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Benefit-Cost Analysis: An Integral Part Of Environmental Decisioning

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ABSTRACT

In making environmental management type decisions, benefit-cost analysis is often omitted. Because it should be an integral portion of all environmental systems analyses, an approach toward setting up the framework of performing a B-C Ratio is presented here.

Benefit-Cost Analysis is a quantitative portion of the traditional decision-making process, which is (in brief):

1. Identify the problem to be studied.
2. Analysis, and listing of various alternatives.
3. Evaluate each alternative (pros and cons).
4. Select the best alternative.

With respect to benefit-cost analysis, step 2 above will become a qualitative listing, and step 3 will quantify this listing so that a benefit-cost ratio may be determined.

$$\text{B-C Ratio} = \frac{\text{Benefits of decision}}{\text{Costs of implementation}} \tag{1}$$

Formula (1) is greatly oversimplified and will be developed further, as necessary. (For example, present value techniques should be incorporated, where required.)

Let us take an example which has been in the news, either directly or indirectly, over the past few years. This problem concerns a local government

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(call it a County Commission consisting of five commissioners), a collective group of citizens somewhat divided ("conservationists" vs. "progress"), a group of "outside" representatives of a company, and a community rich in natural beauty, but poor in tax receipts and assets thereof.

The Problem: Whether or not to allow a company to establish a business in the community. The problem is further complicated by both short- and long-range implications. We will also make an assumption that the community current unemployment level is approximately 10%.

The company representatives have stated that local hirings will take priority over outside personnel, wherever possible, and that all able bodied unemployed people in the community willing to work will be hired. The company is willing to have all plans approved by the Commissioners prior to construction, and to incorporate any "reasonable" changes requested prior to actual construction. After the plant becomes operational (approximately two years after go-ahead), annual taxes to the county would approximate $700,000. Thus, the benefits to the county are formidable; the missing portion of the analysis (for evaluation purposes) is: What are the costs?

What we really have is a problem in environmental management—one that deals with management, benefits, and costs (economic and social), and a change in the environment. All of the above involve a forecast of the future, in which there is always a level of uncertainty. Proper evaluation can help minimize the degree of uncertainty, by carefully considering all the input factors—both "good and bad."

Table 1 lists the known advantages of accepting the company's proposal, as well as the known disadvantages. It is certainly not complete, and may never be at the time a decision must be made. The key to the situation is to make a concerted attempt to minimize the incompleteness. Perhaps another listing (say,

Table 1.

Advantages	*Disadvantages*
1. More jobs.	1. Added noise, smoke, smell, with potential water pollution possibilities.
2. More taxable personal income.	2. Need for additional:
3. More spending.	a. Schools
4. More taxable local business profits.	b. Utilities (water sewerage)
5. $700,000 taxes beginning in 3rd year of incoming company (lower percentage tax on personal income).	c. Firemen and equipment
	d. Policemen and equipment
6. Other companies more likely to build plants in a "progressive" community.	3. Peril to fish and wildlife.
	4. Eventual rise of personal income taxes.
	5. Relocation of peripheral citizens.

Table 2[1]) would be in order. This exhibit would present the known advantages of rejecting the company's proposal, as well as the disadvantages. One might argue that Table 2 would merely reverse the advantages and disadvantages of Table 1. Maybe, but maybe not entirely. Consider the following:

A disadvantage of rejecting the company's proposal might well be a continuation of high county welfare expenditures, or even hunger. Although Table 1 lists more jobs as an advantage, the connotation may be different. Another disadvantage of not accepting the proposal may be that future potential "acceptable type" companies may not even consider our community in light of our current decision.

The real importance of lists of the nature of Tables 1 and 2 (that is, generating both lists) is to minimize the uncertainties relative to the errors of omission. Any decision is subject to two types of errors—the first being that of omitting an important item that should be considered. The other type of error involves errors of observation. This type of error can be a function of the quantitative determination of the figures for the benefit-cost ratio. Of prime importance is to minimize both sources of errors. Next, a refinement of Table 1 and/or Table 2 should be made and consolidated. Once the totality of the listing is agreed upon, numbers should be applied to each and every item. Some of these will be easy, some quite difficult. The alternative is to ignore the difficult quantifiable items, or mask them behind the category of so-called intangibles, or a wide degree of uncertainty. (Keep in mind that total uncertainty is quite rare—most people have an opinion, they just hide behind the "total uncertainty" statement because they are afraid of being wrong.)

When we quantify those items that are to be included in a benefit-cost ratio, the benefits (the numerator part) relate to advantages minus disadvantages to those who will benefit from acceptance of the proposal. (In our example, it refers to the county; that is, those who will be affected by the decision.) Costs to the county mean all the expenditures minus savings incurred by the decision. Thus, we are looking for actual net values. A negative benefit may be added noise, smoke, and smell. A negative cost may be reduction in welfare payments. The "cost" of the added noise, smoke and smell should be subtracted from the numerator (benefits), and the reduction in welfare payments should be subtracted from the denominator (costs). Last, the benefits and costs must be discounted to the present value method; when investment returns are greater than a year away. We are really talking about a cash flow analysis, and performing an economic feasibility study.

One example is that schools, water, sewerage, firemen, policemen and other expansions will probably occur prior to the receipt of the $700,000 taxes (and other inflows) from the company beginning in the third year or so.[2]

[1] Table 2 is not included. The reader should attempt to develop it.

[2] Refer to any standard managerial economics text for a presentation of the present value (discounted) concept and calculations.

Our benefit-cost ratio then becomes:

$$\text{B-C Ratio} = \frac{B_1 - B_2}{C_1 - C_2}, \tag{2}$$

where

B_1 = Present value of positive benefits
B_2 = Present value of negative benefits
C_1 = Present value of positive costs
C_2 = Present value of negative costs

Assume the following:

B_1 = \$4,000,000
B_2 = \$1,400,000
C_1 = \$2,500,000
C_2 = \$ 200,000

By substituting these values into Formula (2), we obtain:

$$\text{B-C Ratio} = \frac{\$4{,}000{,}000 - \$1{,}400{,}000}{\$2{,}500{,}000 - \$\ 200{,}000}$$

$$= \frac{\$2{,}600{,}000}{\$2{,}300{,}000} = 1.13$$

With a B-C Ratio of 1.00, the benefits just equal the costs of the project, taking the cost of capital into account. A B-C Ratio of 1 or greater justifies the project, providing all input data is correct and complete. Further refinements could be made by adding probability ranges of expected attainment.

In summary, a benefit-cost analysis is of extreme practical value in that it forces a realistic systematic listing and study for consideration of a proposal.