Performance Assessment Model for Academic Libraries*

Michael R. Bommer, Ronald W. Chorba, and Walter Grattidge
Clarkson College of Technology, Potsdam, NY 13676

Academic libraries are facing increased difficulties in carrying out their functions by traditional means. The continuing explosion of information coupled with spiraling costs are challenging library managers to accommodate these trends with little or no increase in funding. To meet this challenge, library managers must utilize and allocate re-sources in a more institutionally effective manner. Effective decision-making and planning, however, require appropriate management information. This article describes a conceptual framework for the development of a management information system including performance assessment components for linking institutional goals, library performance, and library management decision-making. The operational methodology required to evaluate resource allocations consistent with aggregate user needs and delineated organizational objectives is outlined. The resultant system would continuously monitor user needs, document availability, service utilization, and user productivity as means both to identify problems and opportunities and to assess the consequences of management decisions.

An essential component of effective library management in an academic environment is the availability to the administrator of an information base to support decisions concerning acquisitions, user services, and manpower assignments. This article provides a conceptual framework for developing such a management information system and identifying operationally feasible indicators for the on-going evaluation of library performance. The management, information system proposed here is designed to operate within a planning, budget, and control structure which is tied directly to overall institutional goals. The model developed in this article is applicable to the management of a library and its associated information dissemination system for any academic institution.

Background

The past decade has seen major emphasis placed on the meeting of individual user needs as the primary criterion for the assessment of performance for a library or information resource service within an institution. As a result, overall indicators of service, such as number or items circulated, number of interlibrary loans, or number of volumes in the local collection, have been regarded as prime measurement variables. Any managerial action which increased the overall values of these parameters has been taken as progressive. Increased use of services has then been presented by the library administrator at budget time as a demonstrated and supported justification for additional resource allocation.

At the present time, both the volume and the cost of published information are increasing at dramatic rates. These are occurring in a period when institutional, financial, and manpower resources are severely constrained and when the allocation of resources for the library must compete with other institutional activities and options. Traditional library budgeting strategies are being called into question. Gore [1, 2] predicted that continuing growth will not be the solution to library problems and suggests the prospect of zero-growth libraries. Schmidt [3] documented the existence of a declining acquisition rate among research libraries coincidental with an increasing rate of published information output. Therefore, in order to provide library users with access to a published information base that is growing at a continuing and awesome rate, it is vital that decisions and plans be made which allocate the library's available resources in the most efficient and effective manner. It is clearly the responsibility of the library manager to articulate the role to be played by the library in the attainment of the institution's overall goals.

The need for objective criteria for allocating available resources consistent with institutional goals and objectives has been cited in a number of studies (see, e.g., refs. 4-6). In recent years a number of resource allocation models have been proposed to help library management make better funding decisions. Rouse [7] proposed a resource allocation formula for expenditure decisions with respect to collection and staffing. Gold [8] proposed a model for book budgeting based upon the rate of use of materials, how the use contributes to the university's goals, and the

associated costs. Burton [9] suggested a budget formula based on user weights, Ryan [10] suggested a model for decisions involving manpower costs and work scheduling, and Kohut and Walker [11] proposed a model for making resource allocations decisions on monograph and serial purchases.

However, effective use of such decision-making and planning models requires appropriate management information. This information must include both operational measurements and strategic performance assessments in order to evaluate overall attainment of institutional objectives. This institutional emphasis was underscored in the 1976 Annual Report of the Office of Library Management Studies of the Association of Research Libraries [12] which stressed the need for performance measures which assess library costs in relation to benefits in order to assist the library with program planning and resource allocation decisions.

Concurrently, a number of efforts have been undertaken to develop operational performance measures for libraries. Many of these studies attempt to measure performance by the expedient of user satisfaction. For instance, Sage, Anderson, and Fitzwater [13] described a selective dissemination system which uses subjective feedback from users to evaluate retrieval transactions. Conner [14] presented survey instruments for document evaluation by users, while Orr [15] suggested a document delivery test and Hamburg et al. [5] suggested a count of document exposures as being useful as a measure of user satisfaction. More recent studies by Allen [16] focused on relating information input to user output. This represents one of the few reported attempts to directly measure the productivity of information services. Rubenstein et al. [17] suggested a series of field experiments to help a library manager assess various types of interventions for improving the overall system, and there have been a number of other studies, too numerous to mention individually, which have identified specific indicators for the activity and performance of separate components of a library system.

The next logical step, therefore, is to develop an integrated system for collecting and analyzing, on an on-going operational basis, those measurements which are critical in making effective decisions and plans. Such a system would in effect provide a basis for applying the body of available research results to specific resource allocation decisions. Thus, this article attempts to synthesize a number of such concepts and ideas, presently extant, into a coherent system of operationally defined variables and associated relationships which would be valuable in developing a model system for performance assessment for academic library services.

Conceptual Structure

Certain conceptual components of the library system can be identified and related to form the "functional model." A major thrust of this article is to suggest valid operational measures which are descriptive of these functional components. What follows in this section is a discussion of these functional components and an explanation of their role in the functional model (see Fig. 1 when terms are defined).

"Productivity of users" is measured in the institutional context by the effective contribution to the solution of a research problem or the accomplishment of an educational mission by a user, as manifested by tangible

(1) intellectual products such as course offerings, lectures, devices, materials, processes, procedures, term papers, and theses;

(2) informational products such as published works, technical reports, patents, research proposals, formal presentations, and demonstrations;

(3) recognitional consequences such as honorary designations, professional and institutional awards, promotions, monetary rewards, supervisor or peer evaluations, student evaluations, and citations by colleagues.

Depending upon the context, the constituency for an academic library includes individual student or faculty members, a class, a group, a task force, a program, or a departmental community of users. Since most users engage in a number of concurrent research and educational activities, it is useful to initially separate each user's needs into *problem spaces*. (The concept of a problem space is borrowed from Newell and Simon [18] who use it in a model of human problem solving.) A problem space is the way in which a researcher, teacher, or student conceptualizes a problem or task in order to work on it.

Information relevant to a problem space resides in one or more internal or external "databases," a term used to represent any repository of text-, numeric-, graphical-, or nonprint-format data or information located within or outside of the institution and including the user's own personal holdings. Personal databases include published versions of documents such as books, monographs, technical reports, journals (either in paper or microform), and duplications of such documents which are products of previous retrieval transactions. For a given user, the general access databases which might contain relevant information are usually those at the primary library of the user's institution, at other libraries that the user may contact directly, either within or external to his/her institution, or at libraries whose holdings are available indirectly through interlibrary loans and other resource-sharing arrangements.

In order to identify within these databases that information relevant to user problem spaces, the problem spaces must first be characterized in terms of "profiles of user needs." These profiles of user needs must be operationally described. One method might be to use a thesaurus of "search keys" or "descriptors" of the type commonly used by retrieval services to structure logically bibliographic or similar databases. Such a structure has been suggested by Swift et al. [19] and Leggate et al. [20]. Thus, each user will be characterized by a composite profile of his/her information needs which can be mapped into "database descriptors" which reflect the current structure in which information is acquired, stored, and retrieved. These
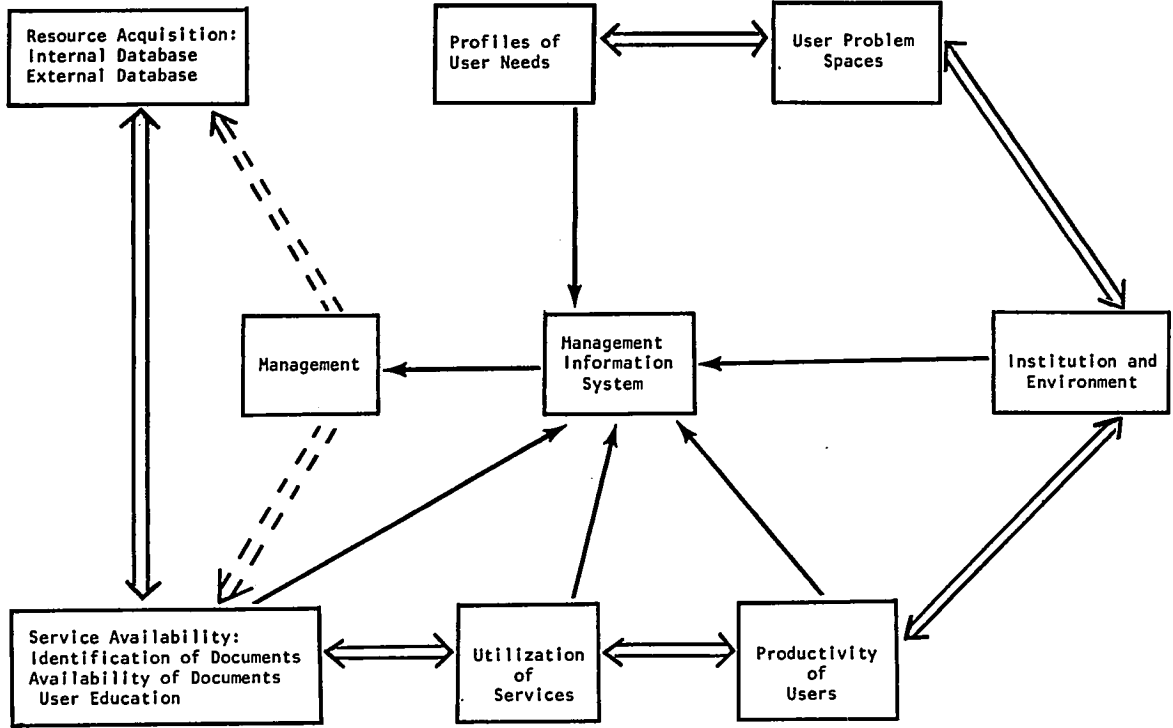
FIG. 1. Model of functional components of information transfer system. Double-rule arrow: functional relationships; single-rule arrow: flow of management information; dashed-line arrow: management intervention actions.

descriptors may then be ranked by some weighted measure of importance or organized into a hierarchical structure or aggregate profile, either by the user or by the library staff.

Over time it is recognized that a user will complete research or teaching tasks, take on new tasks, and make progress on continuing tasks. Therefore, a given user's profile of needs is likely to change over time and such a change contributes our dynamic component to the model. Taking the user's set of problem spaces as input to the library system and with user productivity as the ultimate objective, some of the intervening attributes of the system are now examined.

Utilization of services occurs when a user actually receives a document from the system as evidenced by retrieval transactions. However, such utilization is only an intervening step and not the ultimate, operationally productive step. An analogy can be drawn with management information systems theory where data are said to become information only when they are useful in a decision-making context. Likewise, unless user productivity is included in the analysis, the library is only providing a document transfer system, not an information transfer system. This model requires that the link be specified between service utilization and user productivity.

Availability is an attribute of a specified document's subset of the total holdings of databases accessible by the user. To be available, a document must reside in one or more of the databases and must be identifiable as matching sufficiently the user's information needs profile and be deliver-

able within the user's time interval of acceptability. Availability within a database or resource system can be more precisely characterized by the following subconcepts:

(1) *Completeness:* the proportion of all potentially identifiable documents which have actually been identified. This is seldom, if ever, known with respect to all possible documents, but it is a useful concept for comparing the relative completeness of specific databases.

(2) *Relevance:* the proportion of the identified documents which are, in fact, useful contributions to a particular user's problem space.

(3) *Proximity:* the "nearness" of documents to the user, most usefully measured in units of time. Two subsets of this time interval may be distinguished:

(a) *access time,* during which the user is actively engaged in identification and retrieval effort;

(b) *delivery time,* during which a copy of the document or the document itself is being transported to the user.

(4) *Cost:* to the user to complete the acquisition process. This can present a barrier to access since, in an economic context, the value of a document to the user may not exceed its acquisition cost, or, the user may have only a limited budget to allocate for information retrieval and may not be willing to underwrite specific out-of-pocket cost.

(5) *Psychological factors:* which cause users to be reluctant to use new technology or media. Training or learning barriers or differing perceptions of availability may exist be-

tween users even though all physical factors are equal (see, e.g., refs. 21-23). Library management may choose to allocate resources for the conduct of user education activities designed to encourage new utilization patterns.

Trends and shifts in the aggregate profile of the user community as well as institutional and environmental inputs constitute important changing stimuli to the management information system of the library and in many cases give direction to modifications to traditional resource allocation decisions concerning acquisitions and specific services.

The degree to which the user community's individual and aggregate need profiles are satisfied must be measured according to the availability components discussed above. Developing a practical and valid index of availability as related to user needs is a key task in the development of the information system. Such an index must be compiled and published periodically as a measure of library and information support system effectiveness. Lancaster [24] discussed the evaluation of document delivery capabilities in library systems.

The maximization of document availability from local on-site resources is not longer the ultimate goal of most system managers. Rather, the degree to which local resources are used is important, but the ultimate contribution of all information provided to user productivity is more significant and should be monitored and reported. This conceptual model requires that on-going feedback data on document utilization and productivity must be provided to the system manager for the purpose of evaluating the impact of actions taken to both improve the user community's exposure to available information and to demonstrate improved user productivity.

A second and equally important reason for monitoring utilization and productivity is to modify, with time, the aggregate profile of user needs. Allocation of resources based on an aggregate user community profile requires some weighting of individual user profiles according to one or more priority scales. Ultimately, the rationale for assigning such priorities is the degree to which a given allocation of resources will assist in achieving institutional goals and objectives. Both productivity and utilization are essential elements in chain linking the library to the achievement of the institution's objectives. Thus, measures of a user's utilization and productivity are appropriate inputs in determining a priority weighting for a user's need profile.

In summary, an explicit tailoring of a library to meet institutional objectives requires a management information system comprised of a number of unique features which are currently nonexistent in most libraries. An active effort to obtain and periodically update individual and aggregate user need profiles is essential. Recently Lancaster [25] drew attention to the importance of considering all potential users of an information system rather than just considering active users. The utility of some of the concepts and relationships employed in this functional model have been demonstrated in experimental settings [26]. Their articulation and structure in an operational setting, where factors such as systems cost and user convenience are important,

has not progressed to the point where implementation would be straightforward. The suggestions below are intended to help bridge that gap.

System Development Tasks

The development effort for the library management information system can be partitioned into a series of tasks as described below. Successful completion of all of the tasks would define the relevant operational parameters.

Task 1: Mapping The Decision Support System

In a management information system (MIS) sense, information only has value if it is utilized in the planning and decision-making process. The economic value attributable to a particular piece of information is then a function of the incremental effect it has on achieving all or some part of a desired benefit. What is required is the identification and specification of the operational parameters which link the planning elements and the decision parameters with the input data from user needs, service availability, utilization variables, user productivity, and institutional goals and priorities. The following actions are required:

(a) Identify the array of decisions to be made.
(b) Determine the manner and the time order in which decisions are made.
(c) Identify the operational parameters related to these decisions.
(d) Establish priority weightings for the operational parameters.
(e) Develop the format for the reporting system for data on the operational parameters.

Task 2: Profile of User Needs

Profiles of user needs are dynamic and must be monitored periodically by library management in order to detect trends and shifts in the user community's need structure. An operationally effective reporting system must employ data capture sources which entail low cost and minimum user inconvenience. The approach to describing user needs is based on the assumption that it is desirable to use descriptors which are reflective of those which specific users employ when searching the database. For the variety of users present in an academic setting, a composite vocabulary may be formed from commonly available database thesauri. Data captured from users would then be mapped in terms of such keyword descriptors. In any case a thesaurus or controlled vocabulary of descriptors which is consistent with both the available information retrieval databases and institutional concerns needs to be adopted.

To operationalize the capture of user need profiles, it is desirable that the procedures themselves have minimum

visibility or inconvenience to users and require minimal explicit input. The following sources can provide such data:

(i) abstracts and bibliographies of research proposals, papers presented at meetings, and papers submitted for publication by faculty and staff members;
(ii) bibliographic search requests;
(iii) library acquisition requests;
(iv) course descriptions, textbooks, and course reading lists;
(v) reserve reading room listings;
(vi) circulation and interlibrary loan records;
(vii) theses and dissertation proposals.

If institutional procedures require that the transactions associated with each of the above sources generate or be accompanied by descriptors which can be mapped onto the composite vocabulary, the library can capture a relative frequency distribution for each user mapped onto the descriptor vocabulary. This process would primarily entail a systematic clerical procedure requiring little additional direct user input.

Explicit contact with users would be necessary in only two instances. First, when a new faculty member is appointed or when a new program or course is introduced, an initial profile would be established. The user interview would be structured in much the same fashion as in librarian-assisted bibliographic searches. The end-product would be a set of descriptive keywords with a user-specified priority associated with each. Over time the user-specified priorities would be gradually replaced (in a Bayesian sense) with relative frequencies reflecting actual transactions of the type listed above. Thus, the user profile would systematically track changing user interests. Initial priority specifications would be designed to decay over time unless reinforced by transaction-originated input.

The other instance of direct user contact would be a periodic (perhaps annual) report to users of their current profile, including profile descriptors and imputed priorities. Users would need to respond to this report only if they wish to revise their priorities, delete descriptors, or create entirely new interest areas within their profile. Users should also have the opportunity to inspect and revise their profile on demand throughout the year. Therefore, the user would retain responsibility for the validity of his/her profile, but the system would attempt to minimize the extent of explicit user input. The resultant profile will be descriptive of the user's needs in a manner directly useful to the library.

In assessing the amount of effort to be spent on implementing the data system, the marginal value of the information obtained from each potential profile data source must be established, as well as a forecast of the required manpower and related costs. It is important to consider how much information will be sufficient for the decision-making process, what is the overlap of information from different data capture sources, and how valid is the information from different sources relative to true user needs.

Task 3: Monitoring Patterns of Utilization

In managing the multiplicity of services offered by the library, any attempt to make decisions linked to user needs and priorities requires that utilization patterns be monitored over time. On the resources side, the library must be able to identify and measure the individual and aggregate use of, and the associated budget allocations for, each service. On the utilization side, a methodology must be developed for identifying the form of consumption of these services by specific users. Data capture with respect to each usage event must describe type and amount of service as well as user identity.

Some of the service measurements of interest to this task are

— number and nature of documents circulated from local sources,
— number and nature of documents circulated from other library or information resources,
— number of copies of documents provided locally or at other libraries (hardcopy or film),
— number and details of bibliographic search requests (by database, items retrieved, cost, etc.),
— number and types of documents placed on reserve and the relative frequency of circulation of such items,
— number and types of requests for new books or journal subscriptions.

The guiding premise is that services which consume financial or other resources should be measured with respect to every relevant utilization attribute.

Thus measurement of utilization means not only counting aggregate service deliveries but also recording the distribution of such service deliveries among users. With some of the service deliveries listed above, it is possible to record the user profile directly (e.g., bibliographic searches and documents placed on reserve for specific courses). For general circulation, copying, and interlibrary loans, it might be difficult to confirm the need profile associated with the transaction without requiring explicit user input. However, the stored user profile could be used as an implicit profile associated with the transaction. Alternately, if the document of interest has an associated bibliographic code, this could be used to infer the need profile being satisfied.

In a report of service utilization, one dimension of the report would be the type of service and the other dimension would be the allocation (by numbers, cost, and percent of total) among classes of users or identifiable aggregates of need profiles. A typical set of user classes might be graduate courses, undergraduate courses, graduate student research, and faculty research. A typical set of profile aggregates might be energy, transportation, health services, and computers. For any given service, the utilization pattern among user or profile classes can be reported, and, for any given class, the pattern of service utilization can be reported. Thus, the distribution of services, by number, percentage, cost, manpower, and required space, could be examined with respect to user needs (and ultimately related to user

productivity) in ways which are not possible through any existing information system.

Task 4: Productivity Assessments

A category of information which is almost universally lacking at present for library management is specific feedback on user productivity. Existence of a direct relationship between library utilization and resultant user productivity is, of course, not well established. Orr [27] suggested that if a cause-effect relationship indeed exists between library utilization and productivity, it is not clear which is the cause and which is the effect. Nonetheless, a strong argument can be made that allocation of library resources should be made with priority given to those resources which serve the needs of and are used by recipients who contribute the most to achieving institutional objectives. Therefore, an effective information system should provide library management with an efficient means to periodically monitor individual user productivity in a reasonably valid fashion.

There is at present little opportunity to borrow from previous research to find operational measures in this area. For this reason an extensive primary research effort would be necessary as part of this task. The objective would be to obtain an invisible (to the user) means of monitoring institutional productivity with the ability to map the measure of productivity onto the previous descriptor vocabulary. This would permit a comparison of productivity, availability, and utilization all in terms of the same dimension: the profile of user needs.

For a university setting, objective evaluation would focus on informational products of user productivity. Such products include books, monographs, chapters, refereed articles, other publications, invited papers, and contributed papers. Other factors such as grants, patents, activity in professional societies, honors, and awards would also be measured.

Task 5: Indexes of Availability

The availability of documents suited to a user's needs is an essential factor in assessing the performance of a library with respect to the user. The profile of a user's needs, again expressed in terms of descriptors, can be employed as the criterion for judging document availability. Keywords in a user profile can be arranged in a hierarchic fashion and ranked by priority at each level by the user, either explicitly or implicitly. Group aggregates of user profiles can then be formed by scaling each user in the group by priority according to productivity, utilization, or other criteria.

Although the conceptual model of a library (see Fig. 1) refers to availability as a single concept, there are, in effect, multiple dimensions which are subject to measurements. Some of these dimensions include (1) proximity of documents to the user with respect to access time and delivery time; (2) access cost to the user and the system; (3) medium of access (original, xerox, film); (4) possession by ownership, loan, or use only on premises.

In executing this task, a library will be further developing a recognized important capability in being able to quickly assess the availability of identified documents in its own or in other collections. Such an assessment can be applied to any needs profile representing individual users or priority-modulated aggregates of users. Applying the assessment to the aggregate of the entire user community would yield a gross measure of the availability of relevant information to the institution.

The measures of availability would be reported in much the same way as utilization. Tabulations of degree of availability (time, cost, etc.) could be produced which show distribution with respect to relevant categories of user profiles and user types. In addition to periodic reporting of overall performance, there should also be a capability for *ad hoc* reporting for specific profiles, such as, for example, a comprehensive evaluation of document availability with respect to a specific field of study. Examples of such needs are evaluation of library holdings and access performance by accreditation teams, accessing the need for acquisitions to support a new program, and developing comprehensive reading lists for undergraduate and graduate programs and courses.

Task 6: Institutional and Environmental Influences

The informational parameters identified in tasks 2-5 are representative of current and on-going user interests and activities. Such information is undoubtedly sufficient for overall planning and decision-making, provided current activities are conforming with institutional goals and objectives. However, this is not the case if institutional goals and objectives change. In that event information on these developments becomes an important factor in anticipating and planning for future requirements. For example, an administrative institutional decision to develop a new program or change the emphasis of a current program can have profound effects on future requirements for library and information services. In such an instance, the specific information on institutional goals and objectives provides direction for modulating resource acquisition and service provision policies by which to meet these future requirements.

Within this task, a methodology must be developed for translating institutional goals and objectives into operational decision-making parameters. A link needs to be developed between institutional goals and objectives and the projected aggregated set of user profiles. This projected set of profiles would then be assigned weights in accordance with the institutional priorities and associated target dates. Continuity with the aggregate profiles of current users is one of the boundary conditions.

Implications

In attempting to apply the available body of research knowledge relevant to library decision-making and planning activities, the individual library director must first have a means to identify problems and opportunities in his/her own particular institutional context and then have a means

to assess the consequences of alternative resource allocation decisions. Since the library manager operates within a context of resource constraints and institutional objectives, the need is to set priorities for action within a rational framework. This article has attempted to establish such a framework within which measurement results, research findings and technological developments may be implemented as rational responses to identified user and institutional needs.

Application of this concept in a given library situation will, as always, be related to specific cost-benefit considerations. A system of this nature will require the deployment of current institutional and library resources in order to provide the necessary input data for the decision-making process. The economic trade-offs with respect to investing in such a database will therefore depend on the institutional pressure on resources for the library and on the institution's concept of the role of the library and the value of its current level of support.

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