Abstract
Purpose – This paper seeks to show that when managing strategically a library administrator might want to use cost-benefit analysis to prudently spend money and, consequently, would need to understand this methodology.
Design/methodology/approach – The paper discusses the various types of cost-benefit analysis and discusses some of their strengths and weaknesses.
Findings – It is helpful for library managers to have a proper knowledge of cost-benefit analysis.
Practical implications – One methodology is provided that librarians should consider when contemplating what purchases to make.
Original/value – This paper will help librarians better manage their libraries by making them aware of cost-benefit analysis.
Keywords Library management, Cost benefit analysis, Net present value, Return on investment, Internal rate of return
Paper type Viewpoint

I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail (Maslow, 1966, pp. 15-16).

A previous article (Linn, 2009) was about cost-benefit analysis (CBA) and how some who speak and write about the subject do not seem to know much about it. In fact, given the discussions about return on investment (ROI) in the library profession, one could be led to believe that it is the only method to conduct CBA. This is as ill-conceived as only owning one tool, a hammer, and using it for all purposes, including measuring, screwing in screws, and sawing wood.

Methods of CBA, such as ROI, are important tools in assisting one in making informed decisions, particularly concerning capital investments. This is why financial management textbooks usually explain these techniques in chapters about capital budgeting. Because of the importance of CBA, a knowledgeable manager who strategically invests the finances of the library would know ways of conducting a CBA and know how and when to use the various types that exist.

Generally, the most important decisions a library administrator makes concern what to do with scarce resources. This usually comes down to people, money, or both because these are typically what are needed to accomplish what one wants to do. The largest expenditures of money are often for capital assets, which are items that are expected to be of use for a long period of time. Because of the great expense involved, prudent managers would want to make the best possible choice between the options that they have. This is where CBA comes into play. CBA is used “to determine whether
the favorable results of an alternative are sufficient to justify the cost of taking that alternative. This analysis is widely used in connection with capital expenditure projects” (Shim and Siegel, 1989, pp. 115-6).

CBA can be quite useful in deciding whether or not to make a large capital expenditure. For example, is it a better financial decision to purchase a particular machine or to lease it? Another example would be in choosing between two similar devices to purchase when one costs more and is expected to last a few years longer than the other. CBA would help a manager make an informed decision in these situations.

There are various methods of conducting CBA, of which ROI is only one. Experts seem to agree that no one method is perfect, but disagree on which one or ones to use. For example, the late management guru Peter Drucker wrote that:

Companies typically measure their proposed capital appropriations by only one or two of the following four yardsticks: return on investment, pay-back period, cash flow, and discounted present value [i.e. net present value]. But we have known for a long time – since the early 1930s – that none of those is the right method. To understand a proposed investment, a company needs to look at all four (Drucker, 2003, p. 107).

The professor of my corporate finance class had a different perspective. He taught that one should calculate both net present value (NPV) and internal rate of return (IRR). If both recommended the same purchase, one should buy it. If the two made different recommendations, he said that one should then use discounted payback period to “break the tie”. It is also interesting to note the responses to a survey of 392 chief financial officers done a decade ago. It found that this percentage of these CFOs “always or almost always” used each of the following methods of calculating CBA:

- IRR – 75.6 percent;
- NPV – 74.9 percent;
- hurdle rate – 56.9 percent;
- payback period – 56.7 percent;
- discounted payback period – 29.5 percent;
- accounting rate of return (which is the same as the way that some people calculate ROI) – 20.3 percent; and
- profitability index – 11.9 percent (Graham and Harvey, 2001, p. 198).

It is interesting that the method that is currently in vogue among librarians is one that is not widely used by CFOs, presumably because of its numerous shortcomings, which include varying methods of calculation.

But what is each of these methods of doing CBA? How does one calculate them? The following discussion of the various methods of conducting CBA provides a brief overview of these techniques. Although knowing of these methods is quite valuable for an administrator, it would be prudent to learn more about them before using them to make financial decisions. What follows is just an introduction to the most frequently mentioned types of CBA. Administrators would be wise to learn more about the ones that they want to use before putting them into action.

Learning the net present value (NPV) requires that one first know what present value (PV) is. PV 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” (Emery and Finnerty, 1997, p. G14) and NPV is the PV “of the expected future cash flows minus the cost” (Emery and Finnerty, 1997, p. G12). NPV “is the present value of all the cash flows connected with the project, all its costs and revenues, now and in the future” (Emery and Finnerty, 1997, p. 344). 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 – the cost is foregoing the opportunity to earn a rate of return on money while you are waiting” (Pringle and Harris, 1984, p. 55). 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 lifespans, NPV can give a misleading result. To help offset this last problem, when that situation arises NPV is often used in conjunction with the profitability index. Here are two different ways of expressing the NPV formula:

\[ \text{NPV} = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}, \]

which can also be written as:

\[ \text{NPV} = CF_0 + \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n}. \]

In these equations, \( t \) is the time period (\( t = 3 \) if the time period is three), \( CF_t \) is the net cash flow at time \( t \), \( r \) is the discount rate per period, \( n \) is the number of time periods.

Internal rate of return (IRR) is the “discount rate at which the net present value (that is, the value of all future cash flows, in excess of the original investment, expressed in today’s dollars) of an investment equals zero” (Argenti, 1994, p. 228). 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. Furthermore, 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. The IRR is the number that makes the formula correct when it is inputted for \( r \). Thus, \( IRR = r \) in this formula:

\[ 0 = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}. \]

The profitability index (PI), which is occasionally called benefit-cost ratio, provides the relative profitability of a project.

The idea underlying the PI is to measure the project’s “bang for the buck.” By scaling (dividing) the present value of the future cash flows by the amount of the initial outlay that is necessary to get the return, you can see how much return is obtained per dollar invested. Thus with a PI of 1.24, you get $1.24 of present value back for each $1 invested, or an NPV of $0.24 for each $1 invested (Emery and Finnerty, 1997, p. 355).

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. This is the PI formula:
The NPV, IRR, and PI methods will always recommend making the same investments for independent projects, but can suggest different outcomes for mutually exclusive projects. Independent projects are projects that have cash flows that are independent of each other. Mutually exclusive projects are those that, if one of them is taken, then the other(s) must be rejected. For example, if one is investigating Project A and Project B, a mutually exclusive decision would mean that one must choose either A or B, while if they were independent projects, one could invest in A or B or both of them. It would seem that most librarians would be dealing with mutually exclusive projects. An example of this would be when the library’s parent institution decides whether to build a new library using Plan A, which will cost $X, or using Plan B, which will cost $Y; it is most unlikely that they could afford or would want to build both.

Some define ROI like IRR, others calculate it like average rate of return, and still others do it in additional ways, such as accounting rate of return. Consequently:

\[ \text{Return on investment} = \frac{\text{Return}}{\text{Investment}} \]

Payback period (PP) is “a method of analyzing investment opportunities that determines how long it will take the cash inflows expected from an investment to repay (payback) the initial outlay” (Pringle and Harris, 1984, p. 289). Some advantages of using PP are that it is easily understood and that it favors expenditures that generate large early cash flows. Some disadvantages are that PP ignores the time value of money, it cannot be used to compare projects with differing economic lives, and it ignores any cash flows that accrue after the payback period, which leads to an over-emphasis of short run profitability. One calculates payback period using:
Discounted payback period is an improved version of payback because it incorporates the time value of money. The added feature is that with discounted payback the expected cash flows are discounted by the project’s costs, including the cost of capital. Cost of capital is the “required return for a capital budgeting project” (Emery and Finnerty, 1997, p. G5), such as 10 per cent per year. As a result, discounted payback is defined as the number of years required to recover the investment from discounted net revenues. Like PP, when using discounted payback, one should undertake the proposed project if the discounted payback occurs within a preset timeframe. A drawback to this method is that, like PP, it ignores all cash flows after the cut-off. Although “it is better than payback, the discounted payback method is still not an adequate indicator by itself […] If you can understand the idea of discounted payback, you can understand and use net present value, so why bother with discounted payback? This is probably why discounted payback is not very widely used in practice” (Emery and Finnerty, 1997, p. 359). The formula for discounted payback is the same as the one for PP. The difference is that, instead of using the cash flows as inputs, one uses the PV of the cash flows.

Hurdle rate is “a minimum standard for the return required of an investment, used in selecting from among alternative investment choices” (Helfert, 1997, p. 490.). Obviously, before using this method one must have a level of return that one wants to “hurdle”. As a result, this method does not have a formula.

One may also find average rate of return (ARR) mentioned as a CBA option. It, however:

… contains a fatal flaw that makes it completely unacceptable as a decision method. It averages cash flows across time periods, actually distorting the representation of the cash flows. After all, a project may offer an attractive cash flow for a year or two and then end without repaying the initial investment. The ARR considers only the average cash flow during the period, not the total over the project’s life […] It has no redeeming features. Don’t use it (Emery and Finnerty, 1997, p. 359).

After reading this condemnation, one should to recall that one way to calculate ROI is the same as the way to calculate ARR. The ARR formula is:

\[
ARR = \frac{\text{Average cash inflow}}{\text{Average amount invested}}.
\]

An obvious weakness of CBA is that in many instances there is uncertainty about the value of one or more of the variables that are used to compute the formulae. For instance, because a change in the value of a variable will cause a modification of the NPV, there can be uncertainty about the potential investment’s outcome. This is a risk for the organization. Sensitivity analysis (SA) allows one to better understand how much risk is involved because it indicates how much the PV will be altered in response to a given modification in a variable when other ones are held constant. Consequently, SA is not a method of conducting CBA as much as it is a means of analyzing one’s CBA. It is a way to better understand what would occur if certain events transpire. It addresses the question “What happens if things do not occur as predicted?”. As a result, it is often thought of as a
“what if” technique. For example, what if this investment generates 10 percent less revenue than expected or if its costs rise 15 percent more than expected? One of the disadvantages of sensitivity analysis is that its results are always somewhat ambiguous. Another weakness is that the underlying variables that influence the outcome can be interrelated. For example, if one wants to purchase a copier for the use of the library’s customers, the cost is a specific amount. However, while the amount of revenue it will generate is a specific number, it cannot be known precisely ahead of time. This is also true of the maintenance costs. Note that the amount of revenue and maintenance costs will probably be related; the more the copier is used, the more money it will generate and the more maintenance costs are likely to be.

In summation, there are many ways of conducting a cost benefit analysis. Consequently, there is no reason why a library administrator should be limited to having only one tool in their toolbox, especially one, such as ROI, that is relatively poorly regarded. It is unfortunate that some are promoting the use of one, flawed CBA tool.

References
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