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ABSTRACT

Although two economic methods, cost effectiveness and benefit-cost analysis, are frequently mentioned as useful tools for educational decision making, only one, cost effectiveness, has potential for making a contribution to this field. A benefit-cost analysis tries for each alternative to measure benefits and costs, which are then discounted to yield a present value. Unofrtunately, in educational systems benefits cannot be measured, and the idea of a discount has no meaning. However, a cost effectiveness analysis may have application to education since it compares the different costs of alternatives against the different performance levels on objectives. A decision criterion must be able to relate and measure all the performance of difference alternatives. Most educational organizations do not have the data for a cost effectiveness analysis, yet the thinking and judgments on relative value and performance are most desirable. (WH)

MAKING SENSE OF COST-EFFECTIVENESS AND BENEFIT-COST ANALYSES*

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My formal academic education has been primarily in economics and statistics. In 1965, I first began to puzzle over ways to apply economic methods to the problems of education. It was then that the concepts and methods of benefit-cost and cost-effectiveness analyses became familiar to me.

I was asked to speak to you today about making sense out of cost-effectiveness and benefit-cost analyses. While that is a formidable objective, nonetheless, I believe that we can do just that.

Before we examine each of the methods it will be useful to draw a distinction between two kinds of analytic remedies.

Conceptual Analytic Models and Practical Analytic Tools

I would like now to draw a distinction between conceptual analytic models and practical analytic tools. A conceptual analytic model describes a set of information requirements and a method to transform these information requirements into a useful management decision tool. Conceptual analytic models often exist several years before practical applications are made. These models are important for they provide a general framework to guide those who will ultimately perform the first practical applications.

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A practical analytic tool describes a set of information requirements which are feasible -- that is, information requirements that are obtainable or could easily be obtainable and are within the existing state of the art of measurement technology -- and a method to transform these information requirements into a useful management decision tool.

The essential distinction, then, is that for an analytic tool to be considered as practical it must be technically possible to obtain the information required.

Now we shall consider the conceptual analytic models of benefit-cost analysis and cost-effectiveness analysis. After that we shall examine these models by asking ourselves if they are more appropriately classified as conceptual or practical.

As we shall see both approaches have roots deriving from methods developed by economists.

BENEFIT-COST ANALYSIS

Benefit-cost analysis derives from work, primarily in the field of water resource development, some of which was done as early as the 1920's. Methodologically it aims at the selection of one or more projects from a pool of alternatives. Each alternative is viewed as a capital investment project with the analysis focusing upon benefits and costs.

When a banker evaluates a potential investment, he considers the stream of incomes and costs over the lifetime of the venture. He knows that receiving $1000 ten years from now is worth less than receiving $1000 today because

he can invest the $1000 he receives today and have close to $2000 in 10 years. Benefit-cost analysis evaluates a public-sector investment just like the banker evaluates a private-sector capital investment.

Let us now consider the information requirements and how this information is assembled into a decision criterion.

Information Requirements

1. For each alternative, we need an estimate of benefits to be derived for each year. The symbol B_{1t} refers to the benefits for alternative 1 in time period t.
2. For each alternative, we need an estimate of costs to be incurred for each year. The symbol C_{1t} refers to the costs for alternative 1 in time period t.
3. For each alternative, we need a definite number of years for which the project alternative will be considered. The symbol N refers to the number of years benefits and costs are to be explicitly included in the analysis for a given alternative.
4. For all alternatives a discount rate must be selected to use as a way of translating future benefits and costs into present day terms. The discount rate is a "reverse" interest rate. The symbol i refers to the discount rate.

The Decision-Criterion

The term decision-criterion refers to how the decision-maker sorts alternatives into those which are acceptable and those which are not acceptable.

Now we assemble the information so as to be able to calculate the present value for each alternative. The symbol V_1 is the present value of alternative 1. That is,

$$V_1 = \sum_{t=1}^{N} B_{1t} - C_{1t} / (1+i)^t$$

This calculation is performed for each alternative and the V's are compared. Higher V's are preferred.

The Acid Test: Feasibility

Let us consider the application of this approach to education -- more specifically the public schools. Many controversies and arguments arise out of attempts to operationally define the information requirements under any set of realistic conditions. Essentially, we are confronted by three main problems in using benefit-cost analysis as a basis for school district decisions.*

1. The superintendent of schools is continually bombarded by immediate pressures. He is forced to show results -- now. In a well-balanced community, the superintendent may be able to trade-off some of the pressure for present-period results for the promise of expected improvements in the future. But only the most farseeing of communities will allow costly future-oriented programs to be initiated totally at the expense of the

*While I have selected the school district as a focal point, much of the argument extends to such diverse consideration as government investment in educational R & D, university investment in new curricula, state level investment in new initiatives suggested through legislation and the like.

present. In planning at the national level, some form of benefit-cost analysis may be desirable, but the superintendent, as a result of many years of "non-planning" at the local level, is not today afforded this basic view of planning for his schools.

2. Benefit-cost analysis requires that both benefits and costs be translated into common units (typically dollars). This is usually an unmanageable problem, since the benefits of education are, in general, both intangible and incommensurable. While it may be possible to reduce benefits to a common unit;* it is conceptually improbable that this unit would be dollars. Ratio of benefits to costs could be utilized but this change introduces the methodological idiosyncracies of ratios into the already murkey waters.

3. A discount rate must, according to the requirements of the method, be chosen to adjust future benefits and costs to present-value terms. How does one select a discount rate for the intangibles of education? This is a problem of considerable consequence to the analysis because studies in the water resource domain and other

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*Ellis B. Page has been working on this problem. See for instance:

Ellis B. Page and Thomas F. Breen III. "Educational Values for Measurement Technology: Some Theory and Data" in Frontiers of Educational Management and Information Systems - 1973. Proceedings of an Invitational Conference on the Occasion of the Dedication of the Lindquist Center for Measurement, Iowa City, April 6-7, 1973. Boston: Houghton-Mifflin, 1973.

Also see, Ellis B. Page. "Seeking a Measure of General Educational Advancement: The Bentee," Journal of Educational Measurement, Spring, 1972.

domains have consistently demonstrated that choice of a discount rate parameter (e.g., 4% versus 5%) is sufficient to alter the rankings of V's for the alternatives being considered. Add to this the 1974 inflation-interest rate fluctuation realities and what do you have?

Summary for Benefit-Cost Analysis

While benefit-cost analysis exhibits potential as a way of conceptual thinking and as a way of viewing problems, it offers little of practical significance, in my judgment, to those of us who want to make better, more informed educational decisions.

As a vague, vogue, somewhat general notion, it has been bantered about, especially by funding agencies when they are in a cutting posture -- "The benefit-cost picture here does not look very good." This, of course, means that the fundee must, in order to contradict the conclusion, find some data-based way of demonstrating that the benefit-cost picture is, indeed, good. Struggle as you may, there is no way to provide counter evidence.

COST-EFFECTIVENESS ANALYSIS

Cost-effectiveness analysis derives, principally, from work done in the Department of Defense under Secretary McNamara in the early 1960's. Many of the technical problems of developing military systems were analyzed within some form of effectiveness/cost framework.

Methodologically, it aims at the selection of one or more alternatives each of which has been designed to meet one or more objectives. It is a natural substitute for benefit-cost analysis for situations in which benefits

are incommensurable and inappropriate for dollar valuation.

The method is usually applied with one of two perspectives:

1. For a given level of effectiveness, find the alternative(s) that minimizes cost outlays.

or 2. For a given level of cost outlay, find the alternative(s) that maximizes effectiveness.

Information Requirements

In 1970, Research for Better Schools published a monograph that I wrote on this subject.* At the time my interests were to identify the kinds of information that a school district would need to (1) assess where it was and (2) know how to proceed from there.

I developed a framework which went from the over-simplified to the complexities of schools. The analyses in each of the cases developed within the framework focused upon information requirements. Let us look at the essentials of what I found. (See Figure 1 on the following page).

Perhaps we can slowly walk through the framework. It begins with what is perhaps the simplest decision case of all -- a decision-maker wants to select one alternative from a set of alternatives; he is unconstrained by dollars and the frame of reference is a-priori (before the fact) -- that is, he is also unconstrained by any ongoing activities. This case is what I referred to as "a utopian R & D situation."

The analysis continues and I will now highlight some of what we find.

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*See reference 3 under Cost-effectiveness.

FIGURE 1

A CASE CLASSIFICATION OF LOGICALLY RELATED DECISION PROBLEMS

CASE	STRUCTURE	DECISION FRAMEWORK	RESOURCE LEVEL	COMMENT
1.	Single objective with set of proposed plans (activity-designs) for achieving the objective; one plan is to be selected.	A priori	Unlimited	A utopian research and development problem.
2.	Single objective with set of activity-designs; one to be selected.	A priori	Limited	The constraint limits admissible alternatives; but still no incentive to economize.
3.	Evaluation of Cases 1 and 2.	A posteriori	Known	A performance evaluation involving a partition of outcome space.
4.	Single objective with set of tasks; several to be selected as a program package.	A priori	Unlimited	A more complex version of Case 1; still utopian.
5.	Single objective with set of tasks; several to be selected as a program package.	A priori	Limited	The constraint limits admissible alternatives as in Case 2; still no incentive to economize.
6.	Evaluation of Cases 4 and 5.	A posteriori	Known	A more complex version of Case 3.
7.	Multiple objectives with multiple activities; several to be selected.	A priori	Unlimited	A much more complex version of Cases 1 & 4; the relative weight of objectives becomes important.
8.	Multiple objectives with multiple activities; several to be selected.	A priori	Limited	The general cost-effectiveness case; the only case meeting the necessary and sufficient conditions for cost-effectiveness analysis.
9.	Evaluation of Case 8.	A posteriori	Known	The general program evaluation case; provides cost-effectiveness evaluations for present year and inputs for next year's budget.

Sooner or later we end up with Case 9 which is the evaluation of an ongoing system with multiple objectives and multiple activities designed to meet these objectives. Case 8 is the situation in which the findings of Case 9 are used to allocate resources for the future.

Some other highlights of possible interest are:

1. The first genuine incentive to economize (by economize I mean to get more for the dollar -- not to reduce costs in the strict sense of the word) is Case 8 in which we have multiple objectives (and thus multiple outcomes that are important) and a constrained budget. Budgetary constraints by themselves do not necessarily result in more economical operations -- nor do multiple objectives necessarily result in better allocations of resources.
2. Public sector organizations are usually not rewarded for finding a cheaper way to do something. Sometimes in fact there may be disreward because there are indications that "you did not need all that money." This is sad.
3. Benefit-cost analysis comes in at Case 8 if it comes in anywhere (this, again, is because of the feasibility impediments).

The Decision Criterion

It is somewhat difficult to specify a precise decision criterion here but I will try. In doing this I must simplify some rather complex relationships.

The overall thrust of the approach is to help an ongoing organization achieve more of its objectives given the dollars it has to work with.

It is made up of performance scores from component activities and value assignments made to these activities. Thus we have

$$P_1 v_1 = \text{effectiveness for activity 1}$$

and $\sum_{i=1}^{N} P_i v_i$ = sum of the effectiveness scores for all N activities.

What we try to do is rearrange activities in such a way that we can produce the largest ΣPv for the amount of money available.

Let us examine two sketches to help our thinking

Sketch #1
A View of the Organization

Overall Objective	Programs and Projects 1	2	3	. . .
O_A	a_{A1}	a_{A2}	-	
O_B	a_{B1}	-	-	
O_C	-	a_{C2}	a_{C3}	

.
.
.

The symbol O_A refers to overall objective A. The numbers refer to programs and projects. An activity, e.g., a_{B1} refers to program 1's contribution to overall objective B.

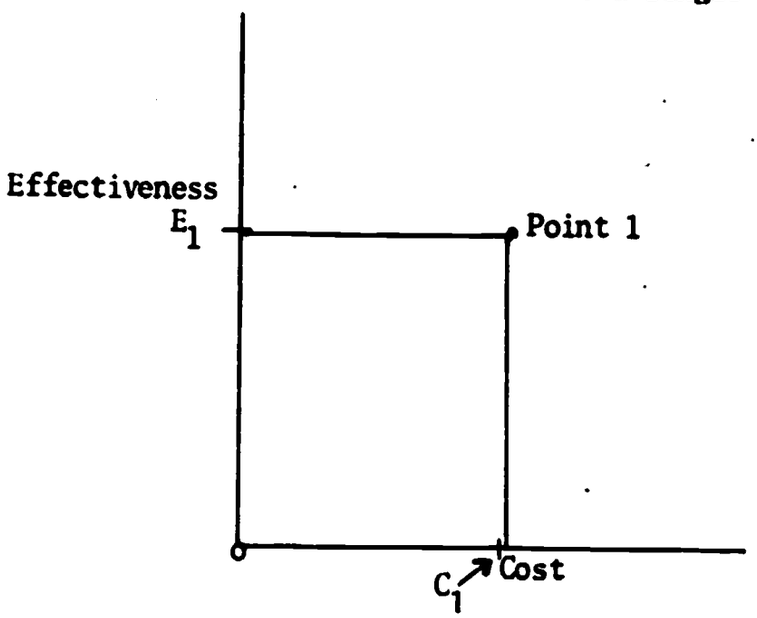
To conduct the appropriate analyses it is necessary that each overall objective be weighted to reflect importance (this of course brings

us to ..... ("whose values"). Further it is necessary that the activities contributing to a particular overall objective be assigned values. And lastly, it is necessary that a performance measure (sometimes more than one performance measure) be assigned to each activity, ideally on a scale from 0 to 100. With these pieces of data we can arrive at a measure of effectiveness.

This part of the analysis will tell us where we have been -- that is, how well the organization is now performing with respect to its present overall objectives.

To see the effects of alternative changes it is necessary, however, to introduce costs.

Sketch #2a
The Effectiveness-Cost Point for a Single Activity

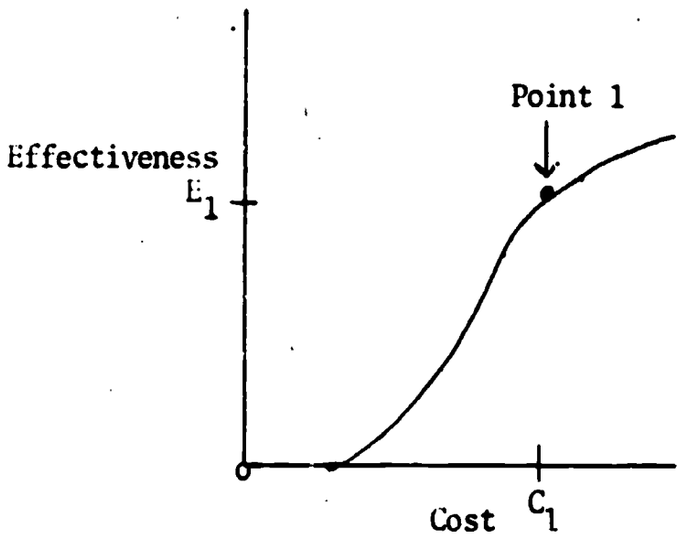


Point 1 tells us that if C_1 is spent it will produce E_1 results. Unfortunately this does not tell us what to do -- even if C_1 and E_1 were actual figures we still would not know what to do. Thus, the information we have about effectiveness and cost as a result of our present year's

operations is not sufficient to tell us anything about what to do next.

What do we need to know in order to make decisions? First we need a curve for each activity similar to that presented in Sketch #2b.

Sketch #2b



With this information we can now see that point 1 is a very good level of funding for the activity represented in the sketch. The effectiveness axis, remember, reflects both value assignments and performance. Now if we have curves such as this for each activity (standardization being achieved through value assignments and costs), we can allocate a budget and consider the potential effects of that allocation on organizational objectives.

Where is the rub? First, it is highly unlikely that any organization has the full range of data to allow someone to construct the sketch in 2b. Secondly, then, selected points on the curve must be "estimated" using expert judgment. We must delicately balance objective and subjective data. All of this opens many new questions -- yet when we do

not explicitly use these data our decisions, nevertheless, implicitly presuppose the data. Even if the data are very soft, it is reasonable, in my opinion, to expect that decision-makers provide explicit judgments in an open manner.

The Acid Test: Feasibility

This approach is, very generally, implementable but with difficulty because, after all, this is a new way of thinking. For school districts to implement such an approach there is need for extensive training and given the tenor of the times, a bottom-up implementation strategy may be required. By "bottom-up" I mean that teachers and principals should work with overall objectives, performance measures and figure out how well they are doing. Then, as they get feeling for the data that describe present performance they can push for changes needed to support the classroom. This push will create the need for cost information and the cost and effectiveness can get together.

Summary

I have tried to draw for you some frameworks within the area of applying economic-based methods to education. There are other methods that I have not considered because the agenda was already packed with material. The very nature of the material is highly technical and as such we may have spent too much time on technicalities at the expense of overall understanding. There is, however, a certain amount of technical appreciation that is prerequisite to overall understanding and I hope that I have struck an appropriate balance.

My biases are strong as to the relative applicability of the two methods to education. Benefit-cost analysis just is not feasible while cost-effectiveness can, I believe, help us sharpen our judgments and, perhaps, enable us to be more effective in the decisions we make.

How effectively have we met our objective of making sense out of the methods? As we recall, effectiveness as a measure has two contributing elements -- relative value and performance. For those of you who attended this session, relative value must have been reasonably high. The final assessments of performance I must leave to you.

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