



Analysis of Costs and Performance

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NEARLY ALL systems analysis work is directed in greater or lesser part toward achieving improvement in system performance relative to system cost. The vast majority of studies, however, either treat cost-effectiveness in a somewhat subjective way¹ or relate to specific library processes and subsystems.² The purpose of this chapter is to outline the most practical approach for analyzing costs and performance in a manner comprehending all the services and processes of a library or group of libraries. A library management information system is proposed which provides budget, cost and performance data for planning and control purposes in addition to conventional financial and statistical statements. This approach is practical not only in the sense that it is oriented to practical library management problems and goals, but also in the sense that it is designed to be a cost-effective aid to library management. The emphasis is on producing essential data at minimum cost.

A related modeling approach is briefly described. For theoretical discussion of cost-effectiveness analysis and cost-benefit analysis and their application in other fields see the Additional References. The paper by Walsh³ provides an excellent summary of the formidable theoretical and practical problems in the cost-benefit area. Closer to the library field are discussions by Lancaster,⁴ Orr⁵ and Wessel.⁶

A LIBRARY MANAGEMENT INFORMATION SYSTEM

Hayes and Becker argued cogently for the adoption of cost accounting by libraries: "In summary, a cost accounting system is continuing rather than intermittent; it is concerned with the total library and not with some detailed aspect of it; and it ties together costs with effectiveness rather than being concerned with simply one or the other. Cost

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accounting is a management tool of primary value to the librarian in his day-to-day control of his own library."⁷

Hayes and Becker provide a brief sketch of a cost accounting system with a list of possible report outputs, tentative cost reporting forms and illustrative unit costs. Operation of the system represents a cost in itself: "It is relatively easy to accumulate statistics or to control budgets; it requires a recording system to tie the two together. As a result, a cost accounting system represents a cost in itself. Its costs must be weighed against values received."⁷

Hayes and Becker discuss rather than describe a system and it is necessary to refer elsewhere for a clearer idea of the main outputs of such a system and for background statistical⁸ and accounting works. Concerning accounting, Horngren⁹ is both thorough and readable. Concerning budget statements, Brutcher¹⁰ and Raffel and Shishko¹¹ are most helpful; the following account synthesizes and attempts to extend the approaches in the literature on library management information and accounting.

PURPOSE

As Horngren puts it: "Budgets are designed to carry out a variety of functions: planning, evaluating performance, coordinating activities, implementing plans, communicating, motivating, and authorizing actions. . . . When administered wisely, budgets (a) compel management planning, (b) provide definite expectations that are the best framework for judging subsequent performance, and (c) promote communication and coordination among the various segments of the business."¹²

There is a vast difference between a management information system and the mere reporting of miscellaneous retrospective statistics such as those of United Kingdom university¹³ and public libraries,¹⁴ although the system must also produce such statistics as required. Budgets are a planning tool recording expected workload, output and costs. Performance and cost are regularly compared with projected budget figures and corrective action is taken as necessary on any variances. The process may be continuous: continuous budgets are increasingly used, whereby a twelve-month forecast is always available by adding a month or quarter in the future as the month or quarter just ended is dropped. Concerning process budgets, it is highly desirable that the budgetary process be participatory, i.e., that section and department heads responsible for expenditure participate in preparing the budget projection. This draws them directly into the planning process and in-

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sure their interest in and commitment to the budgets for their section or department.

SYSTEM OUTLINE

The minimum inputs for a full system are:

1. Budget and actual figures of expenditure for capital items, indirect revenue expenditure, and direct expenditure by cost center.
2. Process and program parameters specifying the proportions of department/section costs attributable to each process and program. These parameters may be established by periodic surveys.
3. Basic performance data for the process budget and external returns.

This data is coded, punched and input to a data processing system. Given adequately coded data and appropriate computer programs virtually any analysis can be produced; tables 1-5 illustrate some basic analyses. The main operating costs of the system are in the planning process to set the budgets, the recording and input of the data, and computer process time. Data recording and input is kept to a minimum by use of intermittent surveys for process and program analysis; the costly alternative is direct recording of each person's activity all the time.

Tables 1-3 illustrate analyses designed for budgetary control of total library costs and output. The budgets represent definite expectations about the future, against which present costs and output statistics are compared. While these are summary analyses, they would in practice be built up from and supported by departmental analyses involving departmental managers in the budgetary process.

Table 5 is an illustrative process budget statement derived from the basic data in tables 1-3. The process budget, as its name implies, shows the costs and output indicators of the main library processes. It readily shows movements in the cost-performance ratios of the main library processes and is a powerful tool for monitoring costs and performance.

Some points should be noted concerning the process budget statement. Its "processes" are not synonymous with departments even though the names may be the same—order, catalog, reference, etc. Reference process costs include reference work done by all departments, not merely the reference department; for instance, members of the catalog department may undertake reference work and this cost is shown against the reference process and not against cataloging. Direct labor, material and expense are costs booked directly against the various pro-

cesses. Indirect costs are those which are not booked directly against processes and is a powerful tool for monitoring costs and performance, costs and their mode of apportionment. The document exposure unit included in the process budget is described in detail by Hamburg.¹⁵ Survey techniques are used to quantify the average reading time per loan, per photocopy, per library visit; these figures are then applied to the number of loans, photocopies and reader visits to obtain total reading or "exposure" hours. If the number of visits to the library is in doubt, survey techniques can be used to determine the average number of visits per reader per time period.

Table 6 shows an illustrative program budget statement designed to assist in planning the proportion of total resources to be devoted to the library's main objectives or "programs" and to monitor actual expenditure against budget. The programs in the table are those identified by Raffel and Shishko¹⁶ for the M.I.T. libraries; other libraries such as public and national libraries will identify quite different programs. There are, however, differences between the approach advocated and that proposed by Raffel and Shishko. First, the program budget should not exist in isolation and should be integrated into a scheme of inter-linking budgets—as tables 1-6. This necessitates imposing a uniform mode of analysis by cost element—labor, etc.—and process. Second, the power of the program budget as a management tool is greatly enhanced by including both budget and actual figures.

SYSTEM OPERATION

This is straightforward:

1. Capital, revenue and output budgets are prepared and input to the machine system.
2. Actual performance data is recorded using codings to differentiate costs by department, by cost element (e.g. labor, etc.) and by cost center (e.g., repairs and maintenance, computer time, etc.). These costs and output statistics are input to the machine system.
3. From this data the data processing system can produce capital, revenue and output budget statements (tables 1-3).
4. Input or use of a table of indirect cost centers and their mode of apportionment by department enables apportionment to be performed and an indirect cost budget statement to be produced (table 4).
5. Input or use of a table of proportions of direct and indirect departmental costs attributable to different processes enables the data

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- processing system to produce a process budget statement (table 5).
6. Input or use of a table of the proportions of process costs attributable to different "programs" enables the production of a program budget statement (table 6).

SOME CONCEPTUAL QUESTIONS

All costs, both capital and revenue, are included in summary budget statements to give full costs and to allow comprehensive review. The means of dealing with capital and indirect expenditure is straightforward in practice, but is the area in which there is most room for difference of opinion on points of detail. First, there is the question as to which items are capital expenditure and therefore apportionable to departments under the heading of depreciation. Then there is the mode of depreciation—straightline, declining balance, etc. For both capital and indirect revenue expenditure items the most appropriate basis of apportionment for each item is a choice which tends to vary between institutions.

The mode of dealing with the book budget may be noted. Librarians are used to treating the book budget as annual revenue expenditure. This type of expenditure is shown as capital—in line with accounting practice which treats items as capital if their value is not consumed within the normal accounting period of a year. The reason for this practice is that otherwise the cost picture is continually distorted by the "lumpiness" of this type of expenditure. It becomes difficult to interpret changes in costs and unit costs from period to period because of variations due to jumps in the book budget or purchases of equipment, building work, etc. Puristically, treatment of the bookstock as a capital item means valuing the stock. In the absence of records of any better alternative, insurance value may be used. Practically, it is not important to value the stock unless interlibrary comparisons are a definite objective; the important thing is that ups and downs of current capital expenditure should not be allowed to disguise movements in revenue expenditure and output.

Indirect costs may be apportioned in more than one way, depending on the object of the exercise. As illustrated in tables 4 and 5, indirect costs have been apportioned over processes chosen as the ones whose costs the library is most likely to want to monitor. However, if the object was to determine the rate of charge to the user for library services, then the costs of acquisitions, cataloging, administration and research and development would be apportioned over the direct user services—

circulation, photocopy, reference—to give the full costs of these services.

MODELING

The budgetary system outlined operates as a fairly comprehensive formal statement of the library's operations. It is not properly a mathematical model of the library since it does not embody equations representing constraints on the library and relationships between the input and output of the library. It is possible to build in these equations and turn the budgetary system into what is sometimes called a "corporate financial-planning model." This has been done at the Sun Oil Company¹⁷ at the cost of ten man-years analytical time and three man-years of computer encoding. The model works and is used for budgeting, revising budgets and examining a variety of decision alternatives.

The nearest equivalent to such a model applied specifically to libraries is the University of Durham's model.¹⁸ This is a linear programming model which was programmed to accept details of:

1. Resources expended: staff time by staff grade; cash, seathours; and quantity of empty shelving.
2. Actual service levels: a) items acquired, b) items used inside library, and c) issued on long loan, etc.

From these substitution rates are derived: one new item stock worth the same as 1,300 user reference hours, and worth the same as ninety items on long loan, etc. This table of substitution rates is then used in subsequent calculation where resources expended or actual service levels may be altered to determine the consequences of these changes. The sort of changes which can be simulated with this model include changes in book prices, book budget, and use of different ratios and quantities of different grades of staff.

MAJOR SYSTEMS CHANGES AND LONG-RANGE PLANNING

While the budgetary system described is a very effective planning and control tool for normal purposes, special decisions call for special modes of presentation. This is the case for major capital budgetary decisions, e.g., to computerize library housekeeping procedures or to open a new library branch. Capital expenditure entails heavy present cost which is made in the expectation of reaping future benefits which may include financial savings; very often one is comparing an existing sys-

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tem having high and rising costs against a new system which has a significant implementation cost but a lower or more constant annual running cost once it is fully operational. Comparison is not fairly achieved by simple addition of the costs of both systems over a number of years. This is because money has a time value. £1 today is worth more than the expectation of £1 in five years. Even neglecting uncertainty and inflation, the £1 of today may be invested and will grow by perhaps 5 percent per year, yielding approximately £1.28 in five years. Similarly, a cost of £1 today is a heavier cost than a cost of £1 in five years. The appropriate method for comparing which takes this into account is the discounted cash-flow method. To quote Horngren: "Because the discounted cash-flow method explicitly and routinely weighs the time value of money, it is the best method to use for long-range decisions."¹⁹

Table 7 illustrates this method of comparison which is used by the United Kingdom Government Civil Service Department for evaluation of all major automated data processing projects. The department uses a ten-year projection and a 10 percent discount rate: the ten years is based on a three-year development period and an assumed seven-year computer system life. The costs of the existing and prospective systems are both projected forward over ten years. For each of the years the prospective system costs are subtracted from the existing system costs. A discount factor is applied to each of the resulting figures which are then summed to give a "present value" of the prospective system. If the present value is positive it indicates that money could be borrowed at 10 percent to support the project and this would leave finance in hand. Projects of this type will normally be supported by Her Majesty's Treasury on economic grounds, subject to reliability of estimates and countervailing noneconomic factors. If the present value is negative, the prospective system must be justified on grounds other than cost. Cost is, of course, only one criterion of system acceptability and it is always necessary to compare the other relevant advantages and disadvantages of the alternative systems—factors such as user and staff acceptability, speed of throughput, accuracy and reliability.

There appear to be no examples of full discounted cash-flow analysis in reports advocating library automation. The closest found is the cash-flow analysis presented in the final report of the South West University Libraries Systems Co-operation Project which uses the tabular method without discounting.²⁰ In the same report graphical techniques are used; similar graphical analysis is used in the report of the Systems Development Project of the National Library of Canada.²¹

This article has outlined a library management information system concerned with total library costs and performance. The system is essentially an adaptation of well-proven industrial and commercial management accounting techniques to the library context.

Faced with rising numbers of publications to purchase, rising average publication prices, rising labor costs, rising service demands, libraries are more than ever under pressure to make the resources they have go as far as possible. In this situation they are under some compulsion to apply management techniques designed to enhance their cost-effectiveness. Since there are well-proven industrial and commercial management techniques which have not been applied by libraries in any thoroughgoing way, it would be logical to make full use of these techniques. The type of system outlined offers both direct and indirect gains. By improving its budgeting and financial control, a library reaps a direct gain; by demonstrating to its funding authority that it is using the latest techniques and doing its utmost with the funds available, it reaps a further gain. In the long run a library's chance of increased budget allocations is increased by showing as clearly as possible the total picture of its present activities and future plans with associated costs and statistics.

The system described can be beneficially developed as a data processing system package. The prospects for such a package being used by number of libraries are much better than for technical processing system packages: there is more benefit in standard accounting procedures and less reason for variation. It is perhaps surprising that the library automation specialists should have concentrated on the more difficult tasks of library housekeeping and information retrieval, to the relative neglect of library management information. The fact that computers are so well-proven in industrial and commercial management information systems is another reason for anticipating a successful library management information package.

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TABLE 1

ILLUSTRATIVE CAPITAL EXPENDITURE BUDGET STATEMENT

Purposes: 1) Compare actual and budget capital expenditure for current budget period and aid setting next year's budget; and 2) show actual expenditure totals to be carried over into indirect cost budget as depreciation.

	This Year's			Next Year's Budget £
	Total budget £	Budget to date £	Actual to date £	
Accommodation				
building structure	x	x	x	x
fixtures & fittings	x	x	x	x
decoration	x	x	x	x
soft furnishings	x	x	x	x
Furniture, Machinery & Equipment				
furniture	x	x	x	x
equipment—dp	x	x	x	x
—printing	x	x	x	x
—binding	x	x	x	x
Library Materials				
monographs	x	x	x	x
serials	x	x	x	x
maps	x	x	x	x
music, etc.	x	x	x	x
Totals	x	x	x	x

TABLE 2

ILLUSTRATIVE REVENUE EXPENDITURE SUMMARY BUDGET STATEMENT

Purposes: 1) Compare actual and budget revenue expenditure for current budget period and aid setting next year's budget; and 2) show overall revenue cost picture which is further analyzed in indirect, process and program budgets. In practice the budget would be supported by more detailed analyses, e.g., staff costs by department.

	This Year's			Next Year's Budget £
	Total budget £	Budget to date £	Actual to date £	
Direct Costs				
staff	x	x	x	x
material	x	x	x	x
expense	x	x	x	x
Indirect Costs				
depreciation	x	x	x	x
repairs & maintenance	x	x	x	x
rentals	x	x	x	x
other	x	x	x	x
Totals	x	x	x	x

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TABLE 3

ILLUSTRATIVE OUTPUT BUDGET STATEMENT

Purpose: Show budgeted and actual output statistics for planning and control purposes.

	This Year's			Next Year's Budget
	Total budget	Budget to date	Actual to date	
Book selection				
titles selected	x	x	x	x
Book orders				
no. orders	x	x	x	x
Cataloging				
titles cataloged	x	x	x	x
Circulation				
vols. loaned	x	x	x	x
Photocopy				
pages photocopied	x	x	x	x
Reference service				
number readers	x	x	x	x
Administration				
number employees	x	x	x	x

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TABLE 4

ILLUSTRATIVE INDIRECT COST BUDGET STATEMENT

Purpose: Show allocation of overhead by department as first step to allocation by process.

Costs	Estimated Life	Basis of Apportionment	Departments						
			Tec. services		Public services			Adm. totals	
			Acquisition £	Cat. £	Circ. £	Photo. £	Ref. £	£	£
<i>Depreciation</i>									
Buildings	40 yrs	sq. ft.	x	x	x	x	x	x	x
Equipment	5	% equipment	x	x	x	x	x	x	x
Computer	7	time	x	x	x	x	x	x	x
Books	10	no. books			x	x	x		x
Journals	20	no. journals			x	x	x		x
<i>Repairs & Maint.</i>									
Buildings		sq. ft.	x	x	x	x	x	x	x
Equipment		% equipment	x	x	x	x	x	x	x
Computer		time	x	x	x	x	x	x	x
Books		no. books			x	x	x		x
<i>Rentals</i>									
Buildings		sq. ft.	x	x	x	x	x	x	x
Computer		time	x	x	x	x	x	x	x
Photo repro.		page	x	x	x	x	x	x	x
<i>Other</i>									
Insurance		sq. ft.	x	x	x	x	x	x	x
Light		sq. ft.	x	x	x	x	x	x	x
Heat		cu. ft.	x	x	x	x	x	x	x
Admin. salaries		% staff	x	x	x	x	x	x	x
Indirect labor etc.		dept. use	x	x	x	x	x	x	x
Total Indirect Costs			x	x	x	x	x	x	x

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TABLE 5

ILLUSTRATIVE PROCESS BUDGET STATEMENT

Purpose: Project expected future costs, output and unit costs as part of the planning of future operations and to monitor actual performance against budget figures.

Process	Direct Costs						Indirect costs	Total costs	Output units*	Unit costs	Document exposure hours		Unit cost/exposure hours	
	Labor		Material		Expense						B	A	B	A
	B	A	B	A	B	A	£	£	£	£	£	£	£	£
	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Acquisition	x	x	x	x	x	x	x	x	x	x				
Catalog	x	x	x	x	x	x	x	x	x	x				
Circulation	x	x	x	x	x	x	x	x	x	x				
Photocopy	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Reference	x	x	x	x	x	x	x	x	x	x				
Administration	x	x	x	x	x	x	x	x	x	x				
R & D	x	x	x	x	x	x	x	x						
Total	x	x	x	x	x	x	x	x						

* Output units:
 Acquisition = number of orders
 Catalog = number of titles cataloged
 Circulation = number of volumes loaned
 Photocopy = number of pages photocopied
 Reference = number of readers
 Administration = number of employees

† Budget to date (B) and actual to date (A) data.

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TABLE 6

ILLUSTRATIVE PROGRAM BUDGET STATEMENT

Purpose: Project expected future costs as part of a plan of future operations and monitor actual performance against budget figures.

Program and Process	Direct Costs						Indirect Costs			
	Labor		Material		Expense		Total			
	B* £	A £	B £	A £	B £	A £	B £	A £	B £	A £
<i>1. Research & General Collection</i>										
1A Acquisition	x	x	x	x	x	x	x	x	x	x
1B Catalog	x	x	x	x	x	x	x	x	x	x
1C Circulation	x	x	x	x	x	x	x	x	x	x
1D Photocopy	x	x	x	x	x	x	x	x	x	x
1E Reference	x	x	x	x	x	x	x	x	x	x
1F Admin.	x	x	x	x	x	x	x	x	x	x
<i>2. Required Reading & Studying</i>										
2A to	x	x	x	x	x	x	x	x	x	x
2F	x	x	x	x	x	x	x	x	x	x
<i>3. Research & Development</i>										
3A R & D project name	x	x	x	x	x	x	x	x	x	x
3F Admin.	x	x	x	x	x	x	x	x	x	x
Total	x	x	x	x	x	x	x	x	x	x

* Budget to date (B) and actual to date (A) costs.

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TABLE 7

ILLUSTRATIVE DISCOUNTED CASH-FLOW PROJECTION

Purpose: Set out costs of alternative capital investment/development decisions in a time related manner to aid decision on whether or not to support a proposal on cost grounds.

Year No.	Projected Costs (£1000)										Total
	1	2	3	4	5	6	7	8	9	10	
<i>Existing or Revised Manual System</i>											
Staff	x	x	x	x	x	x	x	x	x	x	x
Stationery	x	x	x	x	x	x	x	x	x	x	x
Totals A	50	52	54	56	58	60	62	64	66	68	590
<i>Alternative or ADP System</i>											
Staff	x	x	x	x	x	x	x	x	x	x	x
Stationery	x	x	x	x	x	x	x	x	x	x	x
Equipment hire	x	x	x	x	x	x	x	x	x	x	x
Computer time	x	x	x	x	x	x	x	x	x	x	x
Conversion costs	x	x	x	x	x	x	x	x	x	x	x
Totals B	60	70	100	70	46	46	47	47	48	48	582
Totals A-B	-10	-18	-46	-14	+12	+14	+16	+17	+18	+20	+8
Discount factors	1.0	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	—
Present value	-10	-16	-38	-11	+8	+9	+8	+9	+8	+8	-25

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