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ABSTRACT

Cost-effectiveness analysis and cost-benefit analysis are two related yet distinct methods to help decision makers choose the best course of action from among competing alternatives. For both types of analysis, costs are computed similarly. Costs may be reduced to present value amounts for multi-year programs, and parameters may be altered to show differing cost results. Effectiveness is typically an indirect constructed measure of selected program outcomes. For the same unit cost, one can determine which option yields the most effectiveness, or which program produces a given level at the lowest cost. Benefits are program outcomes expressed as money. Benefits are not necessarily recorded by the accounting system of the institution sponsoring the program. For either types of analysis, the rules for evaluating and deciding are essentially the same. The first step in any cost analysis is to determine the cost-center of analysis (the agency, department, programs, sets of programs, or program elements). The constant yardstick in effectiveness analysis is the desired outcome, but in benefits analysis, the constant yardstick is monetary value. Neither method is a panacea, but both are helpful in decision making. Six figures are included. Appendix 1 presents a cost categorization format. (SLD)

COST-EFFECTIVENESS AND COST-BENEFIT ANALYSIS: CONFRONTING THE PROBLEM OF CHOICE

by

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COST-EFFECTIVENESS & COST BENEFIT ANALYSES: CONFRONTING THE PROBLEM OF CHOICE

Bob Johnson, Executive Vice President and Divisional Manager of Widgets Manufacturing Corporation, is concerned about the sluggish sales and rising costs of his division. The key issue facing him now is what to do. Among the proposals he is considering are these:

* Put into place a revised sales incentive system for his sale representatives. Projected marginal cost: $25,000.

* Train his supervisors and their employees in certain work-planning and control techniques, along with a brief orientation to the division's current business situation. Projected cost: $20,000.

* Improve worker motivation through a "job enrichment" program of increased responsibility and worker control of their work. Projected cost: $35,000.

* Install a new set of machinery at certain points in the work-flow to replace deteriorating stock. Projected cost: $150,000.

* Begin a "quality circles" program of worker problem-solving of production problems. Projected cost: $20,000.

And, Bob figures, his other option is always to do nothing and hope that either the economy in general picks up or that some of these expense problems dissolve from tighter controls/ Coming up with $25,000 to $35,000 from existing budget manuevers could be done fairly easily; getting $150,000 for new equipment may be possible but only over the long-term.

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He wants to decide now on what to do, but he simply does not know which course of action would be the best to take. No matter what he decides, he will either be spending -- or losing -- money, now and/or in the future.

His decision depends, in large part, on the evaluation of these proposals.

The Probl..m of Choice

Bob Johnson knows that he is paid to make decisions. That's the job of executive management. Part of the premium paid to them recognizes that their decisions, in particular, are often based on a lot of risk and uncertainty. Bob is feeling that risk and uncertainty a lot right now.

Indeed, the driving rhythms of choice and risk intermix into the overture that introduces the need for evaluation. Naturally enough, people making decisions wish to reduce their uncertainty and all the risk attendant to that uncertainty. "Evaluation" is a way to reduce the risk of making decisions by generating information and opinion on the value of what is under review. Evaluation is the hand-maiden to choice. When there is little risk or uncertainty -- that is, when a decision about what to do and how to act has already been made, there is little need for evaluation.

Managers are held accountable for the financial resources entrusted to them. This applies as much to the County Extension Director's control of his or her budget as it does to a private executive's profit-and-loss-statement. Literally, being respon-

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sible for budget dollars "up's the ante". Managers want straight forward, preferably numerical answers to their basic question: What is the best course of action to take?

One ascendent technology that provides hard and neat answers to that question is the family of analytical methods known as systems analysis (Doughty et al, 1978:3). Harry Summers (1981:28) talks about how systems analysis came to dominate Defense Department thinking in the 1960's; he attributes our strategic defeat in Vietnam, in part, to exactly this analytical bent. He quotes that for such methods of decision-making, " 'the catechism is familiar: objectives, criteria, options, costs, benefits, quantify as much as possible, focus on changes at the margins.' "

Systems analysis forces a rationality, an output-and-outcome calculus, on events for the purpose of evaluating them in order to decide what to do. All forms of analysis usually focus on five distinct parts: goals, alternatives, impacts, models and decision rules. To reach desired end-states (goals), there are always alternative ways to get there. Each alternative has impacts (both costs and outcomes). Determining what those impacts will be requires that certain models be used. Once determined, there will be some criteria (decision-rules) used to decide which option to select. Analysis is the prelude to judgement (Doughty, 1979:7-8).

Two prominent members of this systems analysis family are cost-effectiveness analysis and cost-benefit analysis. Both apply a rational yardstick to various alternative courses of action. These yardsticks permit a "rational" comparison between the

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options so that the best choice emerges from the analysis itself. Both methods begin by computing the costs of the proposals. The costing methodology is derived from basic accounting procedures (plus some), is in many ways the simpler part of the equation to compute and is the same technique for either method.

Effectiveness is a constructed measure of how well any given program produces the same desired outcome. For example, how well do three different teaching systems produce the same commonly defined learning outcomes? Some arbitrarily defined index of learning is constructed; this index is applied against each system to decide that system's relative effectiveness.

Benefits are the actual dollar values created by the program. For a crisis counseling programs, the benefits might be the savings resulting from reduced police and ambulance calls to a home, and the gains at work for fewer sick-days taken.

The intent of both cost-effectiveness analysis and cost-benefit analysis is to provide a means for comparing alternative ways to reach a goal(s). Either way, the rationality of the process pushes the choice to where gain is maximized at the lowest possible cost.

We'll look at how costs are treated first. Then, we'll look at the effectiveness issue and explore cost-effectiveness analysis. We'll then move into looking at the benefits side of things. The conclusion will compare and contrast the two approaches.

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COSTS OF A PROGRAM

Begin by determining what your "cost-center" will be. Programs can be sliced into at least five distinct cost-centers. At the macro-level, there can be the agency (program umbrella group) itself. Community Action Agencies would be an example of this. Second, there could be a departmental center. These are specially organized sub-units of a larger organization. An entire Training Department could be treated as a cost center of a larger organization. Third, there are programs, such as Meals-On-Wheels or Management By Objectives: these are specific, bounded plans of action for achieving certain delimited objectives. Fourth, sets of programs may be treated as a cost-center. A management improvement set of programs could include these programs: a supervisory training program, a career path system, an MBO program and an incentive compensation program. Finally, specific program elements -- a computer-assisted instructional element or a set of home-reading assignments -- could be isolated for cost analysis (Beilby, 1979).

The first task in cost analysis is to decide what the cost-center of analysis will be.

Next, the costs themselves must be determined. A cost is more than the out-of-pocket dollar expenses of doing something. "Costs" can be thought of generically as all those sacrifices associated with a given course of action (Levin, 1975). Rothenberg (1975) refers to costs as those current gratifying opportunities that are foregone. When you take a current dollar of income (revenue) or a current hour of time which you can spend on something you prefer to do now, and instead spend either that dollar or that hour for some future outcome, that is a cost.

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Thus, there is a sublety -- and a rigor -- to computing costs. To simply total receipts is insufficient; all the current gratifying opportunities must be identified, then their costs estimated. At the extreme, this could mean including the costs of client-time. The second step in cost analysis, then, is to list all the specific costs (resources) required for a program (Levin, 1975).

The Economics of "Cost"

For economists, costs arise because prized results or goods are in scarce supply. Goods that are unlimited (such as air) are free. Economies arise to produce and distribute these scarce goods. The price of a good is its cost based upon the relative supply and demand of the good (Gwartney, 1980: 404-419).

For economists, there are three main kinds of costs. Fixed Costs are those established expenditures on factors in production that do not vary with the amount of production. Property taxes or insurance premiums are example of invariant fixed costs. Variable costs are those expenses that change with the amount of production (such as wages paid or purchase of supplies). Both of these explicit costs can be contrasted with the implicit opportunity costs of action: When resources are used for program X, they cannot be used for program Y.

Add together fixed and variable costs and you get the total cost of a project. You can also compute both average costs and marginal costs as well as unit costs. Sunk costs are those expenditures, fixed or variable, already spent on the project. Over the short-term, costs cannot be changed, essentially.

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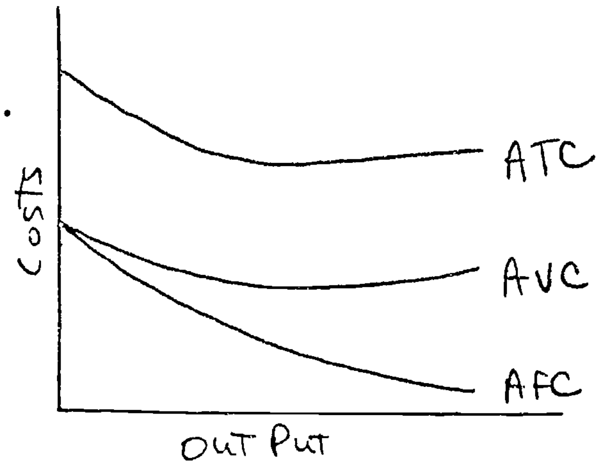
Over the longer term, though, the organization has the ability to reconfigure itself so that it can exert some measure of control over its costs. Finally, as the chart at right shows, costs will vary with the output of the project. The average fixed costs (AFC) will decline with more output. Average variable costs (AVC) will initially decline but then increase. Average total costs (ATC) will reflect the component changes.



This framework is helpful for understanding the costs of programs, because programs will have both explicit and implicit, fixed and variable, unit and sunk costs. Cost analysis must take these costs schemes into account in order to create a full rendering of a program's costs. The cost categories should be comprehensive to include all the resources consumed by a project or program.

Determining Program Costs

The following discussion will show how to compute the costs of programs and functions. While the model could be applied to departments or entire agencies, the accounting for those cost-centers are sufficiently distinct in treatment. Finally, the referent example will be training programs, but again, the ideas discussed should be sufficiently applicable to all kinds of programs.

A program's fixed costs could include expenditures in research and design, equipment and software and facilities (if

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applicable). Variable costs would be trainer time (in and out of the classroom), plus any pro-rated expenses for administrative overhead, supplies, etc. The opportunity cost is the trainee's/participant's time spent in the program.

Weinstein (1982) summarizes these various factors into four cost categories.

1. Direct Program Expenses -- all expenses directly attributable to a given program.

2. Administrative Expenses -- all administrative overhead expenses related to but not directly attributable to a given program (such as the pro-rated salary of the Department Director, etc.)

3. General Organizational Costs -- such pro-rated expenses incurred by the larger sponsoring organization in managing the program (in accounting, personnel, executive management) that are not directly related to the given program.

4. Participant Expenses -- the total compensation paid to the employee while involved in the program, plus any related on-the-job time spent on the training.

The chart of accounts used to classify costs could involve such specific items as personnel, hardware, software. See Appendix 1 for a suggestive listing of such items. What is important is that a comprehensive, easy-to-use chart of accounts be employed. Again, all relevant costs of the program must be accounted for.

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Indeed, it is possible to organize the above two options into one: make an exhaustive listing of specific items (wages, benefits, supplies, hardware, software, etc.) and them compute what each of those items would be for direct, administrative and general organizational expenses. The resulting table shows this chart-system of cost accounts.

Example: Account Charting

Cost Group	Direct Program	Administrative	General Organizational
Line Items	* Salary	* Salary	* Salary
	* Supplies	* Supplies	* Supplies
	* Equipment	* Equipment	* Equipment
	* Facilities	* Facilities	* Facilities
	Etc.	Etc.	Etc.

Finally, to develop the proper cost model, you must also know about a project's life-cycle. Programs evolve. The nature of costs will vary over time. Kearsley suggests four distinct phases in a program's life-cycle. First is the analysis, R&D design phase. This is followed by start-up, investment phase. Once in place, the program begins an operating, maintenance phase. One program may be replaced by another; during this transition period, a new cost structure will take place.

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The following map to pigeon-holing a program's costs emerges.

Cost Group	Line Items	R&D	Start-Up	Operation	Transition	Total
Direct	* Salary					
	* Supplies					
	* Hardware					
	Etc.					$
Adminis-trative	* Salary					
	* Supplies					
	* Hardware					$
General Organi-zation	* Salary					
	* Supplies					
	* Hardware					
	Etc.					$
Participant	* Compensation Rate					$
	Total	$	$	$	$	$

Such a cost computation is necessary for a full and complete estimation of program costs. It also suggests the timing of the expenses and the relative proportions of expense items. This generic cost-map would be modified to meet the unique specifications and dimensions of each program.

<u>Accounting Standards on Costs</u>

A discussion on program costs would not be complete without some reference to the necessary accounting standards which should apply.

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Of course, the critical principle in cost accounting is that the asset or expense item should be recorded at its real cost (Meigs, et al: 16ff). This means, as much as possible, using the actual paid price (the historical cost) of the item. This price is not what the asset could be sold for now nor does it indicate what would have to be paid in order to replace the item. For physical equipment, facilities, supplies and other tangible objects with a market value, this cost principle is easy to establish. It is when various "subjective" costs (such as client goodwill) are considered that this cost principle becomes much more difficult to follow.

Beyond this basic principle, costs have other implications, including:

1. Amortization of Capital Items.

   Capital items are typically pieces of equipment or other tangible goods used in producing outputs; their "life" extends longer than one year. The outlay cost of such items should be spread, usually equally, over the estimated life of the object. Since a capital item may be used by more than one cost center, its expense must be pro-rated, based upon the cost center's use of it (Beilby, 1979).

2. Program Length.

   Some program cost-center's exist for longer than one accounting, budget cycle. Multi-year projects require multi-year cost estimates. A complete rendering of future year costs should be done using constant dollars. This is

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turn means computing the present values of future dollars. (See Weston et al, 1982: 49-63, for a discussion of present value.)

3. Matching Costs & Outcomes

You should use the same period of time to measure both costs and outcomes. Therefore, if you decide the program's length will be two and one-half years, count the costs incurred during that total 2 1/2 year time, but also count the benefits/results accruing for that total 2 1/2 years, at least. (There are other considerations, too, about computing results; see the discussion below.)

4. Ranges of Uncertainty.

Certain cost estimates can be done with a high degree of certainty; some, with a high degree of uncertainty. Should the uncertain figure be a large item in the cost computations, the resulting total cost would be subject to the same uncertainty. Therefore, apply a "sensitivity analysis" to the cost estimate by using upper and lower points; factor these differing points into the total equation to see how the cost estimate can vary (Levin, 1975:95).

5. Sunk Costs.

Do not include sunk costs as part of your cost estimates.

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Displaying Costs

Finally, the costs of a program can be portrayed in different ways. As the life cycle - chart of accounts model above suggests, costs can be broken into specific line items (salaries, supplies, equipment, etc.), into cost groups (direct, overhead, etc.), or by the life-cycle phase. Weinstein (1982) suggests a participant learning hour as a unit cost for training programs.

Levin (1975:98) suggests three additional options:

1. Total program costs can be used to good effect whenever the various alternatives yield about the same result. As Kearsley (1981: 54) is quick to note, selecting the best program here is easy: when the results produced by the alternative programs are about the same, pick the least expensive one.

2. Average unit cost of result: when output levels differ by program, a "unit cost" can be very helpful in comparing the programs. Be careful to keep in mind the absolute levels of output, though: don't let an average unit cost of $100 (but with a total effectivness of only, say, 175) confuse you if a second option average 125 but with a result of 750.

3. Marginal unit cost of result: use this when unit costs change rapidly with the volume of the program.

Costs: Summary

Here, then, is the summary on how to compute the costs of a program.

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1. Define your cost-center: entire agency? department? program? set of programs? program element?

2. Identify all the resources consumed by the program. The life cycle-chart of accounts model can focus this listing.

3. Using the cost principle, compute or estimate the costs of each resource.

4. Decide which costs you will include and which you will exclude.

5. For "big ticket items" whose costs are uncertain, complete a sensitivity analysis with a range of values for the items.

6. Show either total costs (which can be subdivided into line-item, functional or life-cycle parts), average unit costs or marginal unit cost.

This process is to be used for either cost-effectiveness or cost-benefit analyses. Program costs are one side of the analytical process; finding program outcomes is the other. We will now look at one way to capture those outcomes: effectiveness.

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IDENTIFYING RESULTS

Programs are instituted with the intent of producing results: more learning or skill, better capability, less expense, more revenue, whatever. The relative ability of different programs to produce these results -- compared against the costs of each program -- is the essence of rational cost-result analysis.

There is some confusion, though, in this process. As noted above, the cost side of the analysis is reasonably straighforward, albeit subtle and involved. Where things become difficult is on the results side, and part of the entire problem is confusion over what "results" are. "Outcomes", "returns", "benefits", "outputs", "results", "products", "effectiveness" -- all are part of the vocabulary. The problem is that there are no consistently used definitions to these terms. For example, its almost equally likely to look at a study of "cost effectiveness" (Cullen, et. al. 1978) to see that it really is about financial returns or to look at a "cost benefit" analysis (Kearsley, 1981; 1982) to discover it is more concerned with effectiveness.

Let's try to clarify the terms. Programs are designed to create outputs or products. (I will use the terms "output" and "product" synonymously.) Products are the outputs of the work of the program and can range from "welfare payments" to a "trained employee" or a "better functioning group" (or family or team). Programs are organized work-methods that take inputs and recombine those inputs to make specific outputs or products. The product or output is what ends up after the program's work-process is completed.

These products (can) have some monetary value. The value of a welfare payment is at least the amount of the check. Even a

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"trained employee" can be valued (although the valuing method is a little more involved; see Casio, 1982). When the program creates these products for use in the private marketplace, these values can accrue to the firm. An obvious example would be a managed swimming area at a State park that requires a fee for admission, or a sales training program. Both "programs" generate an additional stream of income for the organization. When done for the public sector, the value accrues to the larger community. Here, free energy counseling would be an example. Let's refer to the revenue produced by a program as a "return". The monetary value created by the program is the "return" of that program.

When dealing with costs and returns, there are three traditional methods for analyzing them. The easiest method is the payback of the program: how long will it take the program to generate a return equal to the cost of the program? An incentive program costs $10,000 "up-front", and it will take nine months before the outputs of this incentive program (more work, less expense, etc.) equal to a return of $10,000. The Payback Period of this incentive program is nine months. Second, it is possible to compute the return on investment (ROI) of the program (in finance, a program is called an "income-producing project"). Consider the total costs of the project as the investment in it and then divide that into the total expected return. A job enrichment program requires a total investment of $25,000, and the expected return on it (over the project's total life) is also $25,000. The ROI of this project is unity (1). Should the return be estimated at $50,000, the ROI would equal 2; a $100,000 expected return would be 4 -- for every one dollar spent, four would be collected. Finally, a program's internal rate of return shows the equivalent yield of a program in the organization's internal accounting system. (See Weston, 1982 for a fuller discussion.)

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Programs have outcomes, though, which are more than the sum of their intended return parts. Cooperative extension programs do more than simply yield more profitable crops; they serve as communication links, build an attitude of innovation, act as supports to farmers, etc. (Baer, 1977).

These kinds of outcomes of programs have to be considered, too, when defining what a program does. These outcomes may be impossible to quantify, though. Since decision-makers need a full accounting of what a program makes happen, "outcomes" can simply be listed and included as part of an evaluation or analysis piece. Clark & Olsen (1977) suggest a method for showing the outcomes as part of the analysis: using a "T-account" model, simply list the outcomes in one column and the degree of impact (high to low) in the adjoining column.

Finally, there is effectiveness, and there are benefits.

As is often the case with programs aimed at affecting human beings, the results directly created by the program are difficult to conceptualize as products or outputs. The learning created by a training program or the improved health practices resulting from an outreach program or the altered home energy conservation measures taken by families as a result of a counseling program are difficult to fit into a "product" mold. These results are less tidy and cannot be formed into distinct, repetitive, standardized outputs. Yet results do occur. The problem is how to create some reasonably consistent measure of program results. This is where effectiveness comes in. (We'll pick up on benefits below in that section.)

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"EFFECTIVENESS" ANALYSIS

A program's effectiveness is the program's ability to produce or yield an established result. This result is defined in terms of a constructed (that is, artificial) measure. It is a single measure of results based upon the intended objectives of the program. These results, as indexed by the effectiveness measure, are not put into a dollar value (Forbes, 1974; Lent, 1979).

Cost-effectiveness analysis, then, compares the costs of a program against its power to yield a level of results on some single measure of effectiveness. There should be at least two alternative programs considered. Cost-effectiveness analysis, thus, is an analysis of the extent to which competing programs or techniques create a desired output. The decision-rule is basically to select that option which produces the most yield at the lowest cost. Cost-effectiveness analysis assumes a constant, given goal. It then proceeds to fashion an answer to the question: "given output X, which program A, B,... N will produce the most of X at the least cost?"

The measure of effectiveness, thus, must be a result that is common to all the alternative programs, A, B...N (Levin, 1975). Given the goal of a trained employee or a health-practicing individual or an energy-conscious family, there can be at least two different programs used to produce that goal. An effectiveness measure is constructed to determine how well each of those different programs yield those results. The actual measure of effectiveness can be constructed any number of ways:

* For a training program, say, with well-defined learning objectives that can be summarily assessed with one paper and pencil test, the effectiveness measure could be test score results (Forbes, 1974).

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* For programs whose results may be more complex (such as a health-practices program), results could be multi-faceted: various kinds of knowledge attitude and behavior actions that together produce improved health-practices by the individual. In these cases, some sort of combined, weighted measure can be constructed to assess the various program results. Thus, the single health-practices measure could be constructed as such:

* score on health knowledge test x .25 =
* score on health attitudes survey x .40 =
* score on health behaviors
  self-report questionnaire x .35 = _____
  health-practices measure = .

The weighting (here, .25, .40, .35) given to each factor is in many cases a subjective hunch or guess as to the relative importance of each sub-factor in producing the total outcome. Thus, by this method, "attitudes" play a slightly larger role in health-practices than "behaviors" and both together are three times more important than "knowledge".

Of course, the best way to decide what the actual effectiveness results are is to use the actual program results. This presumes an experiment using the different programs with the effectiveness results of each collected and computed. For after-the-fact evaluations, this is the preferred approach. When not possible, it may be possible to use a panel of experts to assign effectiveness scores to alternative programs (Shipp, 1980). Or it may also be possible to use previous empirical or normative data to estimate

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relative program effectiveness, too. These last two methods may be the only options to use if experiments cannot be performed or if cost-effectiveness analysis is being used in planning.

Effectiveness Analysis: Steps

There are three basic steps to complete when doing an effectiveness analysis (Lent, 1979).

First, identify the alternative programs to be compared. This assumes, of course, that the goal has been established. The decision-maker/evaluation sponsor may tell you what the different programs are; if not, brainstorm a list of alternatives. Describe how each of these program alternatives operate to produce the established program results.

Second, in conjunction with the decision-maker/sponsor, establish what the effectiveness measure will be. Because this measure is artifical and indirect, it is important that the user of the data understand and agree to what is being used -- and why.

Third, actually design and construct the effectiveness measure. This could be a simple as validating a 10-item test or as complex as designing various data-collection methods, pre-testing them and then cranking out a combined, weighted measure.

Once the actual measure is developed, data can be collected and the effectiveness score computed.

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Effectiveness Analysis: Caveats

There are a couple of cautions to keep in mind when doing an effectiveness analysis. For example, such an analysis should never be done if the cost of doing it is more than the cost of the least expensive, wrong alternative.

A program's results may be spread unequally across the target population. Using a single measure (for example, one 10-item test) may not be that sensitive a register of the program's effectiveness. Reliance on a single criteria could be a strategic evaluation and analysis mistake.

Likewise, with multiple registers, the weighting scheme could skewer the effectiveness scores. Such weightings are based on best-guestimate estimates -- but are still personal judgments. It may be necessary to use different weighting schemes in order to determine the internal validity of the process.

Another caution concerns using inappropriate measures. Doughty (1979: 23) warns about using input or through-put indicators when output indicators should be used. Computing a class-contact hour's effectiveness measure will not tell anything about the results of that time.

A generic issue involves the potential decision-maker myopia which cost-effectiveness analysis incubates. One way this occurs is through a one-sided, exclusive reliance on numbers --of costs and of effectiveness. This myopia also blurs the decision-maker's ability to see unanticipated, spill-over, collateral or uncountable effects of a program, and then take them into acccunt when making a decision.

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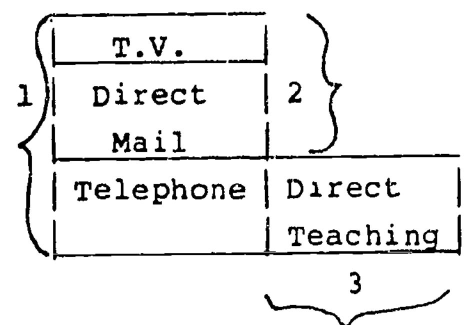
Cost-Effectiveness: Examples

Two examples can show cost-effectiveness analysis in operation.

As a result of legislative initiatives in 1977, Congress wanted more people served by the Expanded Food & Nutrition Education Program (EFNEP). A joint experiment was conducted in Vermont and Nevada (Honnold et al, 1980) to test the cost-effectiveness of three different educational delivery systems. The goal was to significantly increase the nutritional practices of a selected target population. The population was food-stamp recipients with no prior EFNEP experience who were assigned to various groups in the 3-month study.

As the chart at right shows, there were three educational programs tested. Program 1 was a combined TV series, direct mail and telephone follow-up method. Program 2 did not use any phone follow-up. Program 3 was the traditional direct teaching method (one to one or small group).



A learning effectiveness measure was created. This measure was a weighted composite index combining test results on nutritional knowledge, food recall and nutritional behavior. Pre- and post-test scores on this measure were obtained from the various groups who were exposed to the different delivery systems. (Other aspects of the programs --coverage, costs, efficiency -- were also studied.)

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The result? While the learning effectiveness of the three were about equal, costs were not. Program 2 was clearly the most cost-effective; Program 3, the least; and Program 1 was about half-way between.

At Florida State University, the traditional large lecture, survey course in Geology was converted to a self-instructional system. Costs were computed using the life cycle and chart of accounts method suggested above. The effectiveness measure was a scaled pre- and post-test computation from both programs. The individualized system did increase both effectiveness and costs. Two other programs -- small-group instruction and a commercially developed self-instructional package--were added in for comparison. When this was done, with higher levels of effectiveness and the lowest unit costs, the commercially developed self-instructional program was the clear favorite. (Doughty and Stakenas, 1973.)

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THE BENEFITS OF SOCIAL ACTION

Imagine spending $150,000 on equipment... or $150 million on a dam. Either way, for the decision-maker involved, that will be a lot of money. That decision-maker will want to know what he or she can expect to get back from that outlay of funds. The same issue faces decision-makers wondering what they get back from a quality circles program that costs $20,000 or a public health service that costs $20 million. The key issue is the same: "What do I get back?"

Cost-benefit analysis is a way to answer that question. In this sense, cost-benefit analysis is a kissing cousin to the return on investment technique noted earlier. Unlike the measure of effectivness, a benefit is described in monetary terms. In this way, the two factors in the comparison--cost and benefit--are expressed in the same terms, making the actual comparison much easier (Temkin, 1974). Cost-benefit analysis, thus, offers an additional way to evaluate a program.

Cost-benefit analysis is traceable to the laws of the early 1900's governing river and navigation projects of the Army Corps of Engineers. For example, the River & Harbor Act of 1902 requires the Corps to report on "the costs and benefits" of their various projects. Later, this reporting was added to flood control projects (Prest & Turvey, 1965: 683ff). Today, cost-benefit analysis is often used at the macro-economic level in evaluating policy and program issues, such as whether it is better to build a highway, add a hospital or engage in a population-control program. For developing countries, these issues are critical; when resources are scarce, getting the correct answer is essential (Rothenberg, 1975).

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This basic analytical process can be applied to projects and programs less grand in scope, though. We'll look at the mechanics of that process, then see the process at work in a few examples.

Defining the Benefits

Programs create changes in people (at least, that is their intent). Often, these changes lead to real, monetarily-defineable outcomes in the lives of the people in the program or others indirectly affected by the program. As Rossi (1982: 268) points out, such changes are net, marginal outcomes. These marginal benefits are expressed in dollar value. When compared against program costs, the decision-maker can see what return the expenditure creates.

The actual steps in a cost-benefit analysis are straight-forward; remember that the cost side has been reviewed earlier:

1. Trace out the expected outcomes that the program will produce (or has produced). This list will include both hard and soft, objective and subjective outcomes. One way to do this is by thinking through what changes the program produces in the target population; this will either be adding behaviors or taking behaviors away. Either way, list out all the specific results those changes will produce. For example, a job search workshop may accelerate the speed with which a person finds a job. Specific results might include:

   * Marginal increases in income (new regular salary minus previous unemployment compensation).

   * Less stress-induced illness.

* Retained possessions (furniture, car, savings).

* Enhanced self-esteem.

The list could go on.

2. Select those results whose value can be put in monetary terms. In many cases, this may be more of a tactical, analytical decision: can reasonably meaningful monetary data be generated? The intangible benefits will be reported too, but in the narrative of the evaluation.

3. Identify the control group. Programs should make a difference, and it is in that marginal difference that benefits are computed. Therefore, a base-line of non-program performance must be established in order to find out what the people would be like "normally" without the effects of the program. For example, how much stress-induced illness is caused by unemployment, and what is the cost of that illness? Or, what is the typical unemployment compensation received by the target population?

4. Describe the effects of the program. Here, the extent to which the program produces either direct or indirect changes must be detailed. This is the leverage or amount of change produced. It is in this marginal impact that benefits are computed. Using the unemployment example, baseline data might show that workers were unemployed an average of nine months. Results might then show that attendance at this workshop lead to a job within two months, and that unemployed individuals would invariably sign up by their third month of unemployment. The net change would be to produce employment within two months; the net effect, four less months on unemployment.

5. Decide on the duration of the benefits. As we'll see in the example below, some programs (example: Upward Bound) create benefits that last the participant a life-time; others last only as long as the person is in the program. This decision is required in order to determine what the full benefits of the program are.

6. Tabulate the total monetary benefits. At this point, you are working with variables that can be put in monetary value; you have both baseline data and data on program changes, plus a decision on program duration. Using a table, compute the estimated monetary benefits of the changes over the duration decided on.

7. Compute the present value of these benefits. Tenkin (1974: 41) shows the standard present value formula, applied to these variables:

$$V_A = \sum_{t=1}^{N} \frac{(B_t - C_t)}{(1 + i)^t}, \text{ where}$$

V_A = the present value of project A.
B = benefits of the program
C = costs of the program
t = time period (for example, 6 month segments)
and N = duration or number of years of the project's usefulness.

8. Sum the component present values in order to reach a total benefit of the program (in current dollars). Then, compare benefits against costs.

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Like all forms of analysis, there are certain decision rules which apply to the final comparison.

The guiding rule is to select programs that give a maximum benefit at the lowest cost. Generally, this will mean selecting those programs where:

* Present value of benefits exceed present value of costs.

* The annuity flow of benefits exceeds the annuity flow of costs.

* The internal rate of return exceeds the discount rate. (Prest. & Turvey, 1965: 715.)

Caveats

Of course, the actual analysis is never that easy. The items below are some of the issues and cautions to watch when doing the analysis:

* As in all research, look at how well your sample of program participants represents a larger target population. The best analysis in the world will be for naught if the sample is too idiosyncratic for larger comparisons. This means that you must identify the key dimensions of your sample while knowing the key dimensions of the larger universe.

* As noted earlier, use real market prices. Express all monetary values in constant (present value) dollars.

* Evaluate the validity of your data. Data, here, will be of two kinds: market prices used and program effects. At times, either or both of these may not be clearly defined

or established--or if they are, their applicability to the current evaluation is indirect. Point out whether, in your opinion, the data will lead to an over-estimate or an under-estimate of real program effects.

* In a related matter, make every effort to base your data on empirical findings. Minimally, scour the literature to see what kinds of effects similar programs have. As much as possible, use that information as a basis for defining impacts. Pulling numbers out of a hat should be the last option--and may not be appropriate even then.

* You should try to compute all effects which lead to material changes, either directly in the lines of program participants, or indirectly in the lives of others. Price changes caused by the program can be excluded. (Thus, in the metadone program described below, the changes in the price of heroin caused by the supply of methadone was not included, while the savings in criminal justice system processing were.)

* Compute benefits for the realistic length of the program's effect. This length or duration can be based upon best guess or empirical data. Keep in mind, though, that there may be real outer limits on a program's duration, caused by such things as: technological or economic changes (in our job search example, that might reduce the number of employers in an area); maturation of the population (where most participants simply outgrow the use of a drug); or other "secular drift" kinds of trends.

* The discount rate used should be selected carefully. Generally, prevailing market rates can be used.

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* Apply a sensitivity analysis to key variables. For example, in periods of fluctuating rates, two or three different discount rates might be used. Or, for certain benefits that are based on hunches, a range of values might be computed. Likewise, the value of a questionable benefit might even be excluded in a second computation.

* As a general rule, be conservative in estimating benefits: always go for the lesser, more conservative number.

* As noted, intangible benefits that cannot be monetarized can be included--in a narrative statement.

* Finally, include any qualifications or underlying assumptions. These are the premises on which the computations were based--such as that the unemployed person was indeed looking for a job and that the number of employers in the area held constant. And, in the final analysis, what may be more important is the durability and predictability of the benefits, not the actual number itself. Thus, in making a decision about the job search workshop, the decision-maker may want more assurance about the connection between attendance and finding a job than about the exact dollar value of the benefit (Roid, 1974: 61).

Cost-Benefit Analysis: Examples

W. I. Garms (1971) looked at the costs and benefits of the Upward-Bound program for disadvantaged yet capable teenagers; this program was intended to move them into a college preparation track. Using as a control, baseline group their older siblings, a sample of over 7,000 program participants was examined in terms of their high school completion and college entrance rates. Benefits for life-time income, a program stipend and scholarships were compared against such costs as college tuition and foregone earnings while in school. These computations were done from the individual's viewpoint as well as from the larger societies point of view. An example of the former is shown below for non-white males; note that both a 5% and 10% discount rate was used.

Non-White Male

	5%	10%
Benefits (Total)	$4,850	$1,129
Costs (Total)	916	758
Net Result	$3,934	$ 371

At both the 5% and 10% discount levels, the value of the benefits per participant exceeded the per person cost. Garms concludes (p. 220):

> From the economic viewpoint, upward bound is at best a marginal program, and the justification for its continued existence must be sought in presumed benefits which are not accounted for here.

T. H. Hannon (1976) looked at the costs and benefits of a New York City Methadone Maintenance program. Benefits from reduced heroin use accrue to the users themselves (in terms of better health, les arrest, saved expense of heroin and possible legal earnings), to the taxpayers (with less criminal justice system and health systems expenses) and to the potential victims of users (less expense for private police protection, property damage, less fear and anguisn). Since some of these are uncomputable, Hannon computed the benefits of savings due to reduced criminal justice and health expenditures as well decreased heroin expenditures. The control was their pre-program behavior. Costs were computed for a residential program and for an out-patient one. At a 10% discount rate, benefits were always greater than costs.

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CONCLUSIONS

When faced with limited resources, decision-makers feel pressure to select the best course of action from among competing alternatives. While any method of decision-making could be used (including reading a horoscope or the entrails of certain types of fowl), managers tend to prefer rational analysis that give them some indicator of what they will get for what they have to pay.

Cost-efectiveness analysis and cost-benefit analysis are two related, yet distinct approaches to solving this problem. For both, costs are computed similarly. Various program line items are computed at cost for the various phases of the program or project. These costs may be reduced to constant (present value) dollars for multi-year programs and certain parameters may altered to show differing cost results.

The gains of a program can be described in many ways. "Effectiveness" is typically an indirect, constructed measure of selected program outcomes. The measure itself is some sort of test result or behavioral score on a yardstick applied to competing alternatives. The outcome is held constant; each alternative has the same effectiveness yardstick held up to it for comparison. Thus, for the same unit cost, one can determine which option yields the most effectiveness; or for a given level of effectiveness, which program produces it at the lowest cost.

"Benefits" are the outcomes of a program expressed monetarily. These are all the quantifiable returns created by the program. These returns may accrue to the individuals participating in the program and/or to the larger society (including taxpayers). Because these returns are not necessarily collected by and hence recorded into the accounting system of the institution sponsoring the program, these returns are called "benefits".

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Both techniques provide ways by which decision-makers can judge the options before them in order to render a decision about the best course of action to take. They both can be applied to evaluations done ex post facto or to pre-implementation, planning evaluations. The quality of the actual analyses depends upon the quality of assumptions and data used. The refrain "Garbage In, Garbage Out" is sung here, too. Without some empirical grounding, such analyses based upon speculations have limited utility. Thus, when either of these methods are used in the planning phase and are based upon speculative hunches, their total value in decision-making should drop correspondingly.

Both methods, then, are ways to compare competing claims on resources. The rule for evaluating and deciding is essentially the same in each case: select the option(s) that yield the most at the lowest cost. This is a guideline, for it is probably never possible to run across the program that simultaneously has the best outcome and the lowest cost.

In cost-effectiveness analysis, the desired outcome is the same. Different ways to produce that outcome are compared. The time period required to produce those results is not considered though. All the alternatives are examined from the point of view of what they share in common: a way to produce a single outcome.

Cost-benefit analysis, on the other hand, allows the decision-maker to compare different programs with different goals. This is because all parts of the analysis--the costs and the benefits of all the different programs--are reduced to one common yardstick: money. The cost-benefit ratio is the means for comparing the options.

The constant yardstick in effectiveness analysis is the desired outcome (as indexed by an effectiveness measure). For benefits analysis, the constant yardstick is monetary value.

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As a final reminder, decision-makers may find either analysis helpful. But they should not use the results as an excuse for their decisions. Decision-makers are paid a premium to make riskier decisions. Judgement is different than formula. Neither of these methods produce judgement; they merely execute certain formulas. Therefore, neither method is a panacea to the problem of choice. They are assists. The decision-maker must remember to use judgement. This means relying on data produced by these analytical techniques. But it also means not being blinded by them. Problems of choice must be dealt with using all the information available--and this will include the intangible, subjective and non-quantifiable, too.

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APPENDIX 1. COST CATEGORIZATION FORMAT

Examples of Activities and Categories for Cost Analysis

Taken from Doughty & Stakenas, Accountability: Systems Planning in Education. ETC. 1973.

I. Activities

A. Research and Development

1. Needs assessment - front end analysis - initial planning
2. Task analysis - job analysis
3. Curriculum design
4. Prototype development and testing
5. Formative education - preliminary product and program review
6. Materials validation
7. Training program and equipment development
8. Initial personnel recruitment and/or training

B. Investment and Production

1. Acquisition - Installation - Start up costs
2. Procurement of initial stock of training hardware and software
3. Duplication of production masters
4. Construction - Renovation of facilities
5. Purchase of initial spare components
6. Modifications of existing systems
7. Initial deployment of training hardware and software
8. Initial dissemination of duffusion and implementation activities

C. Replacement

1. Attrition
2. Replacement as a result of:

a. Obsolescence
b. Depreciation: Normal use
c. Theft - Vandalism - Breakage

3. Periodic (scheduled or unscheduled) updating of:

a. Content - materials
b. Equipment
c. Procedures - management

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D. Operation

1. Personnel

a. Instructional: salary - travel - benefits (including retirement)
b. Administrative - managerial
c. Maintenance - support
d. Students: salary - travel - benefits

2. Materials - consumables
3. Ongoing training and evaluation
4. Ongoing distribution - deployment of hardware and software
5. Facilities
6. Overhead

II. <u>Cost Categories</u>

A. Personnel: Salaries and Benefits

1. Instructional staff
2. Support staff: Non instruction - secretarial
3. Program administrative - managerial personnel - supervisors

B. Hardware

1. Simulators - trainers
2. Audiovisual equipment

C. Software

1. Instructional materials and supplies
2. Training aids
3. Expendable materials
4. Training manuals, technical manuals

D. Facilities

1. Classrooms
2. Laboratories
3. Self-instructional facilities
4. Administrative - managerial - support facilities

E. Institutional Overhead/Administration

1. Agency - institutional management
2. Libraries
3. Computer facilities
4. Contracted services - consultants
5. Institutional overhead

A. Cost Activities

Program activities are a major focus of any categorization system. Several referenced models employ functional category descriptors similar to those in the outline, but that is not to say that these categories are the only ones that might be acceptable. Several referenced reports include sections containing extensive specification and definition of program activity categories. For our purposes, a brief overview should suffice.

1. Research and Development

Costs include all funds expended to bring an ongoing or planned program (alternative-strategy) into readiness for implementation. R&D expenditure for front-end analysis, design, development, formative evaluation, staff (preservice) training, and procurement of R&D materials and equipment are essentially one-time non-recurring costs and should be so identified. Some non-recurring costs, however, should not be assigned to a R&D phase or function but to an investment and production function. This second major activity includes all dollar costs required to phase a program into operation. These include costs for facility renovation or procurement, instructional equipment, acquisition, and production/duplication of instructional materials. If materials are commercially available, they are also charged to this activity.

2. Facilities

Many schemes include some prorated estimate of facilities or overhead cost in either the investment or operation phase. Considerable study still needs to be given this particular area, but if feasible alternatives being considered all require similar existing facilities, then these costs can conceivably be classified as a constant and perhaps be excluded from the analysis. This will not be the case if new or additional facilities or other overhead are required. Appendix A contains a brief discussion of the range of alternatives for costing instructional space.

3. Replacement

Many models also include various replacement costs for equipment and materials in the operation cost category. This may not be appropriate if alternatives being compared differ drastically in this area. To include the replacement cost of a computer or a simulator in the general operating category may be highly misleading. Within this area, predicting depreciation and obsolescence rates for instructional materials and equipment is often described as an art form. The traditional estimate of a

5-to-10 year lifespan for training hardware, for instance, is based on "normal usage." Factors such as maintenance schedules, amount of use, type of use, user sophistication, and theft rates should be considered and somehow factored into any replacement estimate. Obsolescence predictions for software will depend upon such variables as content stability, style changes in visuals, format (hardbound, cassette, workbook), and usage.

4. Operating

A considerable portion of the recurring costs for any program or alternative should be included in the operating cost category. Instructional personnel, periodic maintenance, expendable supplies, summative evaluation, in-service training and managerial overhead are all recurring costs and should be classified as operational costs. In a conventional setting, one-cycle operation costs might be the funds required to maintain one program (course) for one complete iteration (cycle). Innovative programs will present much more of a challenge. One cycle of an individualized, non-time-based, ship-based program is not so easily segmented, categorized, and costed. Considerable review, testing, and revision will be necessary before any existing conventional procedures will be useful.

A predictive model may make use of ex post facto data to establish cost estimating relationships. It is therefore important that a general cost summary be suitable for both descriptive and predictive data. When lifetime operation costs are required (and they are most important, albeit speculative) conventional programs present much less of a problem than newly evolving innotative types. Although predicting the obsolescence rate of course content, the number of times per year a course is offered, and the number of years it may continue to be offered (before major revision) is a challenge, it does not compare to the difficulty of estimating the scope, duration, and number of cycles in the "life" of a modularized individualized program.

Estimating life cycle costs for Navy personnel has been greatly simplified by analysts in the Personnel Plans Division of the Bureau of Naval Personnel. A sporadically published report, "Navy Military Manpower Billet Cost Data for Life Cycle Planning Purposes" (which was last published in 1973), contains comprehensive annual billet costs for both enlisted and officer personnel. Included in the reported figures are actual and estimated costs for retirement and other fringe benefits. Needless to say, these particular costs can be a significant factor when comparing alternatives with differing degrees of labor intensiveness. In addition, Appendix B contains a discussion of alternatives for determining personnel costs for an operational instructional system.

B. General Guidelines

A reasonable guideline for after-the-fact or predictive cost analysis is to devote attention to any particular category according to the proportion of the total budget reflected by that component. Obviously, personnel costs in most training and education contexts will account for a large percentage of any budget so an analyst's energies should reflect that fact. Fortunately, personnel costs hold few surprises or computational difficulties and may usually be guided by past cost experience or programs that employee similar types of personnel configurations. However, as a proposed program deviates more and more from conventional practice, the utility of conventional program data for guiding cost prediction diminishes.

A category that represents a small proportion of a total budget deserves less attention since even relatively large errors in accounting for or estimating these costs will not significantly effect the total cost figure. The temptation to diligently obtain the latest cost figures for paper clips and pencils and settle for rough estimates of expensive computer time should always be resisted.

The outline provided contains one general functional categorization scheme for Navy education and training R&D cost analysis. It is eclectic in that it includes components found in several but not all costing schemes. Many such schemes do not separate the replacement function from operation activities, but that decision can be made once data are obtained and levels of aggregation can be considered.

C. Program Cost Analysis Summary

Once cost data have been categorized, collected, and processed, one useful way to array or report the results is to construct a summary matrix. Such a matrix helps transform the data into information by identifying recurring and non-recurring costs as well as fixed and variable costs. It also helps decision makers to review and compare instructional alternatives on a functional cost or program-oriented basis.

In Figure 4, general cost categories are listed on the horizontal axis. These are obviously gross categories, but this is intended to be used a summary or a display of aggregated cost data. The vertical axis displays the previously defined activities with a subtotal now added to emphasize and isolate non-recurring dollar costs.

The preceding sections have illustrated the all-important concern for initial emphasis on the function(s) and purpose(s) of any cost-effectiveness analysis.. Cost categorization and matrix reporting schemes, such as the one shown in Figure 4, are important tools but should not be employed before the questions or problems are well defined.

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