R.H., Pings, V.M.,   1968a   "Development of methodologic tools for
Olson, E.E. & Pizer,   planning and managing library services.
I.H.   I. Project goals and approach." Medical
Library Association Bulletin 56: 235-40.

    1968b   "Development of methodologic tools for
planning and managing library services.
II. Measuring a library's capability for
providing documents." Medical Library
Association Bulletin 56: 241-67.

    1968c   "Development of methodologic tools for
planning and managing library services.
III. Standardized inventories of library
services." Medical Library Association
Bulletin 56: 380-403.

56. Pundsack, F.L.   1955   "What the user expects from a library."
Special Libraries 46: 163-66.

57. Purdy, B.F.   1942   "The evaluation of university library
service." Library Quarterly 12: 638-44.

58. Quatman, G.L.   1962   The cost of providing library services
to groups in the Purdue University
comminity, 1961. (Lafayette, Ind.:
Purdue Univ.)

59. Rafeel, J.A. &   1969   Systematic analysis of university li-
Shishko, R.   braries. (Cambridge, Mass.: MIT Press)

60. Randall, G.E.   1954   "Journal routing: greater efficiency at
lower cost." Special Libraries 45:
371-73.

60. Randall, G.E.   1956   "Who uses a technical library?" <u>Special</u> <u>Libraries</u> 47: 195-99.

                      1965   "Special library standards, statistics and performance evaluation." <u>Special</u> <u>Libraries</u> 56: 379-86.

61. Risk, J.M.S.   1956   "Information services: measuring the cost." <u>Aslib Proceedings</u> 8: 269-87.

62. Rubenstein, A.H. 1957   "Setting criteria for R & D." <u>Harvard</u> <u>Business Review</u> 35: 95-104.

63. Sass, S.   1950   "A realistic approach to special librarianship." <u>Special Libraries</u> 41: 160-61, 194-95.

64. Schutze, G.   1952   "Measure of library service - statistics." <u>Special Libraries</u> 43: 263-65.

65. Shank, R.   1959   "Library service to research laboratories of a large university." <u>American Documentation</u> 10: 221-23.

66. Slater, M.   1963   "Types of use and user in industrial libraries; some impressions." <u>Journal</u> <u>of Documentation</u> 19: 12-18.

67. Steig, L.F.   1942   "Circulation records and the study of college library use." <u>Library Quarterly</u> 12: 94-104.

68. Stevens, N.D.   1966   <u>A comparative study of three systems of</u> <u>information retrieval: a summary.</u> (Washington: Howard Univ.)

69. Strain, P.M.   1965   "The circulation pattern of one technical library." <u>Special Libraries</u> 56: 312-17.

70. Taube, M.   1959   "An evaluation of use studies of scientific information." In <u>Emerging solutions for mechanizing the storage and retrieval of information.</u> (Washington: Documentation, Inc.) p. 46-71.

71. Tauber, M.F. & Stephens, 1967   <u>Library surveys.</u> (New York: Columbia
    I.R., Eds.   Univ. Press)

65

72. Taylor, L. 1961 "Cost research on a library service." <u>Aslib Proceedings</u> 13: 238-48.

73. Thompson, J.I. & Co. 1962 <u>Federal government's system for distributing its unclassified R & D reports.</u> (Washington: NSF, Office of Science Information Service)

74. Thorne, R.G. 1955 "The efficiency of subject catalogues and the cost of information searches." <u>Journal of Documentation</u> 2: 130-48.

75. Tomlinson, H. 1965 <u>Defining technical information needs for a research library.</u> (Lackland AFB, Texas: Personnel Research Laboratory)

76. Trueswell, R.W. 1964 "The characteristics of circulation and their effect on the possible implementation of a punched card circulation central system." <u>College & Research Libraries</u> 25: 285-91.

1965 "A quantitative measure of user circulation requirements and its possible effect on stack thinning and multiple copy determination." <u>American Documentation</u> 16: 20-25.

1966 "Determining the optimal number of volumes for a library's core collection." <u>Libri</u> 16: 49-66.

1969 "User circulation satisfaction vs. size of holdings at three academic libraries." <u>College & Research Libraries</u> 30: 204-13.

77. Vickery, B.C. & Hanson, C.W. 1951 "Optimum use of staff: the medium library." <u>Aslib Proceedings</u> 3: 225-34.

78. Wallace, E.M. 1966 <u>User requirements, personal indexes and computer support.</u> (Santa Monica, Cal.: System Development Corp.)

79. Weber, D. 1957 "Criteria for evaluating a college library." <u>Association of American Colleges Bulletin</u> 43: 629-33.

80. Wessel, C.J., et al 1967 <u>Criteria for evaluating the effectiveness of library operations and services. Phase I: Literature search and state of the art.</u> (Washington, D.C.: John I. Thompson & Co.)

80. Wessel, C.J., et al   1968   <u>Criteria for evaluating the effective-</u><u>ness of library operations and services.</u> <u>Phase II: Data gathering and evaluation.</u> (Washington, D.C.: John I. Thompson & Co.)

                                   1969   <u>Criteria for evaluating the effective-</u><u>ness of library operations and services.</u> <u>Phase III: Recommended criteria and</u> <u>suggested utilization.</u> (Washington, D.C.: John I. Thompson & Co.)

81. Wilson, L.R. & Tauber, M.F.   1956   <u>The university library.</u> (New York: Columbia Univ. Press) p. 552-80.

82. Wynar, D. & others   1963   "Cost analysis in a technical services division." <u>Library Resources & Technical Services</u> 7: 312-26.

67