
Library Cost Analysis

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ABSTRACT

A PROCEDURE FOR FUNCTIONAL COST analysis is presented. All costs of materials and services are allocated to a set of library functions representing direct services to users or patrons. The functional or unit costs thus calculated may be reconciled to account for the entire library budget. Functional cost analysis is useful for planning, management, and budget justification.

INTRODUCTION

The purpose of cost analysis is to attach costs to the products or services created or rendered by an organization. In the case of a library, there are no tangible products (except for photocopies) and the primary "product" is a range of services. The first problem in studying library costs is to identify these services in an organized way, and to decide what characteristics of these services drive the cost picture. It is customary and quite sensible to divide the services the library provides into technical services and public services. Public services, now more properly described as access services, help to bring patrons into contact with information-bearing materials (Hayes, 1979). Technical services help to acquire and organize those information-bearing materials so that access may be facilitated. At present, acquisition forms the major part of the technical services side of the ledger. There is a large budget for the purchase of books and materials. There is a further budget for the management of periodicals as they come in and for the cataloging of other serials and monographic materials. Although the cataloging activity has been, and continues to be, radically transformed by the

existence of national utilities such as OCLC and RLIN, it remains a substantial cost of technical services. A rapidly growing cost component, but still not yet large in absolute terms, is the development and maintenance of computer systems and services typified by the online public access catalog.

These new computerized services have the goal of making available to the library patron (in this context frequently called the end user) the same technology used in technical services for more than a decade. Developing these systems and ensuring their usability, reliability, and upward compatibility in a rapidly changing scene, requires a new level of technical skill and professionalism which has not yet been fully recognized in the library profession.

Public services are the familiar activities by which the patrons or end users interact with information-bearing materials. Broadly speaking, these include two types of unassisted access: use of materials in the library and circulation or borrowing of materials, and a very important category of assisted use called reference services.

Peculiarly enough, from the point of view of those who support the library, this relatively small group of public services (relatively small when viewed from a budget perspective) represents the entire library. In other words, the tip of the iceberg, perceived by the users, must carry the entire burden of justifying the library's existence, function, and costs.

Thus, as a first step in functional cost analysis of a library, these services must be quantified. This is a fairly difficult problem which falls into the general area of library performance measurement. Before this is discussed, it is essential to have an agreement on a definition of terms. Measures will have to be defined for the amount of in-house use of materials, circulation of materials and, perhaps most difficult of all, for reference service or support.

However, the *quantity* of service rendered, that tip of the iceberg, by no means tells the whole story. The services are rendered with one or another level of quality under several different definitions of what is meant by quality. The *color* or *brightness* of the tip of the iceberg might be thought of as a qualitative phenomenon, but one subject to some degree of quantitation.

In developing measures of the quality of a library's service, scales of measurement must be created. For an analogy, consider gemology in which qualities such as clarity, brightness, or hardness must be defined. Hardness, for example, is defined in terms of a series of materials each of which scratches the one softer than it and is scratched by the ones harder than it. This is hardly an ideal quantitative measure but at least it puts things into some kind of order. The numbers on this scale do not define the value of the gemstone, nor are they easily related to underlying physical properties such as intermolecular forces which might be responsible for the hardness of the material. Similar problems exist in the definition of such properties as the brightness of color and the loudness of sound.

Defining the qualities of library service is further complicated by the fact that one can distinguish between the physical processes of library service and the intellectual product of library service. In distinguishing between the quality of process and quality of product, the focus is separately on the easily measurable parts of library service and, with much less certainty, on the intellectual parts. Typical characteristics of a library process are the availability of a particular service, the effort (on the part of the user) associated with that service, and the delays involved. Availability is usually measured as chance of success, such as 50, 60, or 80 percent. Accessibility, thought of in terms of patron effort, may be measured in costs incurred by the user, energy expended, or time spent. Delays are measured in hours, days, or weeks that elapse between the expenditure of the user's effort and his actual receipt of the information-bearing materials. These delays originate in the policies, procedures, and practices followed by the library and in external events. These physical characteristics of the library service process are amenable to measurement and have been discussed at some length elsewhere (Kantor, 1984).

Measuring the quality of the product brings this discussion into the gray area where librarianship overlaps with information science. We would like to reach into the mind of the end user to see whether the information delivered actually meets his need. But there is no guarantee that even the end user really knows whether the need was met. For example, he may receive information which claims to be the answer to his problem when this is not true. Or he may receive a partial answer when there is a much better answer to be found in the same collection of literature. In information science, the two concepts of precision and recall (or their various transforms) are introduced in an effort to measure the quality of the product.

The "precision" of a response refers to the ease with which the end user can get the information he really needs from the materials that have been provided. For example, if he gets seven books and the answer is contained in one paragraph on one page of one of those books, then precision is very low. There is a great deal of other material he may have to sort through before settling on the correct answer. On the other hand, "recall" refers to the more difficult notion of "how much of the world's relevant information" has been provided to him. Estimating this is harder than knowing whether the user's need has been satisfied. It would be necessary to know, for the entire world literature, how many items are relevant. So, information science, although it has much to say about librarianship, does not provide foolproof methods for quantifying that qualitative aspect called "the quality of product."

We will not completely close the relationship between the quality of library services and the cost of providing them. Even though this issue will not be resolved here, it is important to note that the frequently made arguments that libraries with higher cost for their services are *ipso facto*

providing a better quality of service, are usually unjustified and often groundless. That they are unjustified is obvious since the measures of quality do not exist. That they are groundless is evidenced by the fact that variations in operating procedures can double or triple the cost of library operations.

AN EXAMPLE IN TECHNICAL SERVICES

Although public services have been called the tip of an iceberg, it is suggestive to represent the structure of library costs as an inverted pyramid balanced on a relatively small tip called public services. This representation of the problem makes it easy to think of costs as flowing down from the various operating activities and expense budgets to public services. The costs must be distributed onto the public services activities in order to make a clear link with the function of the library as it is perceived by those who support it and those who use it. To illustrate the problems that arise in cost analysis, this discussion will begin with technical services. In technical services the troublesome problem of what the user needs or gets does not arise. In technical services, the only concern is with the materials that are brought into the library and with their processing.

A typical breakdown of a technical services budget might look something like Table 1. Most of the budget is in salaries, with some additional space cost and other direct cost and an administrative overhead. Overhead is this activity's share of the central administrative cost of the library, the corporation, or the university. The operation acquires materials, so the costs that enter the picture are cost of materials acquired and the cost of the work performed on them.

How are we to think of this? One point of view is that the technical services operation buys a certain number of dollars worth of "library stuff." The entire cost of the technical services division could be treated as an overhead on the materials that are brought in. This is an impressive 115 percent (= \$69,000/60,000). In the language of cost accounting, all costs of the materials acquired have been "pooled" into one number which is called the base and the technical services division costs are "pooled" into another number which is called "the overhead."

It may seem strange to put labor costs as an overhead on other cost figures. It is much more common to distribute overhead on the basis of labor. However, in this regard libraries need a point of view which is becoming prevalent in industry. When labor costs are substantially changed through the introduction of automation, it eventually makes sense to treat labor as an overhead. It should be noted that, in the industrial situation, labor costs often fall to as little as 10 or 15 percent of total manufacturing costs with the heavy use of automation. In the library case, as in most service industries, labor costs are, at the moment, quite high. Baumol & Blackman (1983) has argued that this will remain true for all time, but the argument is not completely convincing.

TABLE I
BASIC BUDGETARY INFORMATION

<i>Technical Services Budget</i>	<i>Basic Budget Elements</i>	<i>Budget Elements Allocated to Materials Handling</i>		
		<i>Periodicals</i>	<i>Serials</i>	<i>Monographs</i>
Salaries	\$50,000	\$2,536	\$7,609	\$39,855
Space costs	\$4,000	\$500	\$1,500	\$2,000
Other direct	\$7,000	\$500	\$1,500	\$5,000
Overhead	\$8,000	\$464	\$1,391	\$6,145
Total	\$69,000	\$4,000	\$12,000	\$53,000
<i>Cost of Materials</i>				
Periodicals	\$30,000			
Other serials	\$10,000			
Monographs	\$20,000			
Total	\$60,000			

One might object to pooling as some materials are much more difficult to handle than others and are "handled in different departments." The fact that they are handled in different departments should be of no concern. If things can logically be pulled together, one should not be deterred by administrative history. On the other hand, if they require substantially different amounts of labor and if one is planning to do anything about it, it may be important to make a distinction.

An example of this kind of argument is shown in Table 1. The total \$69,000 of technical services costs is broken down into portions attributable to monographs, to periodicals, and to other books in series. A similar breakdown is also made of the costs of materials. As a result, three different overhead figures can be calculated, ranging from 13 to 265 percent (see Table 2).

This "simple example" of technical services costs has become somewhat complicated. There are two more important complications to consider. The first is choice of the base, and the second is inclusion of quality in the analysis. "Dollars expended" is an appropriate base if the library is thought of as no more than a purchasing agent for its institution. If the "function" is to "spend the money" on information materials, then efficiency is fairly measured by how much it costs to spend that money.

Choice of Base

But, even without regard to the end use of these materials, anyone familiar with library processes will realize that the dollar is not a particularly logical unit. For example, in dealing with monographs, the effort expended is likely to be proportional to the number of bibliographic items (or books, as we used to call them) processed. It would

TABLE 2
OVERHEAD RATES

<i>Service</i>	<i>Overhead</i>	<i>Base</i>	<i>Rate</i>
Periodicals	\$4,000	\$30,000	13.3%
Other serials	\$12,000	\$10,000	120.0%
Monographs	\$53,000	\$20,000	265.0%

make more sense to divide the technical services cost for monographs by the number of monographs processed (suppose it is 1,000) to come up with a figure of \$53 per item. If books were more expensive, for reasons not having to do with general price inflation, one would expect that the per book cost would remain the same rather than the cost per dollar spent on books. Similarly, if the cost of books were to miraculously drop, one would not project a drop in the costs of technical services.

Turning to periodicals, the natural unit of measure here is not bibliographic, but is most likely to be the number of single issues processed. Processing periodicals tends to go by the single issue as each is unpacked, checked in, and shelved. Thus it would seem sensible to attribute the cost of this processing to the individual physical issue received. Of course this would complicate life further down the line. Eventually most of the periodicals are drawn from the shelves, bound, and returned to use. In this case the cost of a bound volume would be some combination of the binding cost plus the cost assigned to the handling of each of the individual issues as it came in, plus of course the purchase cost.

Finally, books in series represent a perplexing issue as they seem to be "difficult" not necessarily in proportion to the number of series handled or to the number of volumes handled. Such things as changes in name and publisher and problems of effective cataloging make it hard to specify the natural base number by which the cost of processing ought to be divided.

Quality of Service

To this point the discussion has only been about the problem of assigning cost to a *quantity* of activity. Nothing has been said about the *quality* of that activity. Here, as discussed earlier for public services, there is both quality of process and quality of product. Quality of process (leaving aside the fact that most administrators do think of the cost as one of the qualities of process) boils down to the delays. In most libraries there is no analogue to the notion of availability—that is, the intention (or pretension) to eventually process every book or periodical that is received. The wisdom of this intention could be questioned as will be seen later.

Processing delays are defined by the interval between the time that material arrives in the mail room and the time that it is on the shelf and

in the catalog ready for the readers to use. Techniques have been developed and described elsewhere to measure these delays (Kantor, 1984). On the average these are performed quite easily. The essential fact is that delay is directly proportional to the size of the backlog and inversely proportional to the rate at which materials are processed. This assumes, as is usually the case, that there is a work flow (or several parallel work flows for various types of material), operating on a first in first out queue discipline. New arrivals go to the end of the list and wait to be processed in turn.

It is interesting to note that this aspect of quality—the size of delay—is in principle absolutely unrelated to the cost of technical services operation. As long as materials continue to be processed at the same rate, the cost of processing will not change. If materials are quite old, because there is a large backlog, they will be neither more expensive nor less expensive to process.

There is an exception to this rule. A certain fraction of materials requires original cataloging if cataloged at the moment received, but can be handled by copy cataloging after a suitable delay. This procedure, which has been instituted in an uncoordinated and ad hoc way by libraries around the country, is fundamentally unstable and uneconomic. It can be likened to a suburban community of homeowners all of whom decide not to buy lawn mowers because they intend to borrow from each other. The new initiative for nationally coordinated cataloging being developed by the Library of Congress, The Council on Library Resources, and Association of Research Libraries represents a first effort to control the potential instability of this situation.

Delay can be changed by one time administrative or procedural remedies not having any specific cost structure. One extreme is to hire a task force of part-time specialists to catalog all the books in the backlog. The cost of this is essentially proportional to the number of books, and therefore proportional to the size of the backlog, and finally proportional to the size of the current processing delay.

A second alternative is to place all of the books on special shelves available to the public, advertise their presence, and process only the ones that find their way into use. (This procedure was instituted by H.F. Johnson at Emory University in Atlanta under the clever name of “front log.”) The cost in this case is a simple one-time cost of moving the materials and advertising their presence, plus an amount proportional to the number of books in the collection that actually have value and are used. If the backlog collection fills a few hundred feet of shelves, there is reasonable probability that books of value will find their way into use. If it fills a warehouse sized room 200 feet on each side, without substantial partial cataloging, there is a good chance that much of it will not find its way into use.

Quality of Product

What are the quality features of the product of technical services?

One is correct handling of physical material (putting the right call number on, typing the correct characters on a card or in a database, putting a book onto a shelf in the place that its call number indicates, and so forth). These are straightforward physical processes and the error rate can be measured by taking a sufficiently large sample of work completed and carefully checking it for errors.

More difficult to measure is the quality of the intellectual processes involved in technical services. Primary here is cataloging—both subject cataloging and descriptive. In addition, there are related activities such as the assignment of a classification number and making necessary updates to and checks with various authority files. Thus the cataloging of a book results in the production of an intellectual product which is either a complete original cataloging record or a derived cataloging record sufficiently consistent with both national and local standards.

The quality of this type of work can also be measured, but only with difficulty. A substantial range of results could be considered completely acceptable, but some deviations must be regarded as “errors.” Quality could be measured by the number of books handled for which the resulting records have no errors at all. On the other hand, one could distinguish between substantial errors (for example those that would significantly limit user access to the books) and stylistic errors (which represent deviations from practice having no foreseeable impact on the operation of the library). From this standpoint one would count an operation successful if it produced no substantial errors. Of course, substantial errors could act independently of each other, and one might want to develop measures which compare the number of substantial errors committed with the number of items processed. The number of substantial errors could be in principle larger than the number of items processed, which could result in a 120 percent error rate.

Quality and Cost

There is no generally accepted theory for how the elimination of errors, beyond the performance achieved by routine training and supervision, affects costs. There is certainly some law of diminishing returns, as it becomes more and more expensive to weed out an ever smaller supply of errors. One possibility is that, above some baseline performance, cost will increase in proportion to the number of records that don't have errors divided by the number of records that do have errors (Kantor, 1984). This suggests that going from a 4 percent error rate to a 2 percent error rate could double the cost. This will be called the “good-to-bad” ratio approach.

Another way of looking at errors is to suppose that errors arise not because of the intrinsic difficulty of the material but as a kind of random phenomenon. Thus if there is a 4 percent error rate it means that 96 percent of all the materials are being processed correctly. The cost could be doubled by processing everything twice (not assigning it to the same

people). Under this random error model, the error rate would then drop to 4 percent of 4 percent, which is less than 0.16 percent. Thus, according to what are considered the errors and how avoidable these may be, very different estimates are obtained of the relation between the quality of product and the cost of providing that quality.

Let it be noted that if the baseline performance figure was 60 percent, then under the ratio model, a doubling of costs would represent a rise to 75 percent. On the other hand, under the random errors model, doubling of cost could bring the percentage all the way up to 84 percent, nearly 10 percentage points higher. In this way, the good-to-bad ratio approach seems to provide a kind of upper limit for the cost of improving quality (Kantor, 1984).

COLLECTION DEVELOPMENT—AN INTERMEDIATE EXAMPLE

Collection development, which was conspicuously absent from the earlier cost pyramid, represents an interesting middle ground between technical services and public or access services. Like technical services, collection management has a fairly orderly work product—a set of purchase requests. Unlike technical services, it deals with a somewhat ill-defined body of potential work. In principle, any book or serial is a candidate for consideration. In some ways the quantification of work in collection development is even more difficult than quantification in the area of reference services.

It would be unreasonable to say that a collection management group that recommends the purchase of 1,000 items has done twice as much work as a group that recommends the purchase of 500 items. In fact, if both groups arrived at their results by carefully studying a list of 2,000 candidates, then the second group may have done 50 percent more work because they have eliminated 500 more items from the list. Or, perhaps they have done 50 percent less work by somehow easily skimming off the top 500 items while the other group struggled to allocate the rest of its budget by picking the best 500 from a not-too-attractive remaining list of 1,500 candidates.

Given that it cannot be known, from the number of items recommended, the amount of work done, it seems most reasonable to take as a base figure for the collection development activity the number of items "seriously considered for acquisition." The corresponding cost measure for this activity is the total cost of the activity divided by the number of items considered. Note that when cost is distributed over the materials themselves, this measure is of no use. Eventually the cost must be distributed over the items that are actually acquired with the understanding that it does not represent a measure of the performance of the collection development activity.

The quality of a collection development activity is measured in one way by standard surveys of library holdings. If a library of a given type is expected to maintain a certain list of core journals in a specialty or a

certain list of basic textbooks, then performance can be measured by comparison with those lists. Generally speaking, this tells more about the library's budgetary situation than about the abilities of its development staff. The lists are available to that staff who may not be able to buy what they need.

A totally different perspective is provided by considering the usefulness (that is, use) to the readers. From this point of view, the performance of collection development is measured by the number of use events generated by newly acquired materials during their first two or three years of existence. As with most aspects of a library, this cannot be taken in isolation. For example, the best collection policies in the world will not result in prompt use if technical services has a three-year backlog. The books simply won't be "out there" to be used. By the time they are available, particularly in the sciences, they may have passed their period of peak interest. Similarly, there may be items whose acquisition is important to the institutional mission (for example, because they are used by a key researcher or because they complete holdings in a recognized area of strength), but which are not heavily used after they are acquired.

With all of these misgivings, it would still be interesting for collection development offices to routinely scan the circulation activities and other use indicators for the materials that they recommend. At the very least, it might help to shape their perceptions of the needs of the collections user as perhaps opposed to the needs of "the collection itself."

This completes the preliminary survey of some of the problems and concepts that arise in performing cost analysis for technical services. This subject has been dealt with at length in Kantor (1986, pp. 221-86). The problem boils down to defining the overhead, defining the base, and dividing one number by another. There is, in principle, nothing difficult about it. There is, in practice, a double minefield of intellectual and political pitfalls. Some of the intellectual problems have already been surveyed in this discussion. The cost analyst must be prepared to make decisions that are somewhat arbitrary but defensible and then be able to defend them until better ones come along. The political traps are substantial.

Any cost figure developed at a library and made known to the library's friends and enemies can cause substantial harm. This is particularly true because there has been so little public discussion of costs and sharing of cost information. Any number can be made to look large by an outraged professor who would like to see more money spent on books. What he really ought to ask is whether that number is larger at his library than at another library and if it is larger at his library, is it buying more function or does it just represent poor practice.

The same can, of course, be said for performance measures themselves. There is a great fear that the release of any measure, such as an

availability figure or a delay figure, will be used to harm the library or to attack its present leadership. Manfred F. R. Kets DeVries of the European Institute of Business Administration reports that "a certain amount of paranoia is inevitable in the corporate world and to a certain point it is indeed adaptive" (Wray, 1989, p. 62).

The dangers in the political climate have held the development of performance measures and cost analysis to an absolutely glacial pace in librarianship. Russell Shank proposed, in the early 1950s, measures of availability and processing speed that were later rediscovered by the author (R. Shank, personal communication, 1976). The Public Library Association, in a pioneering effort to introduce analysis of performance and costs, found it necessary to break the ice with a weighty manual (Palmour, 1980) on planning processes with little more than passing reference to the measurement of progress toward objectives. Successive volumes have dealt with the introduction of objective performance measurements in public libraries (Zweizig & Rodger, 1982) and with library costs (Rosenberg, 1985). Unfortunately, even with the advent of a major coordinated work on planning, measurement and evaluation (McClure et al., 1987; Van House et al., 1987), there are still serious gaps in the literature. These have to do with assigning costs to the services that the library provides in a way that makes sense to both the users and librarians, the subject of this article.

The Association of College and Research Libraries has also moved into the arena with the development of a workbook on performance measurement (Van House, 1989, in preparation) which stands somewhere between the PLA's effort and the book published by the Association of Research Libraries (Kantor, 1984).

ASSIGNING COST OF LIBRARY OPERATIONS TO VISIBLE ACCESS SERVICES

When the costs assigned to individual services are multiplied by the number of service events in a year and the results are added, these must equal the total operating budget of the library. Such an assignment of costs is considered "fair to the library." This is exactly the same principle that is used by the U.S. government in reviewing costs in a contractor's proposal. The government does not ask whether the contractor is spending money wisely but simply asks how it is being spent. Presumably the government's protection from contractors who spend money unwisely is that they submit higher bids and are not selected. It is worth noting that in the library world this very important control over "contractor foolishness" does not exist. There are no situations in which, for example, a major university publishes a request for proposals for the management of its library and evaluates more than one option. Generally it reviews this year's budget request, comparing it with last year's budget request and this year's total university budget. This lack of a "competitive market place" makes possible the survival of enormous

disparities in the cost of essentially similar operations at different libraries.

Once "fair" costs for services are arrived at, it is important to realize what they are not. They are not the kind of "purchase price" that can be used without reservation to project future budgets. For example, if it is found that the present cost assigned to a circulating book is \$3.07 per circulation, it could not be projected confidently that if there are 2,000 more circulations next year it will add \$6,140 to the library's operating cost. Such a projection cannot be made because there are enormous interdependencies in the effects of library activities. The figure for the cost of circulation includes, as shall be seen, something of the cost of buying and cataloging and shelving the book that circulates. These costs are "sunk" and if no more books are bought in response to the greater circulation next year, the only additional costs will be the directly attributable costs—i.e., check out and reshelving.

It is sometimes argued that for this reason only the directly attributable costs should be allocated to services and the entire cost of acquiring and organizing the collection should be treated as a capital investment (Hayes, 1979). As attractive as this argument may be, it does not seem possible to apply the other usual techniques for the accounting of capital investment (such as the cost of money or concepts of depreciation) to the book stock. For this reason, accounting all of the expenditures as current expenditures is preferable (Rosenberg, 1975).

Of course, when projections must be made, a complete functional cost analysis will have the necessary information. The cost assigned to a circulation will consist of the fixed or sunk part and the variable part, and in a projection it is the variable part that should be used.

The general approach to library cost analysis proceeds in two steps. First, determine a total cost of a particular information-bearing item: a book, a periodical, a purchased database, and so forth. This assignment is based on the principles described earlier. It includes the purchase cost plus a reasonably allocated share of the processing costs. It has already been noted that most of these costs arise not because of the need to physically install the object in a library, but because of the need to intellectually install it with the creation of appropriate bibliographic control. The payoff for all of this effort lies in the actual use of the items.

Circulation

For any particular kind of use event, such as a circulation, the per event cost of the book must be added to the per event cost of maintaining and operating the circulation system, and stacking and reshelving books. The second part of this sum is easy. The total cost of the circulation department (which is almost entirely in salaries and software/hardware costs) is divided by the number of circulations per year. The difficulty lies in dividing the cost of a book by the overall number of

uses which requires definition of what is meant by a use and what is meant by the overall number of uses.

The costs of the public services are interlinked through the fact that these services all make use of the same body of materials. (Of course there might be a separate collection of materials which is only used for reference support. That cost would simply be added to the direct costs of salaries, software and hardware in determining the per use cost of reference service.) What is meant by "a use" of a book and how are those uses to be compared across the various modes of access (photocopy, circulation, in-house use, reference use, etc.)?

Book Use Equivalency

It was suggested many years ago (Hamburg et al., 1974) that the natural unit of measure is the amount of time that the patron or end user spends in direct interaction with the book. Thus, if I read one book for three hours, while you read another for one hour, I have received three times as much "book use." This is an attractive idea, particularly because it squares very well with the notion that the patron expresses his evaluation of an item by continuing to use it. But, if a book is poorly organized, so that it takes three hours to dig the answer out of it, I might feel that I have not received three hours of *service* but that the three hours represent an added *cost* to me. In addition, books are used in varying ways to satisfy varying needs. In the case of a novel, unless I am preparing a particularly superficial book report, I expect to read the whole thing to derive whatever value it presents. A dictionary is used in quite the reverse way. For online fee-for-time services, that fee may be taken as an indication of value to the end user. But for access to subsidized services, one faces a problem essentially the same as for book use.

The key to allocating the cost of materials among various types of access is called Book Use Equivalency (BUE). Rather than base BUE on the amount of time that the user spends in contact with the book, it is based on the principle of "use until satisfaction." This asserts that the user, freed from other restrictions, uses a book until he has the answer to his question. What this means is that "one user's completed book use" is the same amount of service as "another user's completed book use" even though it is a different book, and it took a different amount of time to complete.

To allocate the cost of books requires the total number of book use events that occur during the year. Usual library statistics report circulations per year, interlibrary loans per year, photocopies per year and so forth. The BUE converts these to a common measure. For most services the BUE is very simple. The photocopying of a single item, be it one page or fifteen pages, represents one book use. The circulation of a book represents one book use. An interlibrary loan represents one book use. On the other hand reference service, in which a staff member assists the

user in finding information, typically requires the use of more than one book. A small sampling study may be done in the library. Details of all of these study techniques are presented in the FUNCOST Manual (Tantalus, Inc., 1986a). Such a study will typically reveal a value somewhere between one and three books consulted per reference engagement. Suppose for convenience that the number is two.

Similarly, a person who is studying the library's books in-house (without checking them out), is generally found to use more than one book in an hour. It turns out that it is much easier to measure the total time that patrons spend in the library reading the library's books than to directly count the number of books used (Tantalus, Inc., 1986b). The equivalency is established by controlled reshelving studies coupled with interviews, as appropriate. In typical studies, it was found that the number was approximately three books used per hour of in-house reading. (If this number seems high, recall that most users who intend to spend a good deal of time with a book will do their best to borrow it and take it to a comfortable location.)

To be definite, refer to the figures in Tables 3 and 4. The total materials costs burdened by technical services is \$129,000. The use statistics are 18,000 circulations per year, 12,000 reference queries, and 10,000 hours in-house. Doing the multiplications shows that the total book use equivalency is 72,000. Thus, a single book use, fully burdened, works out to a cost of \$1.79 (see Table 5).

Consider these statistics in more usual terms. The 18,000 circulations represent about 360 books circulated per week (allowing for two holiday weeks in the year) or about 60 per day. The reference load is distributed over perhaps 2,000 hours a year during which reference service is provided. It represents an average of about six queries per hour. Since the focus is on informational rather than directional queries, this represents a load that may require more than a single reference librarian. Finally, the 10,000 hours of in-house use represent, when divided by a presumed total of 3,000 hours that the library is open, an average of three and one-third people reading the library's books in the library at any time. There may be more people in the library than this, using the catalog, reading their own books, or eating lunch.

From this point it is straightforward to calculate the costs to be assigned to each type of service (see Table 6). The circulation load described represents a total salary cost of \$18,000. A figure of \$5,000 represents hardware/software costs. Accounting hardware/software costs is something that won't be examined in detail here. Essentially the purchase price of software should be amortized over a reasonable number of years, not less than three but probably not more than five. Similarly the price of hardware should be amortized over that period. The cost of \$5,000 a year might represent something like a \$20,000 system with a \$1,000 annual maintenance contract (\$20,000 divided by 5 equals \$4,000 per year amortization plus \$1,000 per year maintenance equals \$5,000 per year).

TABLE 3
BURDENED COST OF MATERIALS

Technical services	69,000
Materials cost	60,000
Total	129,000

TABLE 4
BOOK USE EQUIVALENCY

<i>Service</i>	<i>Level</i>	<i>BUE</i>	<i>Product</i>
Circulation	18,000 circ	1 c	18,000
Reference	12,000 qrys	2 q	24,000
In-house use	10,000 hrs	3 h	30,000
Total			72,000

The total directly attributable costs for circulation is thus \$23,000 and is to be divided by the total number of circulations (18,000) to produce the directly attributable cost of \$1.28. The sum of the cost of book use (\$1.79) and the directly attributable cost is \$3.07, the functional cost of circulation at this library for the year (see Table 7).

Once again, be warned that this is the cost which must be recovered if the library is to pay all of its expenses. It is not necessarily the cost that would be saved if circulation is reduced by a few thousand nor is it the increased cost that would be experienced if circulation increased with other things remaining fixed.

Reference

Turning to reference, suppose that the direct cost of the reference department is \$80,000 in salaries plus a \$20,000 current expense on specific reference materials for a total of \$100,000. This is apportioned onto the 12,000 reference queries giving an average of \$8.33 in directly attributable costs. To this must be added the book use cost which is \$1.79 per use cost times an average of two uses per query or \$3.58. The total, \$11.91, represents the cost per reference query.

In-House Use

The directly attributable cost for in-house use is very small. Suppose the library has a reading area of 600 or 700 square feet with a few tables and chairs. Reasonable rental cost or equivalent value for that space and furniture might be \$12,000 per year. This is divided by 10,000 hours of use to give a figure of \$1.20 in directly assignable costs for the use of the space and furniture. To this must be added however the book use equivalency value of the three books used per hour—\$5.37. Thus the total cost per hour of in-house use is \$6.57 (see Table 7). The numbers

TABLE 5
UNIT COST OF BOOKS PER USE

Burdened cost of materials	\$129,000
Total usage in BUE units	72,000
Unit cost	\$1.79

TABLE 6
DIRECT COST CALCULATIONS

<i>Service</i>	<i>Annual</i>	<i>Events</i>	<i>Per Event</i>
Circulation	\$23,000	18,000 circ	\$1.28
Reference	\$100,000	12,000 qrys	\$8.33
In-house use	\$12,000	10,000 hrs	\$1.20

given here are not unreasonable, but this is entirely a made up example (for a survey of some real world data drawn from academic libraries, see Kantor, 1986, pp. 221-86).

It is interesting—one might almost say striking—that what appears to be the most free use of the library—simply sitting and looking at books—is quite expensive on a per hour basis. Of course an hour of reference consultation would be even more expensive, but most engagements don't last nearly that long.

Reconciliation

Do these costs represent a fair account of the library's budget? The calculational check is shown in Tables 8 and 9, where each service is represented by the product of the activity per year and the assigned average cost recovering the total budget of \$264,000. This completes the example of cost analysis.

DISCUSSIONS AND PROSPECTS

The same techniques used here can be applied to an analysis of any of the library's complex activities. The example given has all the important features: a shared resource (the books) which involves both direct purchase costs, treated as a current expense, and a burden of processing costs. It involves the allocation of this shared resource among several types of activities requiring development of an equivalency ratio applicable to each of the types of activity. In this case the basic unit was called a book use, and a cost assignable per book use was derived. Exactly the same principle could be applied to develop a cost for audiovisual equipment, computer resources, online databases, and so forth. One verifies that the assignment of resource use costs, based on the equivalency, plus the direct costs yields a fair cost for the service itself by

TABLE 7
FULL COST CALCULATIONS

<i>Service</i>	<i>Direct</i>	<i>BUE</i>	<i>BUC</i>	<i>Total</i>
Circulation	\$1.28	1	\$1.79	\$3.07
Reference	\$8.33	2	\$1.79	\$11.92
In-house use	\$1.20	3	\$1.79	\$6.57

TABLE 8
RECONCILIATION

<i>Service</i>	<i>Annual</i>	<i>Unit Cost</i>	<i>Product</i>	<i>Direct</i>	<i>Breakdown Book Use</i>
Circulation	18,000 circ	\$3.07	\$55,250	\$23,000	\$32,250
Reference	12,000 qrys	\$11.92	\$143,000	\$100,000	\$43,000
In-house use	10,000 hrs	\$6.57	\$65,750	\$12,000	\$53,750
Total			\$264,000	\$135,000	\$129,000

TABLE 9
RECONCILIATION

<i>Service</i>	<i>Annual</i>
Circulation	\$23,000
Reference	\$100,000
In-house use	\$12,000
Sub total	\$135,000
<i>Burdened Cost of Materials</i>	
Technical services	\$69,000
Materials cost	\$60,000
Sub total	\$129,000
Total	\$264,000

checking that the sum of all assigned costs returns the total operating budget.

This analysis can be used to explain costs and to justify costs in terms of operations. It cannot be used directly for projection. If the cost of adding another 2,000 circulations must be projected, look to the *direct* cost portion of the circulation activity which is only \$23,000 and project an additional \$2,560 in costs. (All of this, of course, must be adjusted for inflation in a real world.)

Functional cost analysis can be useful to a library manager in comparing the current year's activities with last and in explaining the

relation between the library's large cost of operation and that small tip of the iceberg that is visible to users. There are not yet standards and norms for operating costs. The development of these is by no means an armchair exercise, nor can it be done by a standards committee. It requires the diligent development and sharing of accurate, reproducible cost analyses among peer groups of libraries. The principles outlined in this article should make it easier for groups of libraries to undertake this activity.

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