*Chapter 21*

# On the Methodology of Cost-Benefit Analysis and Risk Perception

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## A CRITIQUE OF COST BENEFIT ANALYSIS

Cost-benefit analysis is a method to weigh the advantages of a project envisaged against its disadvantages. Generally four different types of analysis have been applied, predominantly:

- Cost efficiency analysis (a comparison of different benefit levels maintaining a constant cost structure);
- Benefit efficiency analysis (a comparison of different cost structures maintaining a constant benefit level);
- Quantitative risk-benefit analysis by applying a reference value to the positive and negative consequences of the event (prevalently in monetary units); and
- Revealed preference acceptance model (comparison of benefit and risk in analogy to historically accepted hazards and the extrapolation of the revealed values to innovative events).

Occasionally decision analysis has been included as a distinct method in cost-benefit analysis. But decision analysis is usually referred to as a general approach to rational decisionmaking in which cost-benefit analysis is one of the means.

There has been much criticism on cost-benefit analysis in the past years that is concentrated on the following points:

- Restricted number of possible input variables,
- Systematic biases in finding and evaluating input variables,
- Difficulty of assigning probabilities to rare events,
- Temporary and local inconsistencies of value judgments,
- Ignorance of input unit interaction and side effects, and
- Difficulty of converting qualitative consequences into quantitative measuring units (like dollars).

On a more normative base, cost-benefit analysis has been criticized as an undemocratic method to stabilize the existing power structure of a society and to leave the decisions to a privileged class of experts.

These general comments on cost-benefit analysis apply to all four types. But in particular the risk-benefit and revealed preference methods lead to severe methodological problems. The method of historical analysis by revealed preferences and its extrapolation to pending decisions on innovations does not comply with the weighing process prevailing in the public and at official institutions concerning the risk assessment. This approach appears to be questionable from the normative viewpoint as well (cumulation effect). The determination of an acceptance threshold on the grounds of historical risk comparisons is dependent on the requirement that for historical decisions on risks exact information about the import of risk was available prior to making the decisions, innovations were introduced as a result of rational decisions, and all innovations were brought about the social consent.

These conditions are not consistent with historical reality. The availability of an acceptance threshold requires:

1. A uniform standard for the evaluation of risk or hazards of different origin (for instance of natural or technological origin);
2. Universal standards of comparison for qualitatively varying benefit factors (e.g., shirt, newspaper, electricity, safety) and for cost factors different in quality (say monetary costs, injuries, fatalities); and
3. Restriction to the extent of benefit and risk without considering the sequence in time, the number and social structure of potential beneficiaries or cost payers, the varying identifiability of benefit and risk, and the possibility of individual or collective influencing control (qualitative risk properties).

All investigations in connection with risk perception result in the statement that these requirements are not fulfilled. Cost-benefit evaluations on the basis of monetary standards of comparison (for instance one human life = $400,000) are declined both among population and by decisionmaking agents as being incompatible with their personal formation of judgment. Thus, the direct comparison of cost-benefit functions is methodically inadmissible, because for both categories there is at present no universal yardstick for cardinal measurement.

## THE PROBLEMS OF CALCULATING RISKS AND BENEFITS

At least for the moment, it is impossible to create any quantitative risk and benefit function for varying sources of hazards. Under methodical aspects exclusively, the cost efficiency or benefit efficiency analysis can be permitted, according to which potential alternatives are compared, contrasting their qualitative and quantitative risks with a constant benefit level and vice versa.

It is recommendable that calculation of the losses or benefits be made separately for each consequence, to avoid transferring distinct qualitative features to a base unit. By listing the costs of alternative production systems, for example, they should be separated into monetary losses; injuries; fatalities; redistribution effects; aesthetical, sociological and psychological effects; and so forth.

It is up to decisionmaking agencies (which in ideal circumstances are controlled democratically) to give a societal value to each consequence and to find a proper solution on the basis of value-oriented discussions and interaction with the relevant groups of society.

Even with this restriction on the calculation and interpretation of cost-benefit analysis, there remains one problem unsolved, which is being underestimated by the majority of critics–that of the divergence between individual, group, and societal perspectives of risk-benefit analysis. It has been emphasized in numerous papers that the ordinary layman forms his attitude on the basis of perceptive biases and postrationalized emotions. But it is hard to find a reference for the fact that it might be just as rational for an individual to be against something as for society to be for something.

The rational decision of the individual or of a group is not necessarily consistent with the rational decision of society. This is predominantly the case even in connection with technological large-scale projects, for:

- The direct benefit and the direct cost are of little relevance to the individual citizen (for example, he neither needs the lot of power nor is he obliged to finance the construction of the power station); however, as far as society is concerned, the cost and benefit amounts added up are the most important criteria;
- The indirect advantages and disadvantages are of immediate significance to the adjacent residents, whereas for the decisionmaking agencies, the same are averaged among the entire population and, consequently, related or modified (for example, the location of nuclear power stations in sparsely populated areas);
- As a rule, the indirect advantages and disadvantages are not equally distributed–that is, those who bear the risk will not with precedence profit by the benefit;
- The altruistic cost and benefit considerations of the individual citizen or of a

group will not necessarily be in conformity—and this is the normal case—with the political bearings established by the decisionmaking agencies. So even if the cost-benefit analysis by society is absolutely correct, logically sound, and consistent, special groups or individuals may reach completely opposite conclusions. Generally this behavior has been rated as a product of distorted perceptions. This is in fact partly true, but it is also possible that the deviant judgment is based on purely rational thinking.

It seems necessary in connection with risk-benefit analysis to distinguish among different segments of society—namely the individual level, the intermediate level and the societal level—and it is important to find the components of the risk-benefit analysis that pertain to each of the three levels. Naturally, all components have to be weighted by the (perceived) probability of the expected event and the subjective evaluation factor for each consequence. As a reference model we used the following concept:

1. *Individual cost-benefit analysis* (perception of the individual): direct cost, or benefit respectively (electricity rate, power supply); indirect cost, or benefit respectively (personal risk, improved local infrastructure); altruistic cost, or benefit respectively (perceived risk for society, benefit for society).
2. *Intermediate cost-benefit analysis* (group decision): total of direct cost and direct benefit for the group members (formal and informal groups); total of indirect cost and benefit for the group members and for the group in its capacity as institution and their distribution specific to the group (varying distribution of cost and benefit among the different groups); congruity with group-specific values and ideals, as well as with political and social functions and interdependencies (for instance, environmental protection or competition with other groups).
3. *Social cost-benefit evaluation* (decision model): total of individual beneficiaries or cost units respectively (power supply altogether, costs altogether); total of external effects (positive and negative production effects); congruity with political and social values and political programs.

There are special links among the three levels, forming a dynamic interactive system. The individual is a member of his or her reference group which influences the value and attitude commitment of each group member, his affiliation toward special perceptive patterns, and the selection of information. An exchange of functional support and control takes place between individuals, groups, and administration through political and economic institutions and processes. As to the question of nuclear power, both the general public and special groups have forced government agencies to react to protests and to look for new solutions.

## AN EXPANDED COST BENEFIT ANALYSIS

The main characteristics of the enlarged cost benefit approach are:

- Separation between individual, intermediate, and social level and separate coverage of the cost and benefit considerations;
- Inclusion of the predispositive, dispositive, and situative coefficients of influence on the individual discernment;
- Inclusion of the dynamic structure of political and social institutions and of social processes of forming opinions and decisions at the level of intermediate and social analysis;
- Investigation of the links and connections among the three levels and of their relative importance for each perspective;
- Abandonment of any universal cost-benefit theory; and
- Abandonment of any universal reference unit for cost-benefit analysis. Instead of compound indexes, the qualitatively distinct consequences should be calculated separately.

The prospective advantages of this type of analysis are:

- The possibility of early prediction of conflicts among the levels concerned;
- The knowledge of the planning agencies about decisionmaking on the part of the public and special groups;
- A better understanding of attitude formation toward new projects;
- A higher sensitivity to temporary changes of values and opinions;
- An increased value-neutral procedure on the part of the planning agencies; and
- More evaluative power of the entitled decisionmaking organizations and of the public.

What has been done so far to implement this model by an empirical case study? At present, a study on the individual level of cost-benefit analysis is underway and will be completed by the end of 1979. For many reasons, nuclear power has been chosen to serve as the research model. The starting point for the research program is a functional model of the individual decision process. This model is described in Figure 21-1.

From right to left one finds a sequential order of variables starting with general internal and external characteristics of a person. These patterns influence the rationalization process of beliefs referring to individual and societal recognition of advantages and disadvantages. These perceived consequences are weighted by personal value and attitude commitments and the subjective probability of the events. These considerations result in the formation of cost and benefit. The balance between cost and benefit as well as general affects toward the object

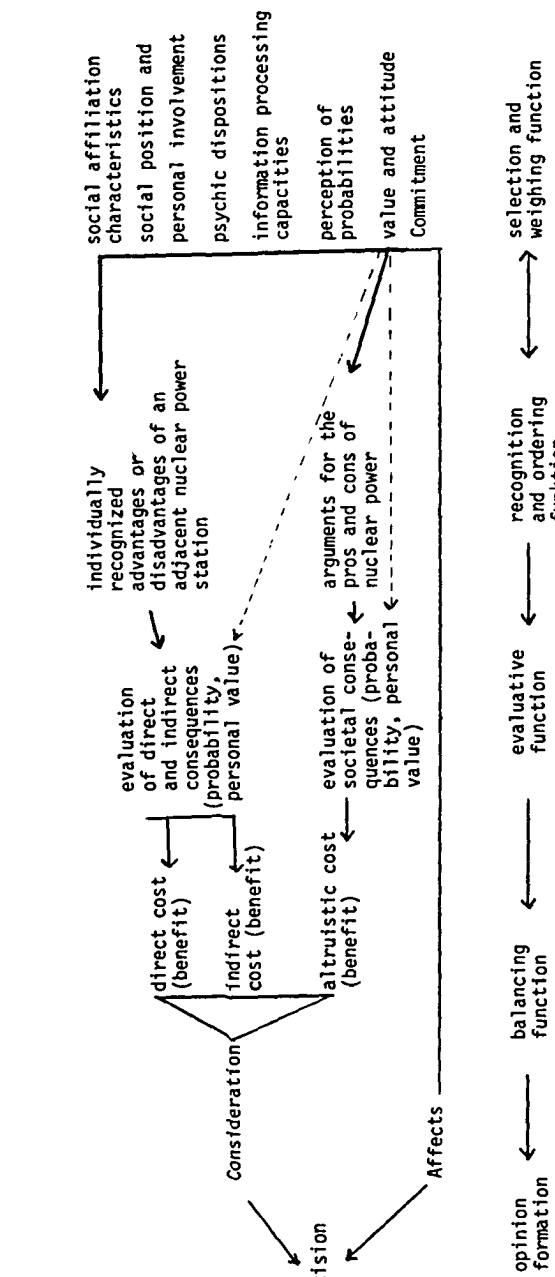


**Figure 21-1.** Individual Decision Model in the Case of Nuclear Energy.

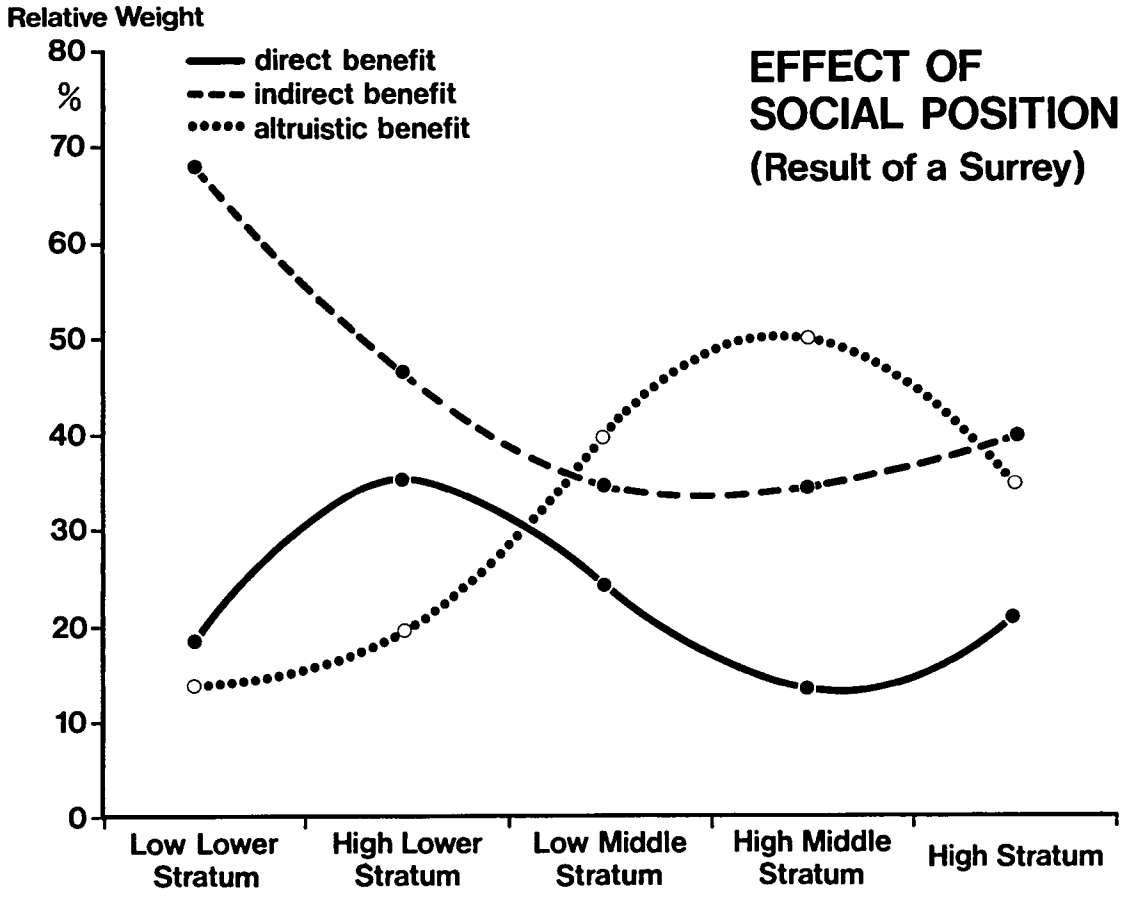


Figure 21-2. Effect of Social Position on Relative Importance of Benefits.

(both of course interfere) lead to the final decision. The testing of this model has not yet been completed, but first results of experiments and surveys show that there is much evidence for the validity of the concept, although the steps of decisionmaking are not consciously followed up by laymen.

Two results of interest become apparent already on first evaluation of the pretests:

- The probability of consequences to be expected is of little influence on personal decisionmaking, whereas the possibility that something might occur is much more important.
- The relative weight of the risk-benefit components differs significantly for the variable "stratification." Middle class persons predominantly reflect altruistic considerations, persons with low positions attribute utmost importance to indirect consequences, and upper class people evaluate the three components almost equally (Figure 21-2.).

These finding are not yet representative, but reassure us that our concept may be a meaningful attempt to improve the method of cost-benefit analysis.