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Economic Analysis Handbook / 2nd edition

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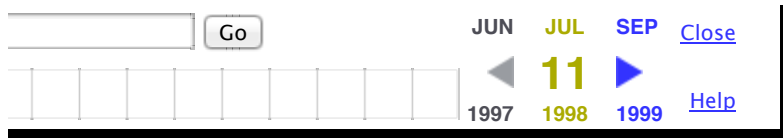
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Economic Analysis Handbook

The Process

CHAPTER II

A. BACKGROUND

Economic analysis is a conceptual framework for systematically investigating problems of choice. An economic analysis postulates alternative means of satisfying an objective and investigates the costs and benefits of each of these alternatives. This orderly, comprehensive presentation of the important considerations of each alternative assists the manager in making and reviewing decisions. It does this by:

- Focusing informal thinking
- Surfacing hidden assumptions, making clear their logical implication
- Providing an effective vehicle for communicating the considerations which support a recommendation

The methodology of economic analysis is depicted on the following pages of this chapter. The next three chapters of the handbook serve to further define the final three steps of the process. Chapter III discusses the procedures and techniques to be used in estimating costs. Chapter IV delineates a method for determining benefit. Finally, Chapter V presents a method for ranking alternatives and testing the conclusions.

B. THE ELEMENTS OF THE PROCESS

The key elements of an economic analysis are: (1) Establishing and defining the goal or objective desired, (2) Searching out hypothetical alternatives for accomplishing the objective, (3) Formulating appropriate assumptions, (4) Determining the cost (inputs) and benefits (outputs) of each alternative, (5) Comparing costs and benefits of all alternatives and ranking the alternatives, and (6) Testing the sensitivity of major uncertainties on the outcome of the analysis.

1. Establishing Objectives

The most important step in analysis is the first step, the definition of the objective. Most simply stated, an objective is some fixed standard of accomplishment. In establishing an objective, we concurrently and implicitly establish the criteria by which we will measure the relative benefits and costs of each alternative.

In every instance, whether the objective is to provide logistic support, or field an effective weapon system or to provide an organization able to function in terms of quantity, time or degree; the objective of the manager is to best achieve the planned mission of his organization.

We may, then, categorize the objective of an analysis according to its impact on the mission of an organization.

There are four levels of abstraction upon which the organization's mission can be defined. From the least abstract to the most, they are: (1) Basic Activity: The number of man-hours or units of work performed. Examples are: engine hours, aircraft flying hours, hours manned, instructor platform hours. When basic activities are evaluated against a standard or against costs, they fall within a unit's "management indicator" program, (2) Organizational Product: What is produced by an

organization. For example, personnel trained, engines repaired, weapons delivered, etc. This form of mission description is applicable to those organizations with a defined, physical output. Organizational products are also used in management indicator programs, (3) Extra-Organizational Value: These include the products or activity of the immediate organization expressed in terms of the benefits received by other organizations or organization levels. For example, the quality of engines repaired, adequacy of persons trained, or tactical assistance as a result of accurate weapons delivery. This is empirical, after-the-fact-data that is not necessarily tracked or measured. (4) Social Values: Public benefits which are equally available to all regardless of whether they were directly associated with the organization that provided them. For example: National defense, law enforcement, public highways, environmental control, etc. The definition of this mission level has proved extremely difficult to narrate.

By relating the objective to the current mission of the organization we can establish certain criteria for judging each suggested alternative. For example, each of 100 persons must be trained to perform an error-free overhaul of an aircraft engine after 80 platform hours of instruction or less. We have established three criteria: 100 persons must be trained, their training must be completed in 80 hours or less, and they must be able to execute perfectly what they have learned.

2. Choosing Alternatives

Once the objective of an economic analysis has been stated, the next step is to determine all feasible means or ways of meeting the objective.

It is the analyst's job to study all feasible alternatives and to present to the decision maker those alternatives most cost effective. This calls for a great deal of skill on the part of the analyst and a certain amount of interaction with the decision maker so that the proper a priori judgments can be made. Often, one who prepares an economic analysis is directed to select alternatives in keeping with certain constraints, e.g., manpower, facilities or funding limitations. This, in itself, tends to eliminate some

alternatives. Despite the a priori rejection of some alternatives, it is only through the reiteration of the analysis for many alternatives that the analyst may feel secure in his final recommendation.

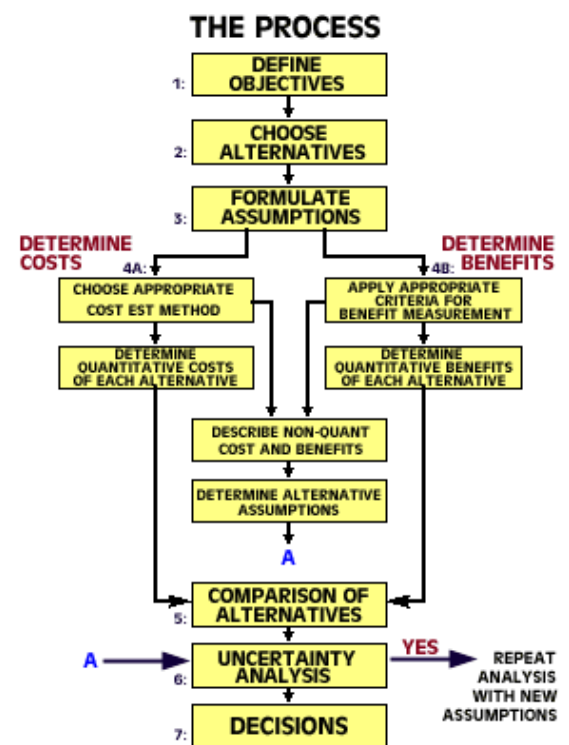
3. Formulating Assumptions

Assumptions are statements made to support and reasonably limit the scope of a study. Because an assumption is a "given" as opposed to a "fact" and relates to a future occurrence, it involves a degree of uncertainty. For this reason, regardless of the degree of impact they might have on the analysis, it is strongly recommended that all assumptions pertinent to its preparation be so identified, for the use of undocumented assumptions detracts from the credibility of an analysis.

Additionally, it is important that we do not confuse assumptions with facts or attempt to ease our role by utilizing assumptions when, with research, factual data could be presented. For example, if we are considering landfill as an alternative to solving a disposal problem stemming from increased waste, we might include in the study, the assumption that sufficient land for this operation is available within a 20 mile radius of the installation. However, in this particular instance, there may have been no obstacle preventing us from the research necessary to present this element of data as a fact rather than as an assumption.

Two very significant assumptions that must be made in all economic analyses concern the "economic life" of each alternative and the period over which we will compare the alternatives.

a. Economic Life.



The economic life of a capital investment project is the period of time over which the benefits to be gained from a project may reasonably be expected to accrue. Benefit from a project is limited ultimately by its physical life. This is the period a facility or piece of equipment will be available before it is exhausted in a physical sense, that is, decayed or deteriorated. The economic life of a project is further limited by its technological life. That is the period before which improved technology makes the building, machine, etc., obsolete. The economic life of a project may further be limited by military or political considerations which may suggest benefit accrual for a much shorter period. The economic lives of the alternatives will ultimately govern the time period to be covered by an economic analysis. Economic life is a key variable and it is important to make the best possible determination.

Maximum economic lives are established for the categories of investments listed below even though the equipment or facilities involved may have a physical or technological life of a greater number of years: Automatic Data Processing Equipment - 8 years; Buildings - 25 years; Operating Equipment - 10 years; Utilities, Plants, and Utility Distribution systems -25 years (this category includes investment projects for electricity, water, gas, telephone, and similar utilities); Weapon/Support Systems - The maximum economic life will vary by type of weapon or support system.

In general, the economic life will be measured against a stipulated level of threat, or represent the period during which a given mission or function is required or can be supported. Also, if the economic life of a system is expected to be less than the specified maximum life, the shorter life must be used for purposes of the analysis.

b. The Period of Comparison.

It is one thing to ascertain the life expectancy of each of our alternatives; it is quite another to appropriately compare these lives within the analysis. When faced with two or more alternatives with different economic lives, the analyst must make an assumption as to when to begin the period of comparison.

The decision maker may state, early in the analysis, at which point in time he wishes any one or all of the alternatives to begin yielding benefits. Given this point in time, the analyst can then determine the first year in which expenditures must be made to satisfy the "benefit yield date" as set by the decision maker. If the decision maker fails to provide this "benefit yield date," the analyst must arrange the expenditures so that the alternatives begin to produce benefits in the same year.

In either case, the first year in which expenditures will have to be made for any one of the alternatives should be considered the base year or year "1" for all alternatives. For example, it is possible for option A to require investment costs for three years before yielding benefit, while option B has zero costs for that year. This imposes an appropriate interest cost for the capital required to finance the alternative which requires a longer lead time.

The period of comparison extends through the time during which an asset will perform, or a service will be rendered, according to some established standard of benefit. When an alternative's benefits fall below this standard, its useful life has ended. The alternative with the longest economic life may determine the end of the comparison period. However, the decision maker or analyst may shorten this period consistent with the objectives and assumptions of the analysis. Whether the longest or the shortest life is used as a basis, adjustment for unequal life is required. If the shortest life is used the residual values of the alternatives with longer lives must be recognized in the cost computation for those alternatives. Should the longest life be used to establish the time period of the analysis the cost of extending the benefit producing years of those alternatives with a shorter life must be recognized. Care should be exercised to insure that the complete and valid costs for each alternative for the entire length of the analysis are presented to the decision maker. Another alternative would be to use the Uniform Annual Cost method as a means of comparison.

4. Determining Costs and Benefits

There are certain formal techniques for conducting a cost analysis. They are explained in some detail in Chapter III. There are three methods for analyzing costs. Two are supported by a defined formal process. The third is largely dependent upon the judgment of the cost analyst. They are the parametric method and the analogy method. The appropriate estimating method must be determined and exercised by the analyst to arrive at the estimated cost of each alternative. Formal costing techniques normally require the services of a costing specialist. Cost analysts are available within the Comptroller function in most commands. However, adequate cost estimates may be made without the assistance of a cost analyst. The adequacy

of the cost analysis must be judged by the decision maker within the context of the problem.

An economic analysis is most effective when applied to situations in which output can be defined in terms of physical yield. It may, however, be applied with less precision where the outputs are not quantifiable and must be accurately defined and measured in terms of relative benefit.

The determination of value or benefit is a tenuous and difficult decision. However, a method for quantifying the more tangible aspects of benefit is presented in Chapter IV. It consists of four steps: (a) Determine, List and Define Relevant Benefits, (b) Establish Sources of Information for Benefit Determination, (c) Collect and Display Information for Benefit Determination, and (d) Summarize, Evaluate and Present Benefit Determination for Alternatives of the Economic Analysis.

5. Comparing Costs and Benefits and Ranking the Alternatives

The actual comparison of each alternative in terms of its cost and benefit is accomplished in this step. If we can measure cost and benefit -on continuous scales we may use a graphical method of comparison. We start by tabulating and then plotting the cost versus the benefit for each alternative with the high benefit for the low cost. If one alternative is strictly dominant over all time periods and for all levels of effectiveness and cost, we have strict dominance and we can rank our alternatives immediately. Unfortunately, this is not usually the case. It is necessary to constrain the problem in a way that one alternative will be preferable to the others. Thus, we select either a fixed cost or fixed benefit schedule and determine how the alternatives will vary over time. Our analysis may then be repeated for inflated (current year) dollars if necessary, and finally a ranking of alternatives can be made.

The analyst may rank alternatives by one of three general criteria. These criteria conform to the three basic types of cost/benefit relationships: Unequal Cost/Equal Effectiveness, Equal Cost/Unequal Effectiveness, and Unequal Cost/Unequal Effectiveness. The three criteria are: (a) Least cost for a given level of effectiveness, (b) Most effectiveness for a given cost constraint, (c) Largest ratio of effectiveness to cost.

The first two criteria are easier to handle than the third. The problem with the third criterion is that it tends to wash out levels of expenditure and relative capabilities of the alternatives. For example, the effectiveness to cost ratio of 1:10 applies to an option whose effectiveness is rated at 1000 and whose cost is \$10,000 and to a much more austere option whose effectiveness is 10 and whose cost is only \$100. The ratio of effectiveness to cost should be used as a criterion only when costs or capabilities are reasonably close for each of the alternatives.

6. Testing Alternatives Under Uncertainty

Since most important decisions involve elements of uncertainty, an ideal economic analysis should address those areas of uncertainty about the state of the world in the future (technologically, politically, etc.). Techniques that are often used are contingency analysis, sensitivity analysis, and "a fortiori" analysis.

Contingency analysis is the investigation of how the ranking of alternatives holds up when a relevant change in criteria for evaluating the alternatives is postulated, or a major change in the general environment is assumed.

Sensitivity analysis can be applied in a situation where there are a few key parameters about which the analyst is very uncertain. Instead of using expected values for these parameters, the analyst may use several values (say, high, medium, and low) in an attempt to see how sensitive the ranking of the alternatives is to variations in the uncertain parameters.

"A fortiori" analysis is applicable to decision problems where generally accepted intuitive judgment strongly favors one alternative. However, based on preliminary analysis, it appears to the analyst that this alternative might be a poor choice and another may be most advantageous. In performing the analysis of the two, the analyst can deliberately resolve the major uncertainties in favor of the generally favored alternative, and see how the other alternative compares under these adverse conditions. If the latter still looks good, the analyst has a strong case in its favor.

Apart from the usefulness of the techniques discussed above in a direct analytical sense, they may also contribute insights that can lead to a new alternative that will provide a reasonably good hedge against a range of the more significant

uncertainties. This may be difficult to do, but if it can be accomplished, it will offer one of the best ways to compensate for uncertainty.

This is the process of economic analysis. It must be remembered that it is only a tool and should be responsive in its application to the problem, the environment and especially, the prerogatives of the decision maker. The decision maker wants facts. An economic analysis attempts to supply him with these facts so that logical decisions can be made.

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