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An Assessment of the Use of Cost-Benefit Analysis in Regulatory Agency Decision Making

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CONSIDERABLE dissatisfaction has been expressed with the process and results of regulatory agency decision making. Recommendations have been made that the Federal agencies employ rational, "balancing" approaches such as cost-benefit analysis in conducting their standard-setting and adjudicatory functions.

This paper examines some current uses of cost-benefit analysis by several agencies in their decision-making processes, and identifies and discusses apparent limitations.

Statutory and Judicial Requirements

Statutes enacted by the U.S. Congress provide the frameworks for regulatory decision making by the Federal agencies and prescribe, usually in general terms, several criteria and considerations to be employed by the agencies in carrying out their discretionary and mandatory functions. Such statutes commonly impose on an agency the requirement *simultaneously* to consider technical and economic feasibility charac-

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teristics and health and environmental effects in their decision-making processes to establish standards, issue licenses, or take other agency action. This responsibility to consider such diverse factors simultaneously may be imposed by a single statute on an agency, or by a set of statutes enacted over time, all of which may apply to a single agency.

Comprehensive statutes to control externalities, such as the Federal Water Pollution Control Act Amendments of 1972, the Consumer Protection Act, the Noise Pollution Control Act, and the National Environmental Policy Act of 1970 (NEPA) are examples of Congressional enactments that call for agency consideration of such factors in decision making. Statutes governing resource development and management by Federal agencies, such as the Outer Continental Shelf and the Submerged Lands Acts, the Reclamation and the Water Resource Acts, and the Atomic Energy Act of 1954 (as amended) also impose similar requirements for decision making on the Federal departments and independent agencies.

Judicial review of agency decision making under these statutes has been particularly rigorous and has had the effect of insuring that Federal agencies comply with such multiple-criteria requirements in their decision processes. For example, NEPA and the Administrative Procedure Act,[1] which apply to all agencies, have been judicially interpreted as requiring agency use of "balancing analysis" *(Calvert Cliffs v. AEC)*[2] and "substantial inquiry" *(Citizens to Preserve Overton Park v. Volpe)*[3] by agencies in their decision-making processes, thereby requiring that all relevant factors such as economic and technical feasibility, and health and environmental effects, must be simultaneously considered.

The agencies have therefore sought to develop and apply new techniques for decision making that can satisfy these statutory and judicial requirements for balancing multiple factors, such as cost-benefit analysis.

Agency Implementation

Agencies are now turning to cost-benefit analysis in an effort to comply with statutory and judicial requirements. Cost-benefit is a relatively

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[1] NEPA (42 U.S.C. 4321-4361) and APA (5 U.S.C. 500-576) are generically applicable to all agencies of the Federal government, and similar statutes have been enacted in many states for applicability to state agency regulatory activities.

[2] In *Calvert Cliffs,* the D.C. Court of Appeals required that agencies use the results of their environmental impact assessments under NEPA in "balancing analyses" to reach their final determinations. [449 F.2d 1109 (1971).]

[3] In *Overton Park,* the U.S. Supreme Court dealt with the need for compiling a full, adequate record to support agency decisions. [401 U.S. 402 (1971).]

simple technique for decision making, and has been extensively used by the Corps of Engineers, the Bureau of Reclamation, and other departments and agencies in the design of water-resource programs, dams, and flood-control and other projects. Engineers and economists are therefore experienced in the application of the technique to developmental purposes. Congress has promoted its use in water-resource programs through the creation and activation of the Water Resources Council.[4] Further, the courts have not objected to the use of the technique per se as a method of reaching balanced decisions in such developmental programs, have generally been unwilling to substitute their judgment for that of the agency on developmental matters which involved the application of the technique, and have usually stated that alleged deficiencies in such uses of cost-benefit is a matter for Congressional review in annual authorization and appropriation hearings held by several Congressional committees on the sequential elements of these long-term developmental programs.[5]

Quite recently, use of cost-benefit has been undertaken by *regulatory* agencies as well, in their decision making to set standards, issue licenses, and reach siting and other regulatory and nondevelopmental decisions. These agencies include, for example, the Environmental Protection Agency and the Nuclear Regulatory Commission.

Several committees of the National Academy of Sciences, the Academy itself, and other advisory and professional associations have recommended further use of the technique by these and other regulatory agencies as the most feasible method for bringing about rational decision making. Social scientists and economists have worked on further development of the technique to enable its users to accommodate qualitative or not readily quantifiable considerations.

Chief among the several regulatory agencies to adopt the technique, provide in their regulations for its use, and employ it as a matter of course in their decision making is the Nuclear Regulatory Commission (NRC). NRC now employs cost-benefit in setting radiation standards "as low as practicable," and in its licensing of nuclear facility construction

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[4] The Water Resources Planning Act, 43 U.S.C. 1962, created the Council. *See generally,* U.S. Water Resources Council, *Summary and Analyses of Public Response to Proposed Principles and Standards for Planning Water and Related Land Resources and Draft Environmental Statement,* July 1972.

[5] *See,* for example, EDF v. Corps of Engineers, 325 F. Supp. 728 (1971); Conservation Council of North Carolina v. Froehle, 340 F. Supp. 222 (1972); and discussion in Hillhouse, *Federal law of water resources development* in FEDERAL ENVIRONMENTAL Law (E. Dolgin & T. Guilbert eds. 1974) at 872-873.

and operation.[6] The Environmental Protection Agency has also promulgated regulations requiring that the technique be used for the establishment of other radiation standards and for the setting of emission standards for toxic chemicals under the Water Pollution Control Act Amendments of 1972. The Consumer Product Safety Commission and several other agencies have not formally acknowledged use of the technique, but recognize that the technique or a rough equivalent is used in its decision processes.[7] Implementation of the National Environmental Policy Act by various agencies, in accordance with the *Guidelines* of the Council on Environmental Quality,[8] has brought about further adoption and use of the technique in certain agency decision-processes (Table 1).

Use of a new technique on this scale for national decision making on matters involving the management of risks may have unforeseen and undesirable implications. The time is ripe to directly address the implications of using cost-benefit in regulatory decision making, before such implications become manifest.

Issues for Evaluation

The use of cost-benefit analysis by regulatory agencies raises several issues that deserve study, so that appropriate corrective measures may be taken in time to avoid undesirable societal consequences. Discussion of these issues is briefly presented here. Note that most of these issues are inherent in any regulatory decision process, but are most urgently and clearly raised when regulation is based on cost-benefit.

a. *Identification of Costs and Benefits.* The identification of costs and benefits may appear to be a relatively simple task, but in reality is an immature art. The Leopold, Sorenson, and GSA matrices[9] are of some use as checklists of some possible effects that may attend the construction of discrete projects, but are inadequate to the task of identifying the effects of a standard (for radiation, for example) that may have national and global consequences over long time frames. To what extent will agency regulatory processes provide adequate notice to potentially af-

[6] *See generally,* 10 C.F.R. 20, 10 C.F.R. 50, and other sections of NRC's regulations, particularly Appendix 1 to 10 C.F.R. issued in 1975. For discussion, *see Consideration of Health Benefit-cost Analysis for Activities Involving Ionizing Radiation Exposure and Alternatives,* Washington, D.C.: National Academy of Sciences (BEIR Committee), 1977.

[7] Findings based on interviews with personnel of various agencies.

[8] CEQ Guidelines, 40 C.F.R. 1500 (1973).

[9] For discussion of matrix methods, *see Review of Decision Methodologies for Evaluating Regulatory Actions Affecting Public Health and Safety,* Chap. 6, Battelle Northwest Laboratories, Report BNWL-2158 (1976).

TABLE 1
ECONOMIC BENEFIT/COST ANALYSIS IN ENVIRONMENTAL IMPACT STATEMENTS *

	Prepared	Included
Agriculture		
Forest Service	Generally	Yes
Soil Conservation Service	Yes	Summarized
Commerce	Yes	Yes
Defense	Sometimes	Yes
Air Force	Yes	No
Army	Sometimes	Sometimes
Navy	Yes	Summarized
Corps of Engineers	Yes	Yes
Health, Education, and Welfare	No	No
Food and Drug Administration	Yes	Yes
Housing and Urban Development	No	No
Interior		
Bureau of Indian Affairs	Yes	No
Bureau of Land Management	Often	No
Bureau of Outdoor Recreation	Occasionally	No
Bureau of Reclamation	Yes	No
Fish and Wildlife Service	No	No
National Park Service	No	No
Geological Survey	No	No
Justice		
Law Enforcement Assistance Administration	Yes	Yes
Labor	No	No
State	No	No
Transportation	Not usually	When prepared
Federal Aviation Administration	Not usually	When prepared
Federal Highway Administration	Not usually	When prepared
Treasury	Not usually	
Energy Research and Development Administration	Yes	Yes
Environmental Protection Agency	No	No
Federal Energy Administration	No	No
Federal Power Commission**	Yes	Yes
General Services Administration†	Yes	No
Nuclear Regulatory Commission	Yes	Yes

*Source: Council on Environmental Quality, *Environmental Impact Statements: An Analysis of Six Years Experience by Seventy Federal Agencies*, Washington, D.C., 1976.

**FPC prepares comparative economic-analysis and cost-effectiveness studies on proposed actions but does not conduct classic benefit-cost studies.

†GSA does a cost evaluation, but an "economic benefit/cost" analysis is not always included or attached to the EIS.

fected interests and enable them to play a role in the identification process?

To what extent will it be possible to identify significant long-term effects by means of the various assessment techniques we now possess or can develop? To what extent will the characterization of effects as costs or benefits reflect establishment values and the status quo and ignore changing values and behavior (e.g., the NRC's characterization of increased energy supply as of virtually unlimited benefit at a time of increased concern about the need to conserve energy and fuel resources and move to small technologies)?

b. *Measurement and Quantification of Costs and Benefits.* Similar uncertainties arise regarding the capacity of regulatory agencies adequately to measure and value costs and benefits, particularly those which cannot be properly valued by the marketplace or economic processes. Can we measure or value such effects as carcinogenicity, mutagenicity, teratogenicity, consumer convenience, or the perpetuation of certain aspects of certain lifestyles such as mobility? Are we ready to accept the valuation of $1000 per man-rem promulgated in 1975 by the Nuclear Regulatory Commission in order to conduct its cost-benefit analyses and set standards for ionizing radiation?[10] Should such values be commonly adopted by all agencies with regulatory jurisdiction over different aspects of the same problem, such as EPA and FDA, which share with NRC to some extent control over ionizing radiation? By what legal procedure shall we set such values? To what extent shall we enable various interests to play a role in the objective measurement and subjective valuation processes? Who will represent the unborn (future generations) in the valuation of mutagenic and other future effects, which arise from standards established by NRC and EPA for radiation and toxic materials?

c. *Consideration of Distributional Effects.* Closely associated with the foregoing issues is the need to consider adequately distributional effects of agency decision making based on cost-benefit. Clearly the adverse effects of radiation emitted from nuclear power plants in accordance with NRC standards will fall most heavily on those living in the environs of the power plants, but this distributional effect pattern is not adequately recognized in the NRC's use of cost-benefit analysis. How shall we safeguard the interests of these impacted groups and others such as the poor, the primitive, and the unborn?

d. *Determination of Appropriate Weighting Factors.* A facile solution to the issues of quantification and distributional effects is the

[10] *See* NRC's Appendix I, *supra* note 6.

use of weighting factors in cost-benefit analysis. How shall we set and determine the adequacy of such factors, in light of conflicting values and varying attitudes about the distributional patterns, and citizen willingness to accept certain probabilities of risks?

e. *Post-hoc Considerations and Enforcement.* After using cost-benefit to establish regulatory actions, it can be assumed that unintentional and intentional violations of the prescribed regulations will occur. The Nuclear Regulatory Commission has learned that despite its application of radiation standards (developed by use of cost-benefit) to utilities, violations occur, such as excessive accidental releases of radioactive effluents. How to enforce or otherwise act on the basis of such violations when, despite the unforeseen increased costs, the economic viability of the regulated party and the needs of dependent consumers are at stake: plant shutdown, the imposition of new safeguards (retrofitting), or waiver of requirements? In other words, is the cost-benefit basis for designing and regulating power plants, in this case, enforceable once the plants have been built and are in operation?[11]

f. *Structural-political Considerations.* In light of the foregoing issues, what structural-political considerations should be addressed? Again, to consider the experience of the Nuclear Regulatory Commission, the cost-benefit analysis used to approve the construction and operation of a new facility is premised on a specific population dose of radiation and its valuation.[12] Yet the Commission lacks the authority to control population density and migration in regions off-site from the plant, and the States are reluctant and/or incapable of maintaining the population subject to exposure at the density levels used in the calculations for initial approval of the facility. Will such structural-political developments proceed concurrently with the use of cost-benefit to assure its efficacy and enforceability over time? Further, in light of the valuation and distributional issues noted earlier, what political developments will be necessary and achievable to enable meaningful participation or representation of various constituencies including the unborn?

g. *Technology-forcing Considerations.* If the emitted substance to be controlled to some degree by cost-benefit regulation is always going to be harmful to some, such as is the case for radiation and for toxic chemicals with linear dose-response relationships, the objective of regulation is to force the development and application of new tech-

[11] *See* discussion in Chap. 4 of NAS-BEIR report, *supra* note 6.

[12] *See supra* note 6.

nologies to provide more effective limitation of releases on the sources of such pollutants, over time. To what extent will the use of cost-benefit for establishing regulations and prescribing control technologies retard the technology-forcing function? Information on control technologies is more available to industry than to government; in the past, industry has presented pessimistic data on the feasibility and costs of new technological developments to government agencies (e.g., auto emission technologies).[13] How shall we assure the adequacy of the data and opinion on such technological developments, so that cost-benefit does not become a tool for conveniently maintaining the status quo on control technology, nor be used to stultify the forcing of new control developments?

h. *Ethical Limitations.* What constitutional and ethical limitations will be applicable to the use of cost-benefit? How will due process, equal protection and other legal and ethical concepts apply to the conduct of regulation by cost-benefit? Is it ethical to use an economic method which requires valuation in order to establish the quality of life of this and future generations?

In another hazard or safety context, that of vehicular safety regulation, it has been noted that:

> If... the principal benefits anticipated are the savings in lives and/or reductions in the frequency or severity of injuries which cannot be reasonably quantified in monetary units, serious theoretical and conceptual difficulties arise.... Virtually all cost-benefit studies involving the loss of life or limb have assigned fixed monetary values... typically obtained either by computing the discounted future income of individuals or by computing the discounted differences between future earnings and personal consumption. These concepts and approaches have been criticized on a number of grounds....
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> National Highway Traffic Safety Administration (NHTSA) has expressed a similar [critical] view. In its recent notice of proposed rule-making concerning school bus crashworthiness, the agency stated that it 'has conducted conventional cost-benefit studies on school bus safety, but the normal valuation techniques evidently do not adequately reflect general public opinion on the importance of protecting children from death or injury. *It is obvious from the voluminous mail and Congressional interest that society places a higher value on the safety of its children than a conventional cost-benefit analysis would indicate...*' [B]ecause of the major conceptual and methodological difficulties in the valuation of life and limb, cost-benefit studies will be appropriate only in the decision-making processes involving standards *not* primarily intended to save lives and reduce injuries — that is... standards to reduce property damage.
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> Congress recognized this distinction. Under Title I of the *Motor Vehicle Information and Cost Savings Act* (P.L. 92-513, 1972) — principally intended to reduce property damage losses resulting from low-speed crashes — it included a mandatory requirement for the Department of Trans-

[13] *See* discussion in Chap. 4 of NAS-BEIR report, *supra* note 6.

> portation (DOT) to consider both the costs and benefits.... However, in considering the National Traffic and Motor Vehicle Safety Act, (P.L. 89-563, 1966) which empowered DOT to set motor vehicle safety standards aimed at reducing deaths and injuries, Congress rejected draft language requiring such studies for safety standards. (Hearings Before Committee on Interstate and Foreign Commerce, U.S.H. Rep., 89th Congress, 2d Session, on HR 13228, "Part 2, Traffic Safety", p. 1203).

Similar Congressional rejection of cost-benefit for setting standards and for other features of regulatory decision making, in favor of the determination of health parameters and other ambient effect-oriented approaches, is found in the legislative history and enactments on Clean Air and on Water Pollution Control. The Federal courts, in reviewing regulatory agency decisions on pollutants with considerable health implications, have also demanded that health factors be given a high priority in the thinking and nature of such decisions, indicating that cost-benefit alone would be inappropriate.[14]

j. *Accountability.* To what extent will the use of cost-benefit analysis promote the accountability of government decision makers to the courts, the affected interests, and the public at large? Will the jargon and arcane nature of the methodology retard lay understanding of agency decision processes? The cost-benefit approach of the Nuclear Regulatory Commission is complex and not easily comprehensible. The courts and other accountability mechanisms must be evaluated in terms of their ability to cope with the advent of regulation based on cost-benefit. For example, the following balancing analyses are all now potentially applicable to the NRC process of approving an application by a utility for a license to operate a nuclear power facility:

(a) Use of cost-benefit by the NRC in promulgating agency standards and other rules of general applicability to power plant performance.

(b) Use of cost-benefit by the NRC in promulgating limitations for a specific power plant for design approval.

(c) Use of balancing analyses in determining whether or not the separate construction and operating licenses should be issued for a specific plant.

For the first two steps, use of cost-benefit is mandated by the NRC's *Appendix I* and other regulations.[15] Alternately, the use of a "balanc-

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[14] *See,* for example, EDF v. Ruckelshaus 439 F.2d 584 (D.C. Cir. 1971).

[15] *See supra* note 6.

ing analysis" is mandated by NEPA for all three steps when such steps constitute "major actions" of environmental significance.

For the dual licensing procedures of the third step, the NEPA mandate for "balancing analyses" is clear; and a Federal court has recently cautioned that the NEPA requirement applicable to the issuance of an operating license may not be short circuited — that a facility which meets NRC regulations does not concurrently and automatically qualify for licensing without the required weighing of risks and benefits under NEPA. Nevertheless, for the specific case before it, the court concluded that:

> Apart from the requirements of NEPA or similar ones already implicit under AEA [Atomic Energy Act], it would be pointless, and a waste of agency resources, to require the AEC [Atomic Energy Commission] to reapply efforts that have already gone into its basic health and safety regulations, in individual licensing proceeding, in the absence of some evidence that a particular facility presents risks outside the parameters of the original rule making. And in evaluating the sufficiency of agency determinations in particular cases it would be stultifying formalism to disregard the whole record and test AEC compliance by only the evidence received at so-called "health and safety" hearings; or NEPA compliance only on the basis of so-called "environmental" hearings.[16]

This judicial decision promotes administrative efficiency by eschewing duplication of balancing analyses, and seems to make good sense. But it is clear that such efficiency is justified only when the risks and benefits appropriate for the facility-licensing balancing task under NEPA have been adequately considered in the prior balancing undertaken by the agency under its own regulations (e.g., NRC *Appendix I*). Determination of these justifying circumstances is a complex task which rests ultimately with the courts. The extent to which the courts can handle this difficult task responsibly will therefore depend on judicial willingness to examine the substantive features of agency decision processes, and the development of judicial expertise on cost-benefit.

k. *Modification and Alternatives to Cost-benefit.* Finally, what modification or alternatives to cost-benefit should be considered, so that the issues identified can be diminished? Will use of screening models, multi-attribute analysis, and other progeny of cost-benefit reduce some of the problems of valuation? Does cost-effectiveness analysis provide a better method of simultaneously considering diverse factors in regulatory decision making and also insuring that various social-well being parameters are not breached by the regulated activities?

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[16] Citizens for Safe Power v. Nuclear Regulatory Commission, 6 E.L.R. 20095 (D.C. Cir. 1975).

This inventory of issues attending the use of cost-benefit analysis in regulatory decision making indicates that research and public discussion on the subject at this time is a responsible and necessary course of action, if future decision making is to be both rational and humane.

Special Considerations in the Regulation of Environmental Carcinogens

a. *Regulatory Patchwork.* Responsibility for the regulation of environmental carcinogens is scattered throughout many U.S. government agencies today. So, as a toxic metal such as cadmium, or an herbicide, or any other carcinogenic chemical wends its way through the environment and food chain to its human receptors, it passes through the jurisdiction of many agencies. But despite the many watchdogs, the same carcinogen may elude certain critical controls because of serious regulatory omissions or gaps in legislated authority enacted by Congress.

The Federal agencies with primary regulatory responsibilities for the control of environmental carcinogens are the Environmental Protection Agency, the Nuclear Regulatory Commission, the Food and Drug Administration, and the Occupational Safety and Health Administration. However, other agencies, ranging from the U.S. Army Corps of Engineers to the Department of Transportation, also play roles in the regulation of carcinogens. Each of these agencies has statutory authority to regulate the use and emission of *some* of the substances, from *some* of the sources, in *some* of the pathways, for the purposes of protecting *some* of the population under *some* circumstances.

Each agency has its own objectives, analytical approaches, databases, and control criteria, but often no agency has adequate authority or motivation to control at certain critical points. Substances such as polychlorinated biphenyls (PCBs), implicated in cancer of the liver, have therefore eluded coherent systematic control. To some extent, this gap may be the result of the agencies' failure to coordinate or implement their functions properly. However, the primary problem seems to be inadequate Congressional legislation, which has established agency functions in this inefficient and uncoordinated manner.

This regulatory patchwork results mainly from uncertainty as to what constitutes cancer, the diversity of suspect substances and their pathways to their victims, the many possible but difficult-to-test synergistic factors, and the varied susceptibility of the affected population.

Environmental carcinogens fall into several classes, traceable to specific sources. The major classes of environmental carcinogens include the trace metals (beryllium, cadmium, etc.), synthetic and organic chemicals (DDT, PCBs, etc.), combustion products (aromatic hydrocarbons), other chemical products (nitrites, asbestos, etc.), and ionizing radiation from medical, industrial, and energy activities.

Each presumed carcinogen has its own environmental and commercial pathway from source to human receptor. Common pathways include air, water, soil, the food chain, drug use, and the direct application of medical and other services. Some human receptors are "voluntarily" exposed as consumers and workers, some are "bystanders" who have not voluntarily subjected themselves to exposure, and some fall into both categories. The human receptors vary in their susceptibility to cancer; the most susceptible include the very young, the pregnant, and those who smoke cigarettes. The unborn are also extremely vulnerable to these substances and create a relatively new and difficult class of receptors for the agencies to try to protect.

The specific contribution to human cancer of each substance and each source, each pathway and causal relationship, the intervention of exogenous and synergistic factors, and the adequacy of laboratory and animal data and their extrapolation to humans are among the myriad issues besetting government regulatory agencies. As a result, the Federal agencies must grapple with the serious problems of legal proof in their attempts to set standards. The same uncertainties confront the Federal courts when they review agency rule-making on standards and other agency decisions.

b. *The Analytical Pattern.* At the heart of the regulatory confusion in dealing with environmental cancer is the analytical method used by the separate regulatory authorities. Many agencies employ a "balancing process," in which the costs of establishing and maintaining any levels of emission and human exposure to a carcinogen are balanced against the economic or social benefits accrued by the production and use of the substance. In some cases, agencies use a highly formalized cost-benefit analysis. In other cases, the weighing of the benefits and risks to society which would be incurred from the various levels of emissions and exposure is more informal. In either case, the net risk or cost and the net benefit is estimated, valued, and quantified before the agency determines which of several possible levels of emission and exposure it should allow, in light of available control techniques.

This balancing approach leads each agency to impose a limitation or level of control on the source of an environmental carcinogen at the

general point where costs or risks are equivalent to benefits. Some agencies add margins of safety or weighting factors to their analysis, either by choice or to satisfy statutory requirements.

The problems of such "balancing" approaches have been discussed earlier in this paper, and include:

- What value should be placed on human life, illness, or suffering?
- Who should decide on such values?
- How should such values be determined?
- How are cases judged where benefits accrue to some but risks accrue to others? How does one judge the distributional and equity issues?
- How should we value the lives of the unborn?
- How reliable and objective are the designated costs of new control equipment, which are largely based on information from the industry to be regulated?
- How accurate is the agency's assessment of benefits to society from the activity in question?

These are significant problems for the balancing process, and at the least, new techniques are badly needed to elicit public attitudes and apply ethical safeguards to protect minorities and the unborn. For example, when the Corps of Engineers proposes to use a chemical herbicide to clear duckweed from navigational channels, and the EPA approves the action (and thus approves the subsequent contamination of the water, environment, and food chain), some relatively arbitrary judgments have been made by the two agencies as to the probability of human illness or death to be sanctioned, possibly resulting from the originally beneficially intended use of the herbicide.

c. *The Costs Add Up.* Today's fragmented use of "balancing" by individual regulators has a pernicious, cumulative effect over many agencies' decisions. Each decision by each separate agency inevitably rationalizes an additional contribution of carcinogens and risks to the human environment. So each decision effectively increases the total amount of environmental cancer. Such regulatory decisions occur daily. These "justifiably" allowable risks could conceivably accumulate to the point where an entire present or future population could be at substantial risk. Although each regulatory body is concerned only with its own incremental contribution to future cases of environmental cancer, each incremental contribution adds to the number of people whose lives will be affected.

One may differ with this conclusion. The results of such incremental decisions may not be additive; there may be safe thresholds of exposure within which no harm occurs; the analysis possibly assumes an erroneous linear relationship between dose and response; perhaps only the same, particularly susceptible human receptors will be at risk, although their risk will be increasing. Nevertheless, some sort of cumulative effect can be expected. Over time it will be substantial.

Taken to its logical extreme, our present fragmented uses of "balancing" in regulation present an even more absurd scenario:

Each agency justifies its own small contribution to environmental cancer on the ground that it constitutes only a minute fraction of all cancer. (Some agencies, such as the Nuclear Regulatory Commission, have already adopted this logic.) But all agency regulations together will create an environment in which the number of cancer cases has increased. So, the Catch 22: as the number of victims of environmentally induced cancer grows ever larger, the significance of each agency's contribution actually diminishes.

Therefore, an agency could conceivably justify an even greater contribution to environmental cancer in the future, and set even less effective controls on the toxic substances it is required to regulate. This scenario, though not yet realized, can be anticipated, given the fragmentation of regulatory authority and the use of balancing in the many small decisions made by the regulators.[17]

Conclusions and Recommendations

The implications of using cost-benefit in regulation deserve analysis far beyond the scope of this review, primarily because of our increasing reliance on the technique to justify decisions which put the health and safety of present and future generations at risk. Assuming that this reliance will continue, we must rigorously review the capabilities of Congress, the administrative agencies, and courts for insuring that uses of the technique are socially appropriate on legal and ethical grounds. We must reinforce the features of administrative practice and judicial review that promote the accountability of those employing the technique, and develop measures for evaluating uses of the technique on specific regulatory matters. The central issue is our capacity for social control of science and technology. We are learning that our problems lie not with stereotypes of agencies and industries, nor with "bad" technologies, but with our analytical and regulatory

[17] For discussion of the issues raised in this section, *see* M. Baram, *Regulation of Environmental Carcinogens*, 78 TECH. REV. (No. 8) at 40-42 (1976) and Chap. 4 of NAS-Beir report, *supra* note 6.