Chapter 4

Cost-Benefit Analysis in Libraries
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COST-BENEFIT ANALYSIS IN LIBRARIES

4.1. INTRODUCTION

In the present scenario, assessment and valuation play an important role in library management. As we know, all types of libraries are facing problems such as rapid expansion of knowledge, explosion of literature, escalation of price, growing demand of users, variant user requirements, and shrinking budget, etc. To overcome these problems, librarians are using different ways and means. In this era of decreasing financial resources and increasing calls for accountability, libraries all over the world face the challenge of representing and quantifying their value to their funders and stakeholders. In the context of an Academic library, librarians must prove the library’s value to the institution in order to secure the financial resources necessary to serve the university and research community. As Financial Authorities weigh competing priorities and allocate limited resources, they need concrete evidence of how the library supports the institution’s strategic goals. In addition, they need evidence that helps them weigh the value of new directions. As librarians and administrators make budgeting decisions, librarians may be asked to prioritize their products and services to focus on those that are most effective in serving the institutional mission with increased financial challenges. Due to economic crisis, librarians with the help of management tool such as Cost-benefit analysis can prove the value or worth as well as justify the expenditure of library’s collections and services.

Generally, every person in his/her daily life uses CBA for making decisions consciously or unconsciously. For example, if a person wants to purchase an item, then he/she will calculate the cost and then compare the cost with the benefits, he/she will get from this item. If benefits are more than cost, then he will decide to purchase that item, otherwise not. Cost-Benefit Analysis is an important aspect of management and helps in decision making. To study the feasibility of any system, to evaluate it or to choose one system out of several alternatives, the decision making authorities have to conduct Cost-Benefit Analysis. In this process, total cost involved in terms of equipments, materials, and manpower have to be taken into account and also value of all the benefits, i.e., economy in terms of money, efforts and time involved have to be calculated. If the value of benefits is more as compared to the cost involved, the
system is suitable and if the results are reverse to this, the system is a misfit. It is, therefore essential to conduct a cost-benefit analysis in the libraries instead of blindly following other techniques.

Library is a non profit making organization. Therefore cost and benefits of any activity or service in the library is a very difficult task, due to many immeasurable components in the operations of the library. To proceed with the project, the benefit /cost ratio must be more than one or the benefits must be greater than costs.

\[
\text{Cost-Benefit Ratio} = \frac{\text{Cost}}{\text{Benefits}}
\]

The ratio must exceed 1.

Due to exponential growth of knowledge and information, libraries are trying their best to acquire all the documents available worldwide. But lack of funds leads librarians into a situation in which they have to take decisions judiciously as to which documents should be purchased and which not. It is the responsibility of the librarian to convince the higher authorities and prove the value of library’s collection and services. For this purpose cost-benefit analysis and cost effective analysis methods are appropriate. Libraries once considered as the heart of the University are now facing questions about their institutional relevance and value. Over the recent decades with the emergence of internet, user-friendly access systems and web2.0 technology has facilitated the user’s ability to access information without librarian’s assistance. In this scenario to prove the economic value of libraries, librarian’s responsibility increases, but with the help of various types of CBA study librarians can prove the worth of the library collections and services.

There are two types of CBA studies. First, CBA can be performed before undertaking a project and involves estimating costs and benefits. Second, CBA can be performed after a purchase or project has been undertaken that involves measuring past costs and benefits (White & Crawford, 1998).

4.2. COST-BENEFIT ANALYSIS: DEFINITIONS

In *Oxford Advanced Learner’s Dictionary* the term Cost-Benefit Analysis is defined as “The relationship between the cost of doing something and the value of the benefit that result from it” (“Cost-benefit”, 2010).

*Collins the Times English Dictionary & Thesaurus* defines Cost-Benefit Analysis as “denoting or relating to a method of assessing a project that takes into
account its costs and benefits to society as well as the revenue it generates” (“Cost-benefit”, 2010).

According to White and Crawford (1998) CBA is the “methodology in which all potential gains and losses from a proposal are identified, converted in to monetary units, and compared on the basis of decision rules to determine if the proposal is desirable”. This definition is strictly quantitative. CBA also can be defined as a measure that helps determine how the benefits of a product or service can be compared to its costs.

Elliott, Holt, Hayden and Holt (2009) defines Cost-benefit analysis as an economic tool that libraries can use to measure the monetary value of the library to the community relative to the investment the community has made in the library either year by year or cumulatively over many years through its investment in collections, equipment, and buildings.

Van House feels that the field of library and information services is appropriate for cost-benefit analysis. Libraries have begun to redefine their services through cost analysis. Careful planning and evaluation are required to provide the most cost-effective programs. Standard evaluation approaches take into account only the effects of alternatives, such as the number of citizens served. But, cost benefit and cost effectiveness analysis take account of both the cost and effects of selecting alternatives. This makes it possible to choose the alternative that provides the best results for any given amount of resources, or that minimizes the resources that need to be used, for any outcome (Van House, 1984).

4.3. GENESIS OF COST-BENEFIT ANALYSIS

Berghammer (1995) described that Evaluations of public projects have occurred throughout history. The modern literature on Cost-Benefit Analysis (CBA) dates back to an article published by a French engineer and economist Jules Dupuit (1804-1866) in 1844. He developed a method to measure the utility of public works. Afterwards, in the 1920's Professor A. C. Pigou refined this concept of public utility. He introduced the concept of social benefit and social cost and a need for measuring public utility. During this period of history, policymakers accepted the idea that projects, public or private, should have a broader social justification for public investment. Further, these justifications should include the positive and negative consequences of public decisions. This was the beginning of a new way of thinking, though actual applications of the CBA started much later. CBAs have been
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4.4. PURPOSE OF COST-BENEFIT ANALYSIS

1. The main purpose of CBA is to assists decision makers in making decisions by providing better information.
2. It is helpful in deciding which major projects to undertake.
3. Maximising the level of performance (at output stage/end result) through best possible utilization of resources (i.e. minimise the costs as far as practicable involved in achieving the level/target).
4. Ascertaining if any particular alternative has benefits exceeding its cost.
5. Improving service standards.
6. Facilitate self-evaluation and self-actualisation, etc.
7. Can determine whether or not alternative projects are socially profitable.

4.5. DIFFERENT METHODS OF CONDUCTING COST-BENEFIT ANALYSIS

There are various methods of conducting CBA:

I. Net Benefit Analysis

It involves subtracting total costs from total benefits. It is easy to calculate, easy to interpret and easy to present. The main drawback is that it does not account for the time value of money and does not discount future cash flow. Cash flow amounts are shown for three time periods. Period 0 is the present period, followed by two succeeding periods. The negative numbers represent cash outlays. A cursory look at the numbers shows that the net benefit is $550.

<table>
<thead>
<tr>
<th>Cost/Benefit</th>
<th>Year0</th>
<th>Year1</th>
<th>Year2</th>
<th>Year3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td>-1,000</td>
<td>-2,000</td>
<td>-2,000</td>
<td>-5,000</td>
</tr>
<tr>
<td>Benefits</td>
<td>0</td>
<td>650</td>
<td>4,900</td>
<td>5,550</td>
</tr>
<tr>
<td>Net benefits</td>
<td>-1,000</td>
<td>-1,350</td>
<td>-2,900</td>
<td>$550</td>
</tr>
</tbody>
</table>

The time value of money is extremely important in evaluation processes. Today’s dollar and tomorrow’s dollar are not the same. The time lag accounts for the time value of money. The time value of money is usually expressed in the form of
interest on the funds invested to realize the future value. Assuming compounded interest, the formula is:

\[ F = P (1+i)^n \]

Where,

- \( F \) = Future value of an investment
- \( P \) = Present value of the investment
- \( i \) = Interest rate per compounding period
- \( n \) = Number of years

For example, if $3,000 invested in business for 3 years at 10% interest would have a value $3,993 at maturity.

\[ F = 3,000(1+0.10)^3 = 3,000(1.33) = 3,993 \]

II. **Present Value Analysis**

In developing long-term projects, it is often difficult to compare today’s costs with the full value of tomorrow’s benefits. The time value of money allows for interest rates, inflation and other factors that change the value of the investment. Present value analysis controls for these problems by calculating the costs and benefits of the system in term of today’s value of the Investment and then comparing across alternatives. Suppose that $3,000 is to be invested in a microcomputer for our safe deposit tracking system, and the average annual benefit is $1,500 for the four year life of the system. The investment has to be made today, where as the benefits are in the future. We compare present values to future values by considering the time value of money to be invested. The amount that we are willing to invest today is determined by the value of the benefits at the end of a given period. The amount is called the present value of the benefit.

To compute the Present value, we take the formula for future value:

\[ F = P / (1+i)^n \]

So the present value of $1,500 invested at 10% interest at the end of the fourth year is:

\[ P = 1,500 / (1+0.10)^4 \]

\[ = 1,500 / 1.61 = 1027.39 \]

That is, if we invest $1,027.39 today at 10% interest, we can expect to have $1,500 in 4 years. (Basandra, 2003).
III. Net Present Value

The net present value is equal to discounted benefits minus discounted costs. Present value is the amount of cash today that is equivalent in value to a payment or to a stream of payments, to be received in the future. NPV is the PV of the expected future cash flows minus the cost. NPV is the present value of all the cash flows connected with the project, all its costs and revenues now and in the future. The advantages of NPV include that it is easier to calculate than IRR, it incorporates all cash flows during all periods of the investments life. And it takes the time value of money into account. The time value of money is based on the principle that “a dollar today is worth more than a dollar in the future. This is because waiting for future dollars involves a cost. NPVs’ disadvantages are that it expects one to know the true cost of capital and that if one is comparing possible purchases of significantly different sizes or lifespan, NPV can give a misleading result.

IV. Internal Rate of Return (IRR)

According to Linn (2010), it is the “discount rate at which the net present value of an investment equals zero. IRR accounts for the time value of money and is easily understood. It can however, be difficult to calculate and be misleading when there is not a large initial cash outflow. It usually but not always agrees with the outcomes from NPV. This is because the formula for IRR is very similar to that for NPV.

V. Profitability Index (PI) or Cost-benefit Ratio

It provides the relative profitability of a project. If the PI is greater than 1.0 it is acceptable, and the higher the PI, the higher the project should be ranked when compared to other possible investments (Linn, 2010).

\[ PI = 1 + \frac{NPV}{\text{Initial investment}} \]

VI. Pay back Analysis

Basandra (2003) gives the payback method is a common measure of the relative time value of a project. It determines the time, it takes for the accumulated benefits to equal the initial investment. Obviously, the shorter the payback period, the sooner a profit is realized and the more attractive is the investment. The payback method is easy to calculate and allows two or more activities to be ranked. The payback period may be computed by the following formula:

\[
\text{Overall cost outlay} \quad \text{Annual cash return} = \frac{A \times B/5 + C \times D/2}{\text{years + installation time/ years to recover}}
\]
VII. **Return on Investment (ROI)**

ROI is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment. The Return on investment is a quantitative measure of the value returned to the institution for each dollar invested in the library (Luther, 2008). ROI is one approach to meeting the challenge of demonstrating value. The basis of ROI studies is to quantify and demonstrate the library’s economic value to the institution. For every rupees spent on the library, the university receives rupees back in the form of additional grants income or donations or long-term value to the community from an educated workforce, more productive faculty, more successful students and graduates. The aim of ROI is to establish a relationship between the library and its university that could be expressed in quantifiable terms and that would satisfy administrators. To do this, the library needs to be viewed as an asset, where income is generated as a proportion of the amount invested in the asset.

There are also differences in ROI values based on subject discipline, which may account for the differences between institutions depending on the degrees they offer or relative size of subject disciplines (Tenopir, 2010).

There are three ways of measurement. Time saved by library users, money saved by using the library and revenue generated with the assistance of the library (Roger, 2001). The present study attempted to measure the revenue or benefits earned by the users (Research Scholars and Faculty Members) of the Universities under study. The ROI is a comparison of the money earned on investment versus the amount invested (Ko, Shim, Pyo, Chang, & Chung, 2012).

### 4.6. METHODS FOR MEASURING LIBRARY VALUE

Oakleaf (2010) and Tenopir and King (2007) described many methods that can be used to measure the value of library products and services. These can be grouped in to three main categories:

1. **Implicit Value**

   Measuring usage through downloads or usage logs provide an implicit measure of value. It is assumed that because libraries are used, they are of value to the users. Implicit values however do not show purpose, satisfaction, or outcomes of use (or whether what is downloaded is actually read). Usage of e-resources is relatively easy to measure on an ongoing basis and is especially useful in collection
development decisions and comparison of specific journal titles or use across subject disciplines. The present study used usage statistics of E-journals/Databases and calculated the Cost per use of E-journals/Databases subscribed under UGC-Infonet Digital Library Consortium in both the libraries under study.

II. Explicit Value

Explicit methods of measuring value include qualitative interview techniques that ask faculty members, students, or others specifically about the value or outcomes attributed to their use of the library collections or services and surveys or interviews that focus on a specific (critical) incident of use.

III. Derived Values

Derived values, such as Return on Investment (ROI), use multiple types of data collected on both the returns (benefits) and the library and user costs (investment) to explain value in monetary terms. The present study also calculated ROI and Cost-Benefit Ratio of Journals collection.

4.7. PROCEDURE FOR CONDUCTING COST-BENEFIT ANALYSIS

There is a difference between expenditure and investment. We spend to get what we need, but we invest to realize a return on the investment. Building Periodicals collection in a library is an investment. Benefits are realized in the form of research submitted by Research Scholars and articles written by Faculty Members and Research Scholars. To what extent benefits outweigh costs is the function of cost/benefit analysis. Cost-benefit analysis involves the following steps to determine whether a project is worthwhile.

1. Identify the costs and the benefits that will result from a project or program.
2. Measure in dollars or Rupees the costs and benefits so that both costs and benefits are stated in common denominator units that can be compared with potential alternative uses of revenues.
3. Incorporate the time dimensions in the evaluation, because costs and benefits must be examined for the entire life of the project, not just for the current fiscal year.
4. Decide whether the result of the first steps yields large enough social profit (net social benefits) to justify the expenditures of limited funds (Berghammer, 1995).

According to Basandra (2003) Cost/benefit analysis is a procedure that gives picture of the various costs, benefits and rules associated with a system. The determination of costs and benefits involve the following steps:

1. Identify the costs and benefits of Journals
2. Categorize the various costs and benefits for analysis
3. Select a method of evaluation
4. Interpret the results of the analysis
5. Take action

4.7.1. COSTS AND BENEFITS IDENTIFICATION

Certain costs and benefits are more easily identifiable than others. For example direct costs such as the subscription cost of journals are easily identified from vendor’s bill payments. Direct benefits often relate one-to-one to direct costs especially savings from reducing costs. Some estimated costs or benefits that have some uncertainty.

A category of costs or benefits that is not easily recognized is opportunity costs and opportunity benefits. These are the costs or benefits skipped by selecting one alternative over another. They do not show in the library accounts and therefore are not easy to identify.

4.7.2. CLASSIFICATIONS OF COSTS AND BENEFITS

The next step in cost and benefit determination is to categorize costs & benefits. They may be tangible or intangible, direct or indirect fixed or variable.

I. Tangible or Intangible Costs and Benefits

Tangibility refers to the ease with which costs or benefits can be measured. An expenditure of cash for a specific item or activity is referred to as a tangible cost. The purchase of journals and employee salaries are examples of tangible costs. They are readily identified and measured costs that are known to exist but whose financial value can’t be accurately measured are referred to as intangible costs. For e.g. employee morale problems caused by a new system or lowered University or library image is an intangible cost. In some cases, intangible costs may be easy to identify but difficult to measure. For example the cost of the breakdown of an online system during library hours will cause the library users to unable access to e-journals and waste human Resources. The problem is by how much? In other cases, intangible costs may be difficult even to identify such as an improvement in user satisfaction stemming from a real-time order entry system.

Benefits are also classified as tangible or intangible, like costs they are often difficult to specify accurately. Tangible benefits such as completing jobs in fewer hours or producing reports with no errors are quantifiable intangible benefits such as more satisfied customers or an improved corporate image are not easily quantified.
Both tangible and intangible costs and benefits however should be considered in the evaluation process.

II. Direct or Indirect costs and Benefits

From a cost accounting point of view, costs are handled differently depending on whether they are direct or indirect. For example the purchase of journal for $2200 is a direct cost. Example of direct benefit is a new system that can handle 25% more transactions per day is a direct benefit.

Indirect Costs

Indirect costs are often referred to as overhead. A system that reduces overhead realizes a savings. If it increases overhead, it incurs an additional cost. Insurance, maintenance, heat, light and air conditioning are all tangible costs. But it is difficult to determine the proportion of each attributable to a specific activity such as a report. Indirect benefits are realized as a by-product of another activity or system.

III. Fixed or variable Costs and Benefits

Some costs and benefits are constant regardless of how well a system is used. Fixed costs are sunk costs. They are constant and do not change. Variable costs are incurred on a regular (weekly, monthly) basis.

4.7.3. SELECT EVALUATION METHOD

When all financial data have been identified and broken down into cost categories, the analyst must select a method of evaluation (Basandra, 2003).

4.8. THEORY OF COST-BENEFIT ANALYSIS

Cost-benefit analysis can be applied to a variety of proposals, such as, modification of equipment for a library's computer system, the purchase of a new machine, library automation, subscription of journals, conducting a training programme or travel to an annual conference etc. The essence of cost-benefit principles is that public financial resources are best allocated to those programs which benefit the community. There are two decision criteria:

1) Net Benefit
2) Cost-Benefit Ratio

According to the Net Benefit method, total costs are subtracted from the total benefits. When the difference between benefit and cost is greater than zero, society is better off.

In the Cost-Benefit Ratio, the ratio is computed by dividing the total benefits (B) of a program by the program's total costs (C). If the ratio is greater than 1, then
the benefits from the program exceed its costs and the program is considered acceptable. If the ratio is less than 1, then costs exceed benefits and the allocation of scarce resources to the program would be rejected. It would be inefficient to support the program. The decision criterion in both net benefit and benefit cost ratio may yield different rankings, however they both tell you if the project is acceptable or not. The method of conducting CBA is continuously growing and there is no single methodology for cost-benefit analysis. A common unit of measurement (usually money) and the calculation of net present value and future costs are characteristics that most studies share.

The real trick to doing a cost benefit analysis is making sure you include all the costs and all the benefits and properly quantify them. The formula for calculating a CBA is Total Benefits–Total Cost=Net Benefit. In the case of Periodicals, they are renewed annually without any following spill over costs, therefore future costs will not be considered. Net present value is simply present value, without involving future discounted benefits. Cost-benefit analysis identifies both tangible and intangible benefits and compares these to the costs. In the case of E-journals purchased through consortium, tangible benefits are increased access and ease of use (i.e., consumption), whereas intangible benefits may be increased research output.

There are two costs related with the consumption of any commodity. The first is the cost of acquiring and maintaining these commodities. The second is the economic cost of the value of time associated with the consumption of these goods and services. For example, the economic cost of consuming information in print format is higher than that of consuming it in electronic format. Therefore, switching from paper to electronic translates into a benefit. Cost-benefit analysis is an appropriate tool for evaluating resource allocation in non-profit entities such as academic library consortia (Scigliano, 2002).

White and Crawford (1998) applied the concept of “direct” and “indirect” costs when they used cost-benefit analysis to justify the acquisition of electronic resources at Heindel Library. They stated, “Library services and products have associated costs, including direct monetary costs and indirect costs such as time. The decision to acquire or provide a particular product or service should involve an examination of its costs and benefits to library customers”. They cautioned that, although direct costs are typically easy to measure, indirect costs are much harder to ascertain.”
When economists speak of costs, they are considering something more than explicit costs. Economists are concerned with full opportunity costs. The "opportunity costs" are the costs of using resources for one purpose rather than another. CBA refers to a specific technique for comparing the negative and positive consequences of alternative uses of resources, including money, manpower, facilities and preferences. The CBA method requires an analyst or evaluator to identify measure and compare all the measurable significant costs and desirable outcomes of alternative programs. CBA is a method by which administrators can systematize the selection process of alternatives by offering specific steps and decision rules (Berghammer, 1995).

Librarians make a variety of financial decisions that support program activities. Identifying the costs and the benefits sounds like a relatively simple process; however, it is often difficult to determine the actual costs and benefits. Determining which costs and benefits are relevant is very important to the analysis. Benefits can generally be classified as real benefits. Real benefits are described as direct and indirect as well as tangible and intangible. Direct benefits are closely related to the main project while indirect benefits are by-products of the project. The indirect effects are known as externalities. Sometimes we receive benefits or costs that nobody intended. These costs and benefits of by products can be priced on the market." They represent added benefits or costs to the community as a whole. Some examples of external costs are: the danger to rivers when business firms pour dangerous chemicals into rivers; construction of a convention centre externalities could be identified in terms of increased levels of sales tax, parking fees, sales at retail stores and restaurants. These are the benefits and costs that spill over to the larger community. There are positive and negative externalities. Examples of negative externalities for the construction of a convention centre could be increase in traffic congestion, crime and pollution.

The various types of benefits and costs can be categorized as tangible or intangible. The term "tangible" is applied to benefits and costs which can be priced in the market, while intangible benefits and costs cannot. Pollution would be considered an intangible cost.

4.9. DIFFERENCE BETWEEN COST-BENEFIT ANALYSIS (CBA) AND COST-EFFECTIVE ANALYSIS (CEA)

Cost-benefit Analysis (CBA) is related to, but distinct from Cost-effective analysis (CEA). In CBA, benefits and costs are expressed in monetary terms, and are
adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "net present value."

In a cost benefit analysis, outcomes are measured in a monetary unit. This allows for the development of the benefit cost ratio and net benefit. The advantage to this is that the analyst is able to make comparisons across policy areas. In contrast, cost effectiveness will not be able to make such direct comparisons because the units of measure are different. Same kinds of methodological problems in identifying and measuring costs and benefits. Many of the problems associated with these methodologies relate to the assumptions that must be made by the analyst. The analyst must determine cost and benefit data, and select a discount rate which can bias the final analysis. Despite the difficulties in conducting this type of analysis, it provides useful information about the use of resources.

The steps in cost benefit and cost effectiveness overlap and there are also some differences. CEA assists decision makers in making decisions by providing better information. It is much easier than cost-benefit analysis because it does not require the measurement of benefits. It requires less time, effort and expertise than CBA.

Both cost-benefit and cost-effectiveness deal with decisions about the allocation of scarce resources. These two approaches assume that society will compare costs and benefits, including time and money, to maximize utility or well-being. One of the distinctions of cost-benefit analysis is to determine the costs and benefits and consider a monetary unit of measure for both. Cost-benefit analysis relates to the benefits (outcomes) of a service to the cost (inputs) of providing that service. The problem within a government setting is that the benefits tend to be in terms of social values and are not so easily expressed in the same dollar unit as the costs (Van House, 1984).

Cost-effectiveness is concerned with efficiency of benefits and costs. In this method, the analyst assumes that all benefits are substitutes for each other, and considers them all equal. By keeping all benefits constant, the objective becomes to choose the least expensive alternative. Cost-effectiveness evaluates the effectiveness of ongoing public programs to ensure the efficient use of resources. Both methods attempt to relate costs of programs to performance and to quantify costs in dollar values. The major distinction between cost benefit and cost effective analysis is how
the outcomes are quantified. Cost effective measures outcomes as a quantitative but nonmonetary unit of measure. For example, the unit of measure might be the number of lives saved or the amount of time saved (Berghammer, 1995).

Cost Effective Analysis is used to evaluate two or more alternatives that will achieve the same objective without measuring the benefits. It is used for giving the best possible profit or benefits in comparison with the money that is spent. Cost effective analysis is the preferred method when it is impossible to measure benefits. It is used to evaluate two or more alternatives that will achieve the same objective without measuring the benefits. It may also be used in a situation where an objective is mandated and program termination is not an option. Hence, the purpose of this type of analysis becomes to achieve a desired program goal or objective at minimum costs.

Cost effective is an analytical technique related to cost benefit analysis. Benefits, however, are not considered. If the benefits of each alternative are the same, it is not necessary to give them a dollar value. Cost-effective analysis is a good substitute for cost-benefit analysis. The costs of each alternative must be identified and measured. Then, the most efficient alternative is selected (Berghammer, 1995).

The cost-effectiveness approach has a number of strengths. Most important is that it only requires combining cost data with the effectiveness data that should be readily available. Its one major disadvantage is that you can compare the cost-effectiveness ratio among alternatives only if they all have the same goal. For example, it would not be possible to compare the cost-effectiveness of programs dealing with reading and mathematics, or education versus health. Cost-effective analysis explores how results can be achieved and which costs are attached to them for reaching different levels of the desired outcomes.

4.10. PRINCIPLES OF COST-BENEFIT ANALYSIS

Watkins explained some basic principles for measuring Cost Benefit Analysis.

I. There must be a Common Unit of Measurement

In order to reach a conclusion as to the desirability of a project all aspect of the project, positive and negative, must be expressed in terms of a common unit, i.e. there must be a “bottom line”. The most convenient common unit is money. This means that all benefits and costs of a project should be measured in terms of their equivalent money value. A program may provide benefits which are not directly expressed in terms of dollars but there is some amount of money the recipients of the benefits would consider just as good as the project’s benefits. Not only do the benefits and
costs of a project have to be expressed in terms of equivalent money value, but they have to be expressed in terms of dollars of a particular time. This is not just due to the differences in the value of dollars at different times because of inflation. A dollar available five years from now is not as good as a dollar available now. This is because a dollar available now can be invested and earn interest for five years and would be worth more than a dollar in five years. If the interest rate is r then a dollar invested for t years will grow to be \((1+r)^t\). Therefore the amount of money that would have to be deposited now so that it would grow to be one dollar t years in the future is \((1+r)^{-t}\). This called the discounted value or present value of a dollar available t years in the future.

When the dollar value of benefits at some time in the future is multiplied by the discounted value of one dollar at that time in the future the result is discounted present value of that benefit of the project. The same thing applies to costs. The net benefit of the projects is just the sum of the present value of the benefits less the present value of the costs.

II. Double Counting of Benefits or Costs must be avoided

Sometimes an impact of a project can be measured in two or more ways. For example, when an improved highway reduces travel time and the risk of injury the value of property in areas served by the highway will be enhanced. The increase in property values due to the project is a very good way, at least in principle, to measure the benefits of a project. But if the increased property values are included then it is unnecessary to include the value of the time and lives saved by the improvement in the highway. The property value went up because of the benefits of the time saving and the reduced risks. To include both the increase in property values and the time saving and risk reduction would involve double counting.

III. Cost Benefit Analysis involves a particular Study Area

The impacts of a project are defined for a particular study area, be it a city, region, state, nation or the world. The nature of the study area is usually specified by the organization sponsoring the analysis. Many effects of a project may ‘net out’ over one study area but not over a smaller one. The specification of the study area may be arbitrary but it may significantly affect the conclusions of the analysis.
IV. The Analysis of a Project should involve a With versus Without Comparison

The impact of a project is the difference between what the situation in the study area would be with and without the project. When a project is being evaluated the analysis must estimate not only what the situation would be with the project but also what it would be without the project. In other words, the alternative to the project must be explicitly specified and considered in the evaluation of the project. Note that the with-and-without comparison is not the same as a before-and-after comparison.

V. Benefits are Usually Measured by Market Choices

When consumers make purchases at market prices they reveal that the things they buy are at least as beneficial to them as the money they surrender. Consumers will increase their consumption of any commodity up to the point where the benefit of an additional unit (marginal benefit) is equal to the marginal cost to them of that unit, the market price. Therefore for any consumer buying some of a commodity, the marginal benefit is equal to the market price. The marginal benefit will decline with the amount consumed just as the market price has to decline to get consumers to consume a greater quantity of the commodity. The relationship between the market price and the quantity consumed is called the demand schedule. Thus the demand schedule provides the information about marginal benefit that is needed to place a money value on an increase in consumption.

VI. Gross Benefits of an increase in Consumption is an area under the Demand Curve

The increase in benefits resulting from an increase in consumption is the sum of the marginal benefit times each incremental increase in consumption. As the incremental increases considered are taken as smaller and smaller the sum goes to the area under the marginal benefit curve. But the marginal benefit curve is the same as the demand curve so the increase in benefits is the area under the demand curve. As shown in Figure-4.1 the area is over the range from the lower limit of consumption before the increase to consumption after the increase.
When the increase in consumption is small compared to the total consumption the gross benefit is adequately approximated by the market value of the increased consumption; i.e., market price times the increase in consumption.

4.11. APPLICATIONS OF COST-BENEFIT ANALYSIS IN LIBRARIES

Cost-benefit Analysis is used as a tool for communicating the value of libraries. It is a powerful tool to use when libraries have to prove their worth and economic value. Librarians must justify their budget allocations and demonstrate values of library’s collection and services to the higher authorities. After the use of CBA, Library can establish the credibility and accountability.

Some applications of CBA in libraries are given below:

1. CBA is used for measuring the economic value of all types of libraries i.e. academic library, public library, special library and national library etc. It can be used to assess the National Library contribution to the national economy. The value added by the national library takes many forms- economic, cultural, social and intellectual.

2. To assess the economic value of all types of collections such as books, e-books, print journals, e-journals, magazines, newspapers, audiovisual materials etc. available in libraries.

3. To estimate the economic value of services provided by libraries such as circulation service, information services, technical services, reference service, newspaper clipping service etc.
4. Cost-benefit Analysis also helps to assess the value library provides in terms of information resources disseminated to their research communities.

5. A Cost-benefit Analysis can be conducted for providing proof of value and demonstrate that their collection development efforts support university priorities and reputation.

6. It can be used to demonstrate that library research collections add to income generating activities, and draw attention to the library’s role in the externally funded research process and underline the correlation between the library and grant activities.

7. Cost-benefit Analysis can be applied to models of library book sales of several types: annual, on-going, and online. In each instance, analysis indicates that book sales are not cost-effective.

8. With the help of CBA, the economic impact of public libraries on the society can be calculated and to explore whether or not the citizens found that their benefits outweighed the costs to provide them.

9. It can be used as a tool for financial decision making for digital library project management. CBA is a useful tool where decisions are based on financial considerations.

10. Cost/benefit Ratio can be used for deciding which journal titles to select for acquisition in a library. Due to shrinking budget CBA provides a hint of journal retention or cancellation.

11. It can be used for comparing print and electronic journals subscribed in the library.

12. It can be used to compare cost-benefit analysis of the two systems of subscription to periodicals i.e. direct subscriptions or the agency system.

13. It can be used for comparing three models of journals access i.e. direct subscriptions, pay per view and big deals.

14. It can be used for comparing the Costs and benefits of periodical ownership against online access of a full-text periodical database in library.

15. It can be used to measure the Return on Investment (ROI) of a Consortium.
4.12. DIFFICULTIES AND LIMITATIONS OF CBA

There are some difficulties in performing a cost-benefit analysis. It is not always a totally objective procedure that can guarantee an evaluation free from error. Identifying the benefits and measuring them in dollars is the most difficult part of cost-benefit analysis in libraries. Choosing different discount rates to compute the present value of net social benefits can drastically affect the outcome of an analysis. Placing a dollar value on benefits can be very subjective, Inflation and other intangible items make placing dollar amounts on future and present value difficult. When many of the important benefits are intangible, cost-benefit analysis is probably not worthwhile. Also, if the needed information is not available at reasonable cost within the time period in which a decision must be made, a major cost-benefit effort is probably not a good idea (Berghammer, 1995).

According to Sidorko (2010) there are many possibilities that may have contributed to the discrepancies. Most of these primarily relate to the data collection processes. For example, the issue of grant funding may be seen as sensitive by some institutions administrations who may have consequently been reluctant to disclose the data, making the investigation process not only time consuming but, more importantly, prone to error and omission. Other factors that certainly contributed to complexity in the data gathering process, and thereby may have contributed to the variance, include:

- Differences in terminology (e.g. different academic ranks and how translated into the data);
- The variations in data collection periods (e.g. the use of fiscal year, academic year, calendar year);
- Languages
- The complexity of managing different datasets of varying quality and volume.

**Disadvantages**

1) Hard to identify all relevant costs and benefits
2) Mistakenly including "transfers" that are not real costs or benefits
3) Hard to place dollar values on certain benefits and costs
4) Impossible to convert some costs and benefits into dollar values (intangibles)
5) Hard to identify the proper discount rate
6) Considerable time, costs and expertise usually required to do a cost-benefit analysis
Some decisions have to be subjective

Severe budget constraints on library budgets have forced decision makers to carefully analyze the different options that are provided within a program. Limited resources force administrators to make difficult choices among competing projects. The most fundamental proposition of economics is that resources are always limited, compared with what people want. "These scarce resources must be allocated among competing wants, so that citizens of the community receive the largest benefits possible.

The allocation of resources involves comparing alternatives. Cost benefit analysis has been used as a method for comparing the worth of competing projects. The objective of a cost-benefit analysis is to provide administrators with a criterion with which they can make choices among competing alternatives.

Administrators must decide if the gain to society (benefit) from the project is greater than the social sacrifice (cost) required to produce the project. If so, the project is recommended as a worthwhile project. A worthwhile project improves society's economic condition because these projects direct resources where their uses provide a greater return than would an alternative use. This is the essence of cost-benefit. The two key decision-making techniques pertaining to the costs of providing automated library service are cost-benefit analysis and cost-effectiveness analysis.

4.13. COST-BENEFIT ANALYSIS AS ECONOMIC ANALYSIS

According to Whitehall (1995) libraries are economic entities, they use resources to satisfy human desires or wants. Economic analysis is relevant to decisions made in libraries because both are about "the allocation of scarce resources to satisfy competing ends" –a definition which describes economics by the nature of the problem to be solved, rather than by the sphere of action. Economists are not people who believe that value is a monetary term only. They are interested in finding a cash equivalent for value because they need to use the measuring rod of money to make comparisons between cost and effect.

Cost-benefit and Cost-effectiveness are types of Economic Analysis and management tools which are used to determine the costs and benefits of a particular project. After costs and benefits are determined these methodologies are used to choose between alternative projects. Hence, they represent a method to make decisions about funding among different types of library functions such as collection development, cataloguing and circulation. Many small libraries cannot keep up with
the rapid increase in technological advancements. The associated costs of expanding computerized library and information services increase faster than library administrators can incorporate such changes in their budgets. Library administrators are thus faced with the task of incorporating new technology in a stressful fiscal environment. Priorities need to be identified, a continuum of services developed and program costs delineated. The issues surrounding costs for automation of small libraries reflect a need for an effective method of outlining priorities and selection of those priorities. This method should also take into account efficiency. The need for cost-benefit analysis in library and information services has become more important as the competition for dollars with other governmental agencies increases.

Several methods for estimating the financial value of libraries have emerged in recent studies. Much of the progress in library valuation methodologies has been made in public libraries. Like academic libraries, public libraries increasingly need to demonstrate their value to their funders in quantifiable terms. The Americans for Libraries Council conducted an extensive review of public library valuation methods and identified 3 popular methodologies: cost/benefit analysis, contingent valuation, and secondary impact analysis (Tenopir, 2010).

4.14. THE CONTINGENT VALUATION METHOD

The contingent valuation (CV) method is a direct and explicit method using surveys to value public goods. The method avoids the absence of markets for public goods by presenting the respondents with a hypothetical market, in which they have the opportunity to ‘buy’ or ‘bid for’ the good in question. The CV method is based on the individual’s own assessment of the good to be valued. The technique aims at eliciting people’s willingness to pay in money amount for a change in the provision of a non-market good. It has been applied for valuing various cultural goods (Noonan, 2003), such as museums and theatres and also libraries (Harless & Allen, 1999; Holt, Elliott & Moore, 1999).

A panel of economic experts set up by the U.S. National Oceanic and Atmospheric Administration (NOAA) examined the technique and supported its reliability (Arrow et al., 1993). The panel also provided guidelines for the appropriate use of the method. These guidelines are still influential in the design of CVM studies.

CV technique is supported by the Nobel Prize winning economists Kenneth Arrow and Robert Solow, permits a rational quantitative evaluation of the total benefit to the nation of publicly funded institutions and programmes. Building on this
analytical achievement, the UK government and international organisations such as the World Bank and the OECD have used the technique, to inform and guide policy (measuring our value).

CVM has been most widely used for estimating through surveys a user’s overall perceived value of all kinds of non-market services. The CVM is used to measure the perceived value of various services offered by the special library by assessing the user’s “willingness to pay” (WTP) and “willingness to accept” (WTA) alternatives to no library services provided (Chung, 2007).

Calculation procedures to determine the benefit score deriving from use of physical resources are as follows:
1. Add all monetary values for time saved (first benefit element).
2. Add all monetary values for resources used (second benefit element).
3. Add 1&2 to obtain the total estimated monetary value for all respondents.
4. Divide the total monetary value by no. of respondents.
5. Multiply the use frequency to measure the actual benefit of the service for the year.
6. Compare this figure with the cost of providing the service.

The outcome can be simplified into the following equation.

The benefit realized through the use of physical resources:

\[ = \frac{\left( T_1 + T_2 + \ldots + T_N \right) + \left( I_1 + I_2 + \ldots + I_N \right)}{N \times U} - C \]

Where:
\( T_1 \) = Value of saved time
\( I_1 \) = Value of resources
\( N \) = Number of respondents
\( U \) = Use frequency
\( C \) = Purchasing price

CVM has been used for decades to estimate the value of nonmarket goods and services in a wide range of areas. Generally two types of methods are available to measure the user benefits of services provided: the revealed preference (RP) and the CV methods. As the RP method drives value estimates from comparable existing market behaviours, it is not readily applicable to evaluate library services that have the characteristics of nonmarket or public goods. In CVM, or stated preference (SP) studies, respondents are presented with fictional situations and asked to respond to
those situations with stated preferences or intentions that reflect the value and benefits of services being measured (Ko, Shim, Pyo, Chang, & Chung, 2012).

In CVM, two types of questions are used to elicit value: willingness to pay (WTP), the maximum amount a person is willing to pay for a service or a good, and willingness to accept (WTA), the maximum amount a person is willing to accept as compensation. Although there has been considerable controversy regarding the difference between and appropriateness of the two types of questions. It is generally agreed that WTP is a more conservative measure than WTA (Martin-Fernandez et al., 2010). As a measure of economic valuation both WTP and WTA represent relative value, expressed in monetary terms, reflecting benefits library users experience in specific situations, rather than the real value of library services.

4.14.1. Difficulties and Limitations of CV Method

There are some difficulties in implementation of methods based on constructed markets, due to their reliance on expressed intent and hypothetical and not real behaviour. Most respondents are familiar to receiving library services at no cost and therefore are not familiar with placing monetary values on library services. Hence, the CVM needs to be modified so that the respondent has an adequate basis to be able to make an educated, well-founded assessment of values they would apply to the library setting. A main objective is therefore to bring respondents’ intentions as closely as possible in line with their feasible actions. The description of the scenario where the valuation is going to take place is critical. Careful considerations are necessary in designing the scenario in a CV study (Chung, 2007).

4.15. COST-BENEFIT ANALYSIS OF JOURNALS

In current years library budgets and shelving space are decreasing, while costs and numbers of journals as well as demands of users are increasing. Librarians are conducting journal use studies for solving these problems. Measuring the use of journal collection is a complicated and tedious process, because Journal collection takes many forms such as journal titles available only in print, print titles that have electronic form also and titles that are only available electronically. Collecting journal usage data has become more complicated because most libraries have both print and electronic journals in their collections. In order to get a complete look at how journal collections are used, collecting usage data for both print and electronic journals is important. Librarians use journal usage statistics for many practical applications:

1. To begin or end subscriptions
2. To justify budget allocations
3. To prioritize research areas, programs and education
4. To seek funding, while university administrations and faculty bodies use citation information for many of the same purposes. Publishers are beginning to price journal and database subscriptions based on the number of articles retrieved from them.

Based on Cost/benefit Ratio approach Kraft, Polacsek, Soergel, Burns & Klair (1976) framed a model for deciding which journal titles to select for acquisition in a biomedical library. They explained a cost/effectiveness approach to the journal selection problem. First of all they developed the list of possible journal titles to be considered, the cost of these titles are recorded and updated periodically. Measurement of total journal usage, journal relevance and journal availability elsewhere calculated for each title. A total weighted measure of journal worth is then calculated, based on subjective weights for each measure. Then the algorithm based on ranked cost/benefit ratios can be applied.

Vaughan attempted to compare the main three methods used in most science libraries; reshelving data, citation analysis and the ISI impact factor rankings. Using the Spearman correlation coefficient ρ, it was found that reshelving and citation analyses generate the most similar ranked lists of journals. It was suggested that librarians should combine results from both methods in order to capture a more complete picture of journal value. He also emphasised that use statistics are usually collected in time of crisis, especially when the collection must be cut due to budgetary restrictions or must be weeded for space on the shelves. It is difficult to compare results of use studies across institutions or even among branches of a single library system, since journal use varies by discipline and user base (Vaughan, 2001).

Since journals are so crucial to scientific communication, measuring published use can be useful for research libraries. According to Chrzastowski and Olesko (1997) scientists cite journals more frequently than scholars in the social sciences and humanities do.

The most popular global method of citation analysis is the ISI’s Journal Impact Factor (IF) as reported in the Journal Citation Reports every year. A journal’s Impact Factor is the fraction (number of citations to articles in that journal in the previous 2 years) / (number of articles published in the previous 2 years in that journal). Garfield
originally proposed it in 1995 as a measure of quality of journals in the Science Citation Index (Garfield 1999).

**4.15.1. Methods for Measuring the Use of Print Journals**

Kraft, Polacsek, Soergel, Burns & Klair (1976) revealed that the key to the journal selection decision model is the measurement of the worth of a journal. Usage is the single most important factor in selecting titles. There are several categories of usage. For example:

1. Circulation, but most libraries do not allow journals to circulate outside the library. In-house use, which is quite difficult to measure, for there is no record keeping involved.
2. One can ask users what items they used via a questionnaire or an interview,
3. One can watch users and record what items one sees in use, one can watch the stacks and record which items are missing from the shelves, or one can investigate to see what items are left in individual carrels, on return carts, on return shelves, and on reading room desks.
4. Another measure of usage is the interlibrary loan (ILL). The count of those items borrowed from other libraries will give an indication of the demand for and use of items not owned by the library. The count of those items borrowed by other libraries may be useful in considering total usage of journal titles.
5. A fifth measure of usage is a count of how often journals are used for photocopying.

Total usage is then the sum of circulation and in-house usage, including photocopying and interlibrary loans (Kraft et al., 1976).

Another method for measuring the use of journals is survey the users by asking question “In the past month (30 days) approximately how many articles have you read? Reading is defined as going beyond the table of contents, title and abstract to the body of the article (King, Boyce, Montgomery, & Tenopir, 2003).

Suseela (2010) has explained some methods for measuring the usefulness of journals such as:

1. Citation analysis i.e. application of quantitative techniques
2. Table count, slips method, direct observation, photocopy requests, interlibrary loan, document delivery requests and data from circulation section or automated circulation system.
3. Conducting surveys by distributing questionnaires to measure the purpose and value of resources especially e-journals.

4. The latest method is the use of log files generated in data servers on every interaction/transaction of the user while accessing the content. They are referred to as usage statistics or usage reports. They will be supplied by publishers, aggregators and consortia to their subscribers or members.

4.15.2. Methods for Measuring the Use of E-journals/Databases

Research has also shown that faculty and students prefer online materials to print (Brown, 1999; Morse & Clintworth, 2000; Rogers, 2001). The ease of access and increased functionality of online materials allow users to review more material in a shorter amount of time, which may lead them to review additional material, review more diverse material or produce publications at a faster rate. These changes in information seeking and use behaviours should be evident from new patterns of citation or online journal usage.

4.15.2.1. COUNTER

COUNTER (Counting Online Usage of Networked Electronic Resources) is an international initiative serving librarians, publishers and intermediaries by setting standards that facilitate the recording and reporting of online usage statistics in a consistent, credible and compatible way. It was launched in March 2002. The first COUNTER Code of Practice, covered online journals and databases was published in 2003. The body of COUNTER compliant usage statistics has steadily grown as more and more vendors have adopted the COUNTER Codes of Practice. This has contributed to the new discipline of usage bibliometrics and a great deal of work is underway to try to establish value metrics associated with usage, in which the COUNTER compliant statistics play an important role.

In 2006 COUNTER carried out research, on the effects of publisher platforms on usage and are currently collaborating with the UK Serials Group on the possible development of a new Journal Usage Factor metric. COUNTER has also worked with NISO on SUSHI (Standardised Usage Harvesting Initiative) to develop a protocol to facilitate the automated harvesting and consolidation of usage statistics from different vendors. COUNTER brings the following benefits to librarians, publishers and intermediaries:
1. Librarians are able to compare usage statistics from different vendors, derive useful metrics such as cost-per-use; make better-informed purchasing decisions; plan infrastructure more effectively.

2. Publishers and intermediaries are able to provide data to customers in a format they want; compare the relative usage of different delivery channels; aggregate data for customers using multiple delivery channels; learn more about genuine usage patterns.

**Objectives**

While COUNTER has greatly improved the reliability and usability of online vendor usage statistics, there is still much to do, and keep the COUNTER codes up to date with changes in the online delivery of information. Their future objectives fall into three broad categories.

1. To improve further the reliability of the core COUNTER data and extend scope of the Code of Practice beyond journals, databases and books.

2. To continue to increase the number of COUNTER compliant vendors.

3. To work with other industry organizations to facilitate the implementation of COUNTER and develop metrics based on the COUNTER data that are of practical value to both librarians and vendors.

**OTHER INITIATIVES ON USAGE STATISTICS**

**ARL STATISTICS AND ASSESSMENT**

The ARL (Association of Research Libraries) Statistics and Assessment was set up in response to the following two needs: increasing demand for libraries to demonstrate outcomes/impacts in areas important to the institution and increasing pressure to maximize use of resources. Of particular interest is the work associated with the E-metrics portion of this initiative, which is an effort to explore the feasibility of defining and collecting data on the use and value of electronic resources.

**NISO/SUSHI (2015)**

NISO is the National Information Standards Organization of the United States. COUNTER has worked with NISO on SUSHI (Standardized Usage Harvesting Initiative) to develop a protocol to facilitate the automated harvesting and consolidation of usage statistics from different vendors. This protocol is now available and may be found on the NISO/SUSHI website above.
REFERENCES


