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**Decisionmaking for Occupational Safety  
and Health: The Uses and  
Limits of Analysis**

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# Decisionmaking for Occupational Safety and Health: The Uses and Limits of Analysis

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A number of different criteria are used for judging the desirability of changes that might improve workers' health and safety. Some have proposed that greater reliance be placed on the use of cost-benefit analysis, cost-effectiveness analysis, and other techniques of economic analysis for decisions concerning workplace health and safety.

This chapter discusses some general issues concerning decisionmaking for occupational safety and health, the history of the use of economic analysis by the Occupational Safety and Health Administration (OSHA), and the merits and limitations of the techniques of formal analysis.

## GENERAL ISSUES IN DECISIONMAKING

The process of improving occupational safety and health involves the identification of hazards, the development of control techniques, and the decision to control. Choices need to be made concerning products and workplace design by many actors—the engineers in charge of design, the managers who make decisions concerning production, and public officials with responsibilities for protecting the health and safety of workers and the public.

The decisions we need to make. . . turn on the question: Which hazards are acceptable, which not, in what amounts, and why?, . . . And who should be empowered to make this decision? (281)

In many cases, the answers to these questions are not simple. Oftentimes facts are uncertain and in dispute. Sometimes, values and ideals conflict with each other. To resolve such disputes, societies rely on various institutional arrangements. In the field of occupational health and safety in the United States, the principal institutions are Congress, the courts, the Occupational Safety and Health Review Commission, and OSHA itself.

This issue of decisionmaking—the question of who is authorized to make decisions and on what basis—is important because the participants can differ greatly on the nature of occupational

hazards and the best means to reduce or eliminate them. Labor, on the one hand, believes that employers have often not done enough to reduce or eliminate workplace hazards and desires a strong governmental presence in setting and enforcing standards. Employers, on the other hand, are often concerned about investing money in unnecessary controls, believing either that their workplaces are not hazardous or that effective, but less costly control methods are available. They also often contend that they, as employers, should be permitted to decide on appropriate control methods, without the involvement of Government agencies or labor unions.

Some disputes about the Government's role in occupational health and safety concern very technical questions about the application of the principles of industrial hygiene and safety engineering; some are debates at the very frontiers of scientific knowledge on the mechanisms of toxicity. But beyond these disputes are more general debates concerning the criteria on which decisions will be made and who shall be empowered to make them. The proposed resolutions of these issues are based on interpretations of technical information about risk as well as the moral and ethical values, the political beliefs, and the immediate economic interests of the various parties

involved. In fact, one prominent feature of disputes on occupational health and safety is that debates over technical questions are often combined with discussions of more general issues of policy, ethics, and social values.

To develop and present the information needed for a fully informed decision on workplace hazards, various observers have suggested different kinds of formal analysis. The techniques are, in many cases, connected with proposals to specify the criteria on which decisions must be based. These criteria range from a vague injunction to consider “all relevant effects” to requirements that controls can be required only when “the benefits exceed the costs.”

### Private Decisionmaking

On what basis do employers make decisions concerning worker health and safety? What decision rules will they follow? Some employers, of course, take actions to protect the health and safety of their employees either out of altruism or enlightened self-interest. But in general decisions made by employers follow the dictates of the competitive market system in which they operate.

Economists have developed models to explain this market-oriented behavior. The simplest and most commonly used model seeks to explain the actions of firms in terms of profit-maximization and cost-minimization. If this is a company’s goal, it will take an action only if the expected revenue is at least equal to the costs of that action. Using the technical language of economics, this means that the firm will produce only up to the point at which the marginal revenue from the last additional product unit is equal to the marginal costs of that unit.

Applied to investments and expenditures for occupational safety and health, this model predicts that to prevent an occupational injury or illness, employers will spend only as much as they can expect to gain in terms of reduced workers’ compensation costs, improved employee productivity, reduced “down time,” etc. Thus, any investment for health and safety must be justified in terms of the short-term and long-term financial benefits to the firm. If the company is attempting to

be as profitable as possible, it will not take actions to protect employee health and safety solely because health and safety are important goals, but only when there are financial benefits to the firm. If the firm does not follow this rule, it may find itself spending money to improve health and safety without receiving any corresponding financial benefit. Competitors that do not also make such improvements will be able to produce the same products at lower cost and then increase sales and/or profits at the expense of the firm that invested in health and safety.

Health and safety professionals have often cited the slogan “Safety Pays” as a justification for improving occupational health and safety. Although in many cases this is true, in other cases it is not. Moreover, even when it does pay, it generally pays only up to a point.

Therefore some businesses will not always take voluntary actions because they will not reap any advantage over their competitors. One benefit of Government regulation is that it puts all firms on an equal footing. A company can undertake investments in employee health and safety without fear that it will lose money to competing firms that do not do so. Expressed differently, Government regulations may require certain measures beyond those that “pay” from the point of view of the individual firm (245).

This is not to say that all employers will ignore occupational safety and health. Indeed, there are numerous examples of employers and their professional staffs who have taken extensive actions to improve worker health and safety, even without pressure from a Government agency. This could be because of the commitment of professionals and companies to goals of ethical behavior or corporate altruism; a decision by the firm to pursue goals other than maximizing profits; or the belief by company officials that such investments, although not profitable in the short term, will ultimately be to the long-term benefit of the firm. (See additional discussion on voluntary activities in ch. 15.)

### Public Decisionmaking

During the congressional debates concerning the Occupational Safety and Health (OSH) Act,



Photo credit Department of Labor, Historical Office

Rescue workers attempt to extricate a trapped worker

many references were made both to the rights of American workers to safe and healthful working conditions and to the high cost of work-related illnesses and injuries. Congress concluded that too many illnesses and injuries were occurring and that the efforts being made and the institutions of that day were not sufficient to achieve the goal of preventing disease and injury in the workplace.

Broadly speaking, two different types of reasoning have been suggested to justify Government intervention. The first is based on ethical arguments, MacCarthy (277) describes four different ethical justifications for Government action that are based on utilitarianism, workers' rights, distributive justice, and public values. Others argue that Government intervention must be justified by economic criteria. In particular, the Government should intervene only in cases of "market failure" and only after balancing costs and benefits of its decisions (425, 446, 463, 685). Three sources of "market failure" are particularly important for worker health and safety: inadequate information, lack of labor mobility and unequal bargaining power, and the presence of externalized costs.

## Decision Tools and Rules

The techniques of cost-benefit and cost-effectiveness analysis have been developed to assist private and public decisionmakers. In pre-

vious assessments concerning medical technology, OTA has considered cost-effectiveness analysis and cost-benefit analysis as parts of a family of related techniques (539). Both are designed to compare the costs and effects of projects or alternative projects. The principal difference between them is that in a cost-benefit analysis, both costs and benefits are expressed by the same measure, which is nearly always monetary. In cost-effectiveness analysis, on the other hand, costs and benefits are expressed by different measures. Costs are usually expressed in dollars, but benefits or effectiveness are ordinarily expressed in terms such as "years of life saved," "days of morbidity or disability avoided," or other relevant measures (539).

Cost-benefit techniques became widely used in the United States in the 1930s and 1940s for the evaluation of public works projects (in particular, for analyzing investments of public capital in projects for irrigation, hydroelectric power, and flood control). The Flood Control Act of 1936 explicitly called for a cost-benefit decision rule by permitting the Government to finance a water project only when "the benefits to whomsoever they may accrue are in excess of the estimated costs" (280). In the 1960s and 1970s, the techniques of cost-benefit and cost-effectiveness analysis were applied in formal budget planning systems in the Federal Government. To some extent, these techniques have also been applied to questions of health policy (539).

Analysis can be a *tool* to assist in the decision-making process or it can be used as a formal decision *rule*. As a tool, the collection of information and its analysis can assist policymakers to reach sound, well-informed, reasoned decisions about the management of workplace hazards. There is widespread agreement, at least in principle, that decisionmakers need to have some minimal understanding of the important features of the problem to be addressed, the factors involved in the decision, and the implications of various courses of action. There are, of course, disagreements concerning the application of this principle. In particular, there are often disputes about how much information needs to be collected and to what extent policymakers should be allowed to act on the basis of uncertain and incomplete information.

As a decision rule, however, formal analysis is considerably more controversial. A decision rule specifies the criteria on which decisions must be based and usually requires that certain findings be made before action is permitted. For instance, a cost-benefit decision rule would be to “select the alternative that produces the greatest net benefit” (463).

As a tool, a *cost-benefit analysis* of a proposed action can be provided to a decisionmaker, who can still decide to undertake the proposed action even if the analysis shows that the quantified costs exceed the quantified benefits. The decision could reflect a concern for the distributional consequences of a failure to act or consideration of some important benefits of the action that could not be quantified. Thus a cost-benefit analysis provides information, but the decisionmaker still has the flexibility to act even when the “bottom line” of the analysis says, “Don’t act.” If a formal cost-benefit decision rule were in effect, the decisionmaker would not be able to include those other considerations in the final decision, but

could only act on the basis of the quantified comparison of costs and benefits.

As a decision-assisting tool, *cost-effectiveness analysis* can be used to describe many of the consequences of an action. But because the costs (in dollars) and the benefits (e.g., in lives saved) are left in incomparable units, cost-effectiveness analysis will provide a clear decision rule only in two circumstances. If a health goal is specified, then a decision rule based on cost-effectiveness analysis will mandate the selection of the least costly alternative that achieves that goal. Alternatively, if a budget or expenditure is fixed, then a cost-effectiveness rule will require selecting the alternative with the greatest health benefit.

In occupational health and safety, two other types of analysis have become important—risk assessment and feasibility analysis. What these imply for OSHA, however, has been the subject of considerable dispute. The meaning of these terms and requirements concerning their use by OSHA have evolved over the last 14 years.

## OSHA DECISIONMAKING ON STANDARDS

### Principles Embodied in the OSH Act

When the OSH Act was passed in 1970, Congress clearly decided to involve the Federal Government in research and regulatory activity. In particular, Congress mandated the adoption of health and safety standards and set forth a mechanism for writing new standards. To some extent, the law removed decisions concerning health and safety from the competitive marketplace by limiting employer discretion. Congress, however, was less clear about the precise decision rules that OSHA would have to follow when setting these standards.

At the beginning of the OSH Act, Congress declared a purpose for Government activity in the occupational health and safety field: “to assure so far as possible every working man and woman in the Nation safe and healthful working conditions.” The act empowered the newly created

agency to set and enforce mandatory occupational health and safety standards. Section 6 laid forth the procedures for adopting these standards: public notice of proposed actions, an opportunity for public comment, the conduct of a public hearing if requested, and a final decision based on the evidence presented to the agency. (Further details about these procedures are given in ch. 12.)

Two subsections of the Act define health and safety standards and specify the criteria on which standards are to be based. Section 3(8) of the Act provides:

The term “occupational safety and health standard” means a standard which requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment and places of employment.

Section 6(b)(5) specifies the criteria for standards concerning toxic materials or harmful physical agents:

The Secretary . . . shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no **employee will suffer material impairment** of health or functional capacity even if such employee has regular exposure to the hazard . . . for the period of his working life. . . . In addition to the highest degree of health and safety protection for the employee, other considerations shall be the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws (emphasis added).

The extent to which the goals of environmental, consumer, and worker protection are to be balanced against the costs of protection has defined much of the debate on regulatory policy during the last decade. Discussions of the standard-setting authority of OSHA and the proper role for cost considerations have focused on these two subsections.

The legislative history of the OSH Act that is relevant to this question is, in the words of the Supreme Court, “concealedly not crystal clear.” In particular, it does not explain what the Congress meant by “feasibility” or how OSHA was to balance economic and technological considerations in setting standards. Neither the original Senate bill nor the House version included specific provisions about regulating toxic substances; in both, the section was added in committee.

The criterion of “feasibility” was first proposed by Senator Jacob Javits (R-NY), who was concerned that the other bills then under consideration “might be interpreted to require absolute health and safety in all cases.” The final amendments that resulted in section 6(b)(5) were added on the Senate floor. They reflect the objections to that section from several Senators. Senator Peter Dominick (R-CO) argued, in particular, that “[i]t is unrealistic to attempt. . . to establish a utopia free from any hazards.” After some discussion, a compromise was reached (280). The language adopted by the Senate was later accepted by the House-Senate Conference Committee and incorporated in the final bill signed by President Nixon.

There is no evidence that cost-benefit analysis was ever explicitly proposed during those debates as a decision rule for the new agency. Congress had previously issued laws that did contain cost-benefit decision rules, starting with the flood control legislation of the 1930s. The nonuse of such a rule in the OSH Act, if not its explicit consideration and rejection, was important in the Supreme Court’s decisions concerning the decisionmaking authority of OSHA (discussed below).

MacLean (280) suggests that one possible reason that cost-benefit analysis did not enter the debates is that it simply did not occur to Congress that such an analysis could be applied to balance health risks against economic costs. At that time—1970—the theory and techniques of cost-benefit analysis, which had been used to evaluate public works projects, were still being developed for application to health and safety issues.

Because of concern about the costs of the OSH Act, language was added to require that OSHA take into account the “feasibility” of its standards. But the final bill also included the goal that “no employee will suffer material impairment.” In the floor debate, Senator Ray Yarborough (D-TX) expressed the sentiment behind this language: “We are talking about people’s lives, not the indifference of some cost accountants.” As commentators have noted, since the passage of the OSH Act “the degree to which the complete protection of safety and health should be compromised by the technological difficulty and economic cost of achieving that protection has been an issue of constant controversy” (51).

## Regulatory Relief

In the early to mid-1970s, policymakers began to face the simultaneous problems of price inflation and unemployment. Added to these was the growing perception, which was not always based on empirical analysis, that the Government’s health, safety, and environmental regulations were at least partially to blame for these economic ills. (For discussions of more general issues in Federal regulation and regulatory reform, see 3.72, 133.)

A series of Executive Orders and other procedural requirements reflected this new perception

and placed new requirements on the regulatory agencies. In 1971, the Office of Management and Budget (OMB) issued a memorandum to all heads of departments and agencies to improve inter-agency coordination concerning standards and guidelines for environmental quality, consumer protection, and occupational and public health and safety. Known as the Quality of Life Review Program, it covered, in theory, any agency action that would significantly affect other agencies, impose costs on “non-Federal sectors,” or increase the need for Federal funds. Agencies were ordered to submit to OMB schedules of future activities and prepublication copies of proposed and final actions. In addition, proposed and final regulations were to be accompanied by a summary that indicated the principal objectives of the rules, alternatives that had been considered, “a comparison of the expected benefits or accomplishments and the costs . . . associated with the alternatives considered,” and the reasons for picking the selected alternative (424).

Although this program was theoretically applicable to all regulatory agencies, in practice only activities of the Environmental Protection Agency were examined by OMB (158,401). The memo had little effect on the activities of OSHA (47).

President Ford issued the first formal Executive Order (E.O. 11821) on regulatory relief on November 27, 1974, as part of his “Whip Inflation Now” program. This order required all major rules or regulations issued by executive branch agencies to be accompanied by “a statement which certifies that the inflationary impact of the proposals has been evaluated” (176). These were called “Inflationary Impact Statements,” probably after the “Environmental Impact Statements,” required by the National Environmental Policy Act.

A Presidential “oversight process” concerning Federal Government regulatory activity was also established at this time (659). A new agency, the Council on Wage and Price Stability (CWPS), was established in the Executive Office of the President to monitor the inflationary implications of private sector wages and prices. CWPS was also authorized to monitor the inflationary impact of Federal regulatory activity, to review the Inflationary Impact Statements prepared by the regu-

latory agencies, and to participate in agency rulemaking proceedings “in order to present its views as to the inflationary impact that might result” (659).

The text of Executive Order 11821 did not specifically refer to cost-benefit analysis. However, in its review of regulatory activities, CWPS defined as “inflationary” those regulations for which the costs exceeded the benefits (304).

Just before leaving office, President Ford extended his Executive Order, without any significant change in substance, with E.O. 11949, issued on December 31, 1976. The name of the required statements, however, was changed to “Economic Impact Statements” (177).

President Carter issued his own Executive Order on the topic of regulatory procedures (E.O. 12044, March 23, 1978; renewed by E.O. 12221, June 27, 1980), which bore the title “Improving Government Regulations.” The name of the required statements was changed to “Regulatory Analyses” and in them the agencies were to present:

. . . a succinct statement of the problem; a description of the major alternative ways of dealing with the problem that were considered by the agency; an analysis of the economic consequences of each of these alternatives and a detailed explanation of the reasons for choosing one alternative over the others.

Regulatory Analyses were required for any regulation that would have an “annual effect on the economy of \$100 million or more” or a “major increase in costs or prices for individual industries, levels of government or geographic regions” (98,99).

The primary thrust of E.O. 12044 was to improve the content of Government regulations and to encourage agencies to compare alternative approaches. Cost-benefit analysis was viewed as a tool “to compare alternative approaches to a given goal; . . . not to evaluate the goal, itself” (157, 170). The CWPS continued to prepare analyses of agency regulations. The Carter administration also created two other organizations: the Regulatory Council to compile calendars of future regulatory actions and to encourage innovative regu-

ulatory techniques, and the Regulatory Analysis Review Group to review particularly important regulations (157).

President Reagan issued E.O. 12291 on February 19, 1981, as a central component of his campaign for “regulatory relief.” Once again, the analysis requirement was renamed, this time to “Regulatory Impact Analysis” (382). Unlike the previous orders, however, which had only required the agencies to evaluate the economic impacts of their decisions, E.O. 12291 set an explicit cost-benefit decision rule: “Regulatory action shall not be taken unless the potential benefits to society for the regulation outweigh the potential costs.” This Executive Order further specifies that “regulatory objectives shall be chosen to maximize the net benefits to society” and requires, to the extent possible, that all benefits and costs be quantified in monetary terms. Thus, E.O. 12291 was the first to require explicitly that regulatory decisions be based on a comparison of quantified costs and benefits.

In addition, the Reagan administration centralized regulatory review in one agency—OMB—and required agencies to submit to OMB copies of proposed and final regulations and the accompanying Regulatory Impact Analysis in advance of publication. Although the legal authority for proposing and issuing regulations still remains with the heads of the regulatory agencies, in practice the requirement for submission to OMB has meant that the agency must receive approval from OMB prior to publication. A Presidential Task Force on Regulatory Relief, chaired by the Vice President, was also established to resolve disputes between OMB and regulatory agencies.

Congress has also added procedural requirements for Federal regulatory agencies. In September 1980, the Regulatory Flexibility Act (Public Law 96-354) was enacted. It requires agencies to prepare “regulatory flexibility analyses” for regulations that would have a “significant economic impact on a substantial number of small entities” (defined as small businesses, small nonprofit organizations, and small governmental jurisdictions). In December 1980, Congress enacted the Paperwork Reduction Act (Public Law 96-511). In general, the purpose of this act was to reduce the

“burden” of federally required paperwork. OSHA and other Federal agencies are required to obtain the approval of OMB before conducting research or issuing regulations that require the “collection of information.” This includes survey questionnaires and written report forms as well as requirements for record keeping. In addition, Congress has considered, but has not enacted, a number of bills that would require Federal agencies to conduct risk assessments and cost-benefit analyses and that would change other regulatory procedures.

### OSHA Standard-Setting

OSHA standard-setting activity has been a source of disputes between management and labor, between advocates of stringent regulation and those desiring regulatory relief, and between those proposing the use of cost-benefit analysis and those who reject any consideration of economic effects. Important to understanding those disputes is the legislative history of the OSH Act, the attitudes of business and labor, and the attitudes of the health and safety professionals who staff OSHA and the National Institute for Occupational Safety and Health. The disputes concerning OSHA standards have often been settled in the courts.

During its first decade, OSHA was criticized by business representatives for failing to take account of the costs of complying with its standards and for not ensuring that those costs bore a “reasonable relationship” to the benefits of the standards. Labor representatives, on the other hand, criticized OSHA for including compliance costs as a factor in its decisions.

The values of OSHA personnel have been described as “pro-protection” and, it has been argued, derive from the professional training and background of the health and safety professions and from their view of the agency’s mission. Most OSHA staff have worked or been educated in the occupational health and safety professions. As one observer noted, “they believe strongly that workers ought to be protected from hazards and that larger reductions of risk are preferable to smaller ones (without much thought of cost).” These val-

ues led the agency to tend to adopt “the more protective of alternatives presented to them by the parties (from outside the agency] or by credible scientific research” (245).

The agency did, however, recognize the need to collect information concerning the technical feasibility and estimated costs of its regulatory proposals. From as early as OSHA’s first year (1971), the agency has endeavored to develop this information using a combination of in-house staff and outside consultants. The goal of this early activity was not to perform cost-benefit analyses, but to provide feasibility and cost-of-compliance estimates to counter the cost estimates and claims of infeasibility made by the opponents of particular regulations (47).

The first major dispute concerning the use of economic criteria involved a more stringent standard for asbestos exposure, which was issued in 1972. At that time OSHA lowered the permissible exposure limit for asbestos from 12 fibers per cubic centimeter to 5, with a further lowering to 2 fibers per cubic centimeter by 1976. The delayed effective date for the 2-fiber limit was designed “to allow employers to make the needed changes for coming into compliance.” OSHA was sued by the Industrial Union Department of the AFL-CIO for, among other issues, having considered economic factors in setting this limit. The Industrial Union Department argued that the phrase “to the extent feasible” in section 6(b)(5) should be interpreted to mean only technological feasibility—i.e. whether or not the technology to control exposures was available.

The D.C. Court of Appeals ruled in this case that OSHA could take account of the costs of complying with a new standard. Thus, in this decision, “feasibility” under the OSH Act was defined to include both technology and economics. According to the court, a standard would be considered economically feasible if compliance with it would not threaten the viability of an industry as a whole, even if individual firms might close because they could not meet the standard (223).

Two subsequent decisions refined this two-pronged definition of feasibility. The AFL-CIO challenged OSHA’s decision to relax a regulation

concerning the guarding of mechanical power presses (“no hands in dies”). In this case, the Third Circuit Court of Appeals ruled that while the OSH Act was a “technology forcing piece of legislation,” OSHA’s determination that the standard was technologically infeasible was adequately supported. In addition, this court, following the reasoning of the earlier asbestos decision, ruled that OSHA could consider “economic consequences” when setting standards. In particular, OSHA could not “disregard the possibility of massive economic dislocation caused by an unreasonable standard” (1).

Secondly, in an industry challenge to OSHA’s regulation of vinyl chloride, the Second Circuit Court of Appeals upheld a “technology-forcing” standard. By this decision, a standard could be considered feasible even if the technology necessary for compliance was not already widespread in the regulated industry. All that was necessary was that the technology was “looming on today’s horizon” and could be brought into widespread use. A standard would be considered technologically infeasible only if meeting the standard was shown to be “clearly impossible” (454a).

... the Secretary is not restricted by the status quo. He may raise standards which require... improvements in existing technologies or which require the development of new technology.

At about the same time as these judicial decisions, President Ford issued the first Executive Order requiring inflationary impact statements. In following years, OSHA came under pressure from the Council on Wage and Price Stability to base its decisions on the results of cost-benefit analysis. A proposed standard concerning coke oven emissions was the basis for the first clash between OSHA and CWPS. CWPS participated in the rulemaking proceeding and argued that OSHA had overstated the expected benefits of the proposed standard. Using its own estimates of the expected number of lives saved and two estimates of the “value of life” from the economics literature, the Council suggested that the proposed standard was not worthwhile. Finally, CWPS recommended that OSHA consider allowing the use of respirators to comply with the standard (290).

Between the time of proposal and of final promulgation, a new Assistant Secretary for OSHA,

Morton Corn, was appointed. About the use of cost-benefit analysis he has written (122):

After arriving at OSHA, I engaged in an in-depth consideration of cost-benefit analysis, applying the methodology to the coke-oven standard. . . . With the dose-response data at our disposal, various assumptions were used to ring in changes on different methodologies for estimating benefits. The range in values arrived at, based on the different assumptions, was so wide as to be virtually useless. The conclusion I reached after this exercise was that the methodology of cost-benefit analysis for disease and death effects is very preliminary, and one can almost derive any desired answer.

In October 1976, when OSHA actually issued its regulation concerning coke oven emissions, its statement of reasons clearly rejected the use of cost-benefit analysis. In part, this position was a reaction to the arguments of CWPS, whose intervention **was** perceived as an attempt to reduce the level of worker protection. In the preamble to the final regulation, OSHA based its rejection of cost-benefit analysis on the difficulties of accurately estimating the expected benefits of the new standard and the lack of “an adequate methodology to quantify the value of a life” (620).

This attitude toward cost-benefit analysis continued during the Carter administration. In 1977, Eula Bingham, as Assistant Secretary for OSHA, expressed concern about proposed procedures concerning economic impact analysis (56):

While one can argue over the specific role of economics in establishing regulations, it is clear to me that economics should not be a paramount consideration in setting safety and health standards. The overriding purpose of the OSH Act is to protect workers, tempered by considerations of feasibility. Accordingly, I would agree that some economic impact analysis should be performed to provide a basis for evaluating industry representations as to economic impacts and possibly to influence the length of the compliance period allowed for a given standard. I do not believe that policy decisions impacting worker safety and health can or should be subject to a formalized benefit-cost test.

CWPS continued to participate in OSHA’s standard-setting proceedings and generally was very critical of OSHA’s proposals. In a widely

publicized case, Charles Schultze (then chairman of the Council of Economic Advisers), his staff, and CWPS became involved in the cotton dust rulemaking process in 1978. They suggested changes in OSHA’s draft standard. After an appeal to President Carter, the major requirements for engineering controls in the standard **were** not changed, although some features of the standard were modified. The intervention by Schultze and CWPS, however, was viewed by many as an attempt to reduce the cost and the protectiveness of that regulation (135,290,479).

In 1978, OSHA issued final standards for benzene, DBCP, arsenic, cotton dust, acrylonitrile, and lead. Four of these six final standards were challenged in the courts. The cases concerning the benzene and cotton dust standards are particularly relevant to the evolution of the use of economic analysis at OSHA.

OSHA’s more stringent standard for occupational exposure to benzene was challenged by the petroleum industry. The Court of Appeals for the Fifth Circuit ruled in this case that the phrase “reasonably necessary or appropriate” contained in the definitional section of the act (section 3(8)) meant that OSHA could issue a more stringent regulation only if it estimated the risks addressed by the standard and determined that the benefits of the standard bore a “reasonable relationship” to the costs. This ruling, in effect, erected a cost-benefit decision rule for the agency to follow. The court invalidated the standard because it concluded that there was insufficient evidence that this more stringent standard would have any “discernible benefits” (13).

This decision was appealed to the Supreme Court, which in the summer of 1980 upheld the lower court’s decision to vacate the standard, although it did not follow the same reasoning. In fact, while the Court voted 5 to 4 to strike down the standard, the majority could not agree on a common set of reasons. Five separate opinions were issued by the Court, but no single opinion had the support of more than four justices. Justice Stevens presented the views of four of the justices who had voted to strike down the standard. In that opinion, the issue of whether the OSH Act required the agency to follow a cost-benefit

rule was not addressed. Instead, this plurality declared that the agency had not made a “threshold finding” that risk presented by benzene exposure was “significant” (224):

By empowering the Secretary [of Labor] to promulgate standards that are “reasonably necessary or appropriate to provide safe or healthful employment and places of employment,” the Act implies that, before promulgating any standards, the Secretary must make a finding that the workplaces in question are not safe. But “safe” is not the equivalent of “risk-free.” . . . a workplace can hardly be considered “unsafe” unless it threatens the workers with a significant risk of harm.

Therefore, before he can promulgate any permanent health or safety standard, the Secretary is required to make a threshold finding that a place of employment is unsafe—in the sense that significant risks are present and can be eliminated or lessened by a change in practices.

After an extensive review of the record in this case, the plurality ruled that because OSHA had not made this threshold finding and because the record before the agency did not contain “substantial evidence” to support such a finding, OSHA had exceeded its authority in issuing the more stringent standard for benzene exposure. The Court did not rule on the issue of whether the OSH Act required a cost-benefit test in addition to this requirement to demonstrate “significant risk.”

The Court provided only limited guidance as to what **was** meant by “significant risk,” words that do not actually appear in the language of the act. To quote the plurality opinion (224):

First, the requirement that a “significant” risk be identified is not a mathematical straitjacket. It is the **agency’s** responsibility to determine. . . what it considers to be a “significant” risk. Some risks are plainly acceptable and others are plainly unacceptable. If, for example, the odds are one in a billion that a person will die from cancer by taking a drink of chlorinated water, the risk clearly could not be considered significant. On the other hand, if the odds are one in a thousand that regular inhalation of gasoline vapors that are two percent benzene will be fatal, a reasonable person might well consider the risk significant and take appropriate steps to decrease or eliminate it. Although the agency has no duty to calculate the exact probability of harm, it does have an obli-

gation to find that a significant risk is present before it can characterize a place of employment as “unsafe.”

In a footnote, the Court noted that the ultimate decisions of the Agency concerning the acceptable level of risk “must necessarily be based on considerations of policy as well as empirically verifiable facts” (224).

Justice Marshall filed a dissenting opinion for the four Justices who voted to uphold OSHA’s benzene standard. In that opinion, Marshall argued that the plurality’s review of the record was “extraordinarily arrogant and extraordinarily unfair” because the plurality had improperly made its own findings concerning factual issues and had unfairly described OSHA’s analysis of these issues. Moreover, this dissent argued that the requirement to demonstrate a “significant risk” was “a fabrication bearing no connection with the acts or intentions of Congress and is based only on the plurality’s solicitude for the welfare of regulated industries” (224).

The issue of whether the OSH Act required a cost-benefit test in addition to a finding of significant risk was taken up in a case concerning a more stringent standard for exposure to cotton dust. Textile industry representatives argued that OSHA had exceeded its statutory authority because it had neither conducted a cost-benefit analysis nor explicitly determined that the benefits of the standard justified the costs of compliance. Labor representatives and OSHA argued that the OSH Act did not require such a cost-benefit decision rule. Instead, after determining that exposure to cotton dust presented a “significant risk” (as required by the decision in the benzene case), the agency was required to issue the most protective standard subject only to the constraint that compliance with the standard be technologically and economically feasible.

The Supreme Court affirmed the OSHA cotton dust standard by a vote of 5 to 3. The majority opinion held that cost-benefit analysis was not required by the OSH Act. Instead, Congress had erected a requirement for “feasibility analysis.” Citing dictionary definitions that “feasible” means “capable of being done,” the Court ruled (17) that section 6(b)(5) of the OSH Act

. . . directs the Secretary to issue the standard that “most adequately assures. . . that no employee will suffer material impairment of health,” limited only by the extent to which this is “capable of being done.” In effect. . . Congress itself defined the basic relationship between costs and benefits, by placing the “benefit” of worker health above all other considerations save those making attainment of the “benefit” unachievable. Any standard based on a balancing of costs and benefits by the Secretary that strikes a different balance than that struck by Congress would be inconsistent with the command set forth in sec. 6(b)(5).

In a footnote, the Supreme Court also endorsed the definition of economic feasibility that had been suggested by OSHA. According to this, to prove a standard economically feasible, OSHA must show “that the industry will maintain long-term profitability and competitiveness” (17). This definition is consistent with the earlier courts of appeal rulings on the standards for asbestos, coke oven emissions, and lead (10,223,654).

The legal battles concerning OSHA standards were not just about the details of economic analysis and risk assessment. In part, these battles took on symbolic meanings. That is, people on both sides of these issues took positions based on what they believed these cases symbolized for Government regulatory activity. Some supported the standards issued by OSHA because these standards were believed to represent strong efforts to control occupational health and safety problems after decades of neglect. They viewed cost-benefit analysis as a technique that was being introduced to weaken governmental protections. Others opposed these standards and supported legal restrictions on OSHA, including requirements for cost-benefit analysis, because they believed that the agency had gone too far in imposing regulatory costs on businesses.<sup>1</sup>

<sup>1</sup>Table A-3 in appendix A presents a list of the legal cases concerning OSHA standards. For further discussion of OSHA’s legal obligations concerning the development of standards, see (333,408). Mintz (307) provides excerpts from primary source documents related to this history of standard-setting, including legal briefs and court opinions.

## Current OSHA Criteria

OSHA now uses a four-step process for making decisions about health standards, as expressed by former Assistant Secretary Thorne Auchter. First, the agency determines that the hazard in question poses a “significant risk.” Second, OSHA determines that regulatory action can reduce this risk. Third, it sets the regulatory goal (for health standards, this is the permissible exposure limit) based on reducing this risk “to the extent feasible.” Finally, OSHA conducts a cost-effectiveness analysis of various options to determine which will achieve this chosen goal in the least costly manner (434,638).

However, it is not clear what criteria apply to *safety* standards and other regulations issued by OSHA. In the cotton dust decision, the Supreme Court left this issue unresolved, but did state that it is possible that Congress could have set different criteria for health standards than for safety standards. It also noted that the “reasonably necessary or appropriate” language of section 3(8) would apply to safety standards (224).

### “Significant risk”

To determine whether a hazard poses a “significant risk of material health impairment,” OSHA now generally uses the techniques of quantitative risk assessment. In several publications since the Supreme Court decisions concerning benzene and cotton dust, OSHA has presented quantitative risk assessments. These risk assessments have calculated the estimated risk at the currently permitted exposure levels and the anticipated risk at the new, lowered exposure levels, in order to show that its proposed standards are addressing “significant risks” and that they will serve to reduce the risk of occupational disease.

As discussed above, the Supreme Court provided only limited guidance on what occupational risks should be considered significant. The plurality opinion appears to have indicated that a 1-in-1,000 risk of death is “significant” while a one-in-one-billion risk is not. However, the example in this opinion refers to a one-in-one-billion risk from a single drink of water and a 1-in-1,000 risk from *regular inhalation* of gasoline vapors. If this

is adjusted for the total **amount** of water the average person consumes, the resulting risk estimates for these hypothetical examples concerning inhalation of gasoline and consumption of chlorinated water are about the same. (McGarity has reached a similar conclusion by calculating the total number of cases expected in the exposed populations for these two examples (297a).)

OSHA's "significant risk" determinations have principally relied on comparing the estimated risks for a particular hazard to the I-in-1, (X)() guideline. For additional support, OSHA has also included comparisons with the risks of fatal occupational injury (derived from the data of the BLS Annual Survey) and with the quantified risks of several occupational health hazards. For example, OSHA has argued that a particular level of arsenic exposure presents a "significant risk" because the estimated death rate at that level (8 deaths per 1,000 workers) is

. . . 1/4 to 1/2 the death rate [from injuries] in the riskiest occupations, 2 to 5 times higher than the risks in occupations of average risk, and 10 to 100 times the risk of the low risk occupations. It is also 1/3 of the maximum permitted radiation cancer risk but about 3 times higher than the cancer risk which 95 percent of radiation workers are under (638).

Finally, OSHA has compared the estimated risks of exposure at currently permissible levels to the estimated risks for exposure that were regulated in previous years. For instance, in proposals concerning new standards for ethylene dibromide and asbestos, OSHA compared the estimated risks for those substances to the risks of exposures to cotton dust and coke oven emissions (642,647).

In one case, OSHA has exempted one group of employers from the OSHA commercial diving standard because the agency determined that the estimated risks of injuries for this group were below those for industries with low injury rates. In explaining its decision, OSHA relied on a calculation showing that the injury rate for scientific and educational divers was lower than the injury rates for a number of industries, including banking (634).<sup>2</sup>

<sup>2</sup>This calculated injury rate was based on the number of reported deaths and injuries divided by 2,000 hours per year, the equivalent of full-time employment, 40 hours per week for 50 weeks per year.

## Feasibility

As indicated earlier, for both technological and economic feasibility the general requirement is that OSHA must show that compliance with the new standard is possible, that it is "capable of being done." **Technological feasibility** refers to the availability of technologies and methods to comply with the new standard. To prove this, OSHA can, of course, refer to plants and technologies that already meet the new standard. But OSHA is not bound just to the status quo. The courts have ruled that the agency has the authority to require technological improvements. The agency must present substantial evidence to prove that it is reasonable to expect that efforts by industry will lead to compliance, even if the exposure reductions are greater than those that have previously been achieved. In the words of one court (654),

OSHA's duty is to show that modern technology has at least conceived some industrial strategies which are likely to be capable of meeting the PEL [permissible exposure limit] and which the industries are generally capable of adopting.

To meet this duty, OSHA uses the information provided in public comments and the public hearings. A feasibility determination usually relies on the reports and opinions of expert consultants, the availability of control technologies, descriptions of plants and companies already achieving the new standard, and general comments submitted to OSHA.

**Economic feasibility** refers to the economic capability of the regulated industries to afford the technologies needed for control. The Supreme Court has ruled that an analysis of economic feasibility does not mean cost-benefit analysis. Rather, OSHA is required to show that compliance with a standard is affordable by the regulated industry as **a whole**. A standard can be considered feasible even if it adversely affects profits and causes **some** employers to go out of business

This calculation, however, substantially understates the risk during diving operations because none of these employees is actually underwater for 2,000 hours per year. In fact, the actual underwater exposure time for these divers is usually less than one-tenth of the time assumed by OSHA (249a). The actual risk estimates for this group of employees while engaged in diving would, therefore, be over 10 times greater than the risk shown by the OSHA calculation.

rather than comply with the standard. However, OSHA must show that the long-term profitability and competitiveness of an industry will be maintained.

To analyze economic feasibility, OSHA generally estimates the costs of compliance for a standard. These compliance costs are usually presented in several ways: for example, average cost per affected firm, average cost per exposed worker, compliance costs as a percentage of industry sales, and compliance costs as a percentage of total payroll costs. OSHA has not set forth any mathematical formula for determining when these costs would be considered economically infeasible. Rather, it presents the costs, and expresses a judgment about whether or not they would impose a substantial burden or have a significant impact on the market structure of the affected industries.

#### Cost-Effectiveness Analysis

Finally, OSHA uses the techniques of cost-effectiveness analysis to evaluate alternative methods of achieving the health protection goal that has been selected on the basis of the risk and feasibility analyses. Cost-effectiveness analysis at this point is applied in a relatively narrow way. It is not used to judge the “worth” or desirability of the standard, but only to select among alternative approaches for meeting that standard.

#### Regulatory Impact Analyses

Executive Order 12291, issued in early 1981, requires that OSHA prepare Regulatory Impact Analyses. These consist of detailed discussions of the quantified benefits, compliance costs, and economic impacts for alternative standards considered by OSHA.

The order also requires that all OSHA regulatory actions be reviewed by OMB, which, to the extent permitted by law, requires regulatory agencies to demonstrate that their regulations are cost-beneficial. Generally, the results of the OMB review and agency responses need not be made public. Thus, it is difficult to determine if OSHA decisions have been altered by OMB’s cost-benefit review (510). It has been argued that OMB and the Presidential Task Force on Regulatory Relief

have improperly influenced at least two OSHA regulatory proceedings, concerning hazardous communication and commercial diving, after private meetings with representatives of the industries affected by the regulations (519,520).

In several cases concerning proposed standards, OSHA has published alternatives suggested by OMB. These include, for example, the 1981 proposal for hearing conservation (637) and the 1984 proposal on grain elevators, which included OMB-suggested alternatives (348). Two disputes between OMB and OSHA concerning proposed standards have been appealed to the Presidential Task Force on Regulatory Relief. In both cases (the cotton dust and hazard communication standards), OSHA was allowed to publish its proposals (637).

OMB suggestions have been incorporated in at least two final standards. For the hearing conservation amendment, several technical requirements were altered (637). In another case concerning a final standard for ethylene oxide exposure, OMB expressed “reservations” about part of the OSHA-drafted standard (in particular, the provision establishing a short-term exposure limit). In response, OSHA removed that provision from the final, published standard, and requested additional public comment (649). OSHA considers OMB review to be “akin to internal review,” after which all final decisions are made by OSHA and the Department of Labor (637).

The General Accounting Office has studied agency compliance with Executive Orders 12044 and 12291 and has collected information on the costs of preparing economic analyses. For ON-IA, these analyses cost an average of \$338,000 (510). Although it is difficult to determine the value and effects of these analyses, the amount of resources used by OSHA to develop them has been substantial.

#### Effects of Decision Rules

Questions remain, however, concerning the actual application of the current OSHA criteria. How large does a risk need to be in order to be considered significant? How is risk to be measured? How is technological feasibility determined?

How costly can a standard be before it threatens the viability of an industry and thus is considered economically infeasible (277)? Indeed, there have been and continue to be disputes about the application of any set of decision criteria by a regulatory agency. In practice, decision criteria may only define a range of allowable decisions and will often not mandate a particular result.

The positions adopted by the participants in OSHA's regulatory proceedings, general political considerations, and the personal judgments of OSHA's Assistant Secretaries and its staff have been and continue to be important to OSHA's decisionmaking. Moreover, OSHA has always balanced various factors before issuing standards. For instance, OSHA stated in its preamble to the vinyl chloride regulation that its "judgments have required a balancing process, in which the overriding consideration has been the protection of employees." These more informal judgments may be even more important than the formal decision rules used by an agency.

In addition, the court battles about OSHA decisions and more general discussions of "regulatory reform" were not only about what the decision rules should be, but also about who should be empowered to interpret and apply those rules. Should the Assistant Secretary for OSHA have the authority to make these decisions with only limited review by the courts? Or should reviewing judges become extensively involved in analyzing the factual record and OSHA's judgments? And to what extent should outside agencies, such as CWPS and OMB, be involved in examining and approving OSHA's decisions?

Because judgment and the identity of the decisionmaker are important, and because there are many uncertainties in estimating effects (discussed below), the adoption of a cost-benefit rule may not lead to decisions that are different from those adopted under a feasibility test. DeMuth (136) has suggested that "just as the Corps of Engineers became adept at demonstrating that every dam that could be built would pay for itself, so the regulatory agencies will learn to demonstrate, with increasing analytical verve, that every new regulation is cost-beneficial."

Would OSHA's decisions have been different under a cost-benefit decision rule? One contract report (262) prepared for this assessment suggests that for at least some of the major OSHA health standards, the use of a cost-benefit decision rule would have led to less stringent standards.

Judith and Lester Lave (262) applied several different decision frameworks to four health standards issued by OSHA--those for coke oven emissions, benzene, vinyl chloride, and cotton dust. They compared the regulations actually issued by OSHA using its criteria of technological **and** economic feasibility and those that the Laves believe would have been issued under a cost-benefit decision rule. In three of these cases--for coke oven emissions, benzene, and vinyl chloride--a cost-benefit analysis would have led to a less stringent regulation. For cotton dust, the conclusion of an analysis is very dependent on the discount rate chosen and the value placed on preventing additional cases of byssinosis (see below for a discussion of these issues). This case, they concluded, is one in which "reasonable analysts can choose values within the range accepted by the economics profession and wind up with opposite conclusions about the desirability of a stringent standard."

The conclusions about the fates of the vinyl chloride and cotton dust standards are noteworthy because in both cases improvements in productivity accompanied compliance with a stringent OSHA standard. In part, those improvements may have been spurred by the necessity to comply with OSHA's stringent requirements. If a cost-benefit decision rule had been in effect for OSHA, these gains in employee health and in economic productivity might not have occurred.

It cannot be conclusively shown that the application of a cost-benefit decision rule would have changed OSHA's decisions and the nature of technological change in affected industries. Lave and Lave had to rely on currently available information. Had a cost-benefit rule been in effect, OSHA might have prepared additional quantitative information, especially on the benefits of its standards.

However, their conclusion does support the concern of many participants and observers that

cost-benefit analysis in practice would not be a neutral decision rule, but one that is biased against improvements in worker health and safety (43,65,115,194,411). For example, Baram (43) has concluded that in many cases “[c]ost-benefit analysis is a ‘numbers game’ that is used to oppose regulatory actions that have been proposed to protect public health and the environment.” Conner and MacCarthy (115) believe that the use

of cost-benefit analysis will prevent regulatory agencies from carrying out their responsibilities to protect health and safety and will lead to extensive delays in an already slow regulatory process—in other words, to a “paralysis by analysis.” Boden (65) has expressed concern that under current circumstances, the use of cost-benefit analysis “may bias political decisions against even those regulatory decisions that are cost-effective.”

## THE USES AND LIMITS OF ECONOMIC ANALYSIS

### Value of Economic Analysis

Economic analysis—including cost-benefit analysis, cost-effectiveness analysis, and the feasibility analysis performed by OSHA—can provide decisionmakers with important information on the problems and alternatives they face and the consequences of various courses of action. In “The Implications of Cost-Effectiveness Analysis of Medical Technology” (539), OTA described 10 general principles of analysis that are applicable to the conduct of both cost-effectiveness and cost-benefit analyses. These principles are:

- Define problem.
- State objectives.
- Identify alternatives.
- Analyze benefits and effects.
- Analyze costs.
- Differentiate perspective of analysis.
- Perform discounting.
- Analyze uncertainties.
- Address ethical issues.
- Interpret results.

Following these principles can lead to the development of clear and useful analyses. But the process of collecting information, ordering it, and analyzing it can be just as important as the final results of an analysis.

Performing an analysis of costs and benefits can be very helpful to decisionmakers because the process of analysis gives structure to the problem, allows an open consideration of all relevant effects of a decision, and forces the explicit treatment of key assumptions (539).

Lave and Lave (262) have suggested that the use of economic analysis “sharpens the questions, clarifies the implications of policies, and generally manages to attain solutions at lower cost.” In addition, when the necessary data are available and when the quantification of intangible effects is not a problem, cost-benefit analysis can shed light on the implications for economic efficiency of alternative projects.

As one element of the decisionmaking process, as a decision-assisting tool, economic analysis can provide guidance and information. In addition, economic analysis can provide support for decisions or actions that may be taken on other grounds. For example, in some cases, decisions based on noneconomic grounds will also be supported by the results of economic analysis. In those cases, most people would support the use of economic analysis. Arguments arise when the analysis supports less stringent standards than those chosen for other reasons.

### Difficulties in Implementation

The limitations of these techniques are particularly evident when they are considered as *decision rules*. In 1980, OTA concluded that cost-effectiveness and cost-benefit analyses exhibited too many methodological and other limitations to justify sole or even primary reliance on them in making decisions (539). That conclusion is still applicable for the analysis of measures to improve occupational safety and health.

A number of the analytical principles—defining the problem, stating objectives, identifying alter-

natives, differentiating the perspective of the analysis, analyzing uncertainties, and interpreting results—are relatively uncontroversial, in large part because they are components of any process of rational decisionmaking. However, the quantification of benefits and costs and application of a discount rate to them are distinctive features of these types of analyses. They are also the features that present the most difficult methodological issues and arouse the most controversy, especially when applied to governmental regulation of worker health and safety.

### Benefits Analysis

The benefits of various alternatives must be identified, and if possible, quantified. Quantification bears the danger that the effects that can be measured will receive more attention than those that are not quantified, even if the unquantified are believed to be more important. Lave (263) has called this a “Gresham’s law of decisionmaking.” On this danger, Mishan has written (308):

. . . the outcome of all too many cost-benefit studies follows that of the classic recipe for making horse and rabbit stew on a strictly 50-50 basis, one horse to one rabbit. No matter how carefully the scientific rabbit is chosen, the flavor of the resulting stew is sure to be swamped by the horse-flesh. The horse, needless to say, represents those other [unquantified] considerations . . . .

The uncertainties of any quantification of benefits begins with uncertainties concerning the relationship between exposures and health hazards. Epidemiologic studies are often limited by small sample sizes, a lack of information on past exposures, and the presence of confounding variables. The results of animal testing present problems in determining the applicability to human populations and in extrapolating from the high doses often used in such studies to the lower doses found in the workplace (see ch. 3 and 542).

Even after identifying the risks involved, an analysis of the benefits of controlling them must discuss the effectiveness of the various technologies that could be applied. Often, information crucial to that analysis is lacking. For example, personal protective equipment is often suggested as a cost-effective alternative to engineering con-

trols, but there is only limited information available on the actual workplace effectiveness of such devices (ch. 8).

After identifying and quantifying the benefits to be expected from a given action, a cost-benefit analysis (but not a cost-effectiveness analysis) requires that these be converted to units that can be directly compared with the costs of the action. Analysts almost invariably choose monetary units for this.

There are two major approaches to placing a value or a price on human lives or lifesaving programs. The first is to consider the value of a life to be the present discounted value of the person’s future income. Because this method, known as the human capital approach, assumes that the value of a person’s life is equal to their expected income, it implies that “women are valued less than men, blacks less than whites, retired people less than workers, and low-paid textile workers less than higher-paid steel workers” (115). In addition, it cannot include the value that other people attach to saving a particular person’s life.

The other major approach has been to evaluate lifesaving programs on what people are “willing to pay” for them. This approach, too, runs into problems. It is difficult to find out exactly what people are “willing to pay.” A survey could be used, but the interpretation of the results is difficult.

Another measure can be obtained from analysis of the additional pay that workers may receive for taking unsafe jobs. (These have been termed hazard premiums or compensating wage differentials. See ch. 15 for a discussion.) It is also possible that consumers are willing to pay “extra” for less hazardous consumer products. Some economists, using the techniques of statistical analysis, have attempted to measure the extent of these “revealed preferences.” These studies are subject to a number of technical problems in the measurement of risk levels and in adjusting for other factors that influence wages and prices. The results of these studies have been used to calculate the “value of a life.”

Table 14-1 shows the wide range of implied values for human lifesaving derived from such

**Table 14-1.—Willingness-to-Pay Estimates of the Value of Life<sup>a</sup>**

Method	Value per statistical life (thousands of 1977 dollars) <sup>b</sup>
Survey approach:	
Acton (1973) . . . . .	38
Jones-Lee (1976) . . . . .	8,440
Landefeld (1979) . . . . .	1,200
Revealed preference:	
Labor market:	
Dillingham (1979) . . . . .	277
Thaler and Rosen (1975) . . . . .	364
Viscusi (1978) . . . . .	1,650
Smith (1976) . . . . .	2,045
Olson (1981) . . . . .	5,935
Consumption activity:	
Dardis (1980) . . . . .	101 <sup>c</sup>
Ghosh, Lees, and Seal (1975) . . . . .	260
Blomquist (1979) . . . . .	342
Portney (1981) . . . . .	355

<sup>a</sup>Where a study included a "central" or "most reasonable" estimate, that is shown, where only a range was given, the lowest value is presented.

<sup>b</sup>Values were converted to 1977 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index.

<sup>c</sup>Unclear from the Dardis study what year's dollars apply, although the estimate presented here appears to be based on an average value for the period 1974-79.

SOURCE: (262)

studies. Two different types of studies are cited. The first, labeled the survey approach, involves surveying groups of people and asking them what they think should be spent on lifesaving programs. The second type, revealed preference, uses data concerning either work and employment (labor market) or consumer purchasing (consumption activity) to calculate either workers' or consumers' "willingness to pay" for risk reduction.

The wide range in these values creates difficulties for analysts attempting to use the "willingness to pay" approach to place a value on the benefits of programs. Besides this practical problem of choosing a figure for valuing benefits, there are also several conceptual problems with using the "willingness to pay" approach to assess lifesaving programs. (See 277 and 297 for a discussion.)

Recently a third approach has been suggested (259). Called "adjusted willingness to pay," it attempts to combine the two traditional approaches by estimating what an individual should be willing to pay to avoid the financial losses associated with premature death. However, it still is not able to include the willingness of family, friends, co-workers, and strangers to contribute to lifesav-

ing programs. Moreover, the value of life derived from this approach remains a function of income and wealth.

### Cost Analysis

The estimation of costs is often thought to present fewer difficulties than the analysis of benefits. Nevertheless, the costs of controls are often hard to estimate accurately. In part this is because many control technologies involve changes in the actual productive process or have multiple uses. For example, what portion of the costs of installing duct work in a new plant should be attributed to the need to dilute an air contaminant? And what percentage should be listed as the cost of providing heating and air conditioning to a plant—an ordinary cost of doing business?

In addition, company officials are usually in the best position to know what needs to be changed in their plants to comply with a proposed standard. But these people also have a vested interest in the regulatory proceeding. Moreover, line managers and plant engineers would rather overstate than understate expected costs in order to ensure that they will be given a sufficient budget within the company to pay for the controls (140). Finally, when OSHA "forces" the diffusion of technology, there is little or no experience on which to estimate the costs of widespread use of a particular new technology. Consequently, the costs of proposed regulations are often overestimated. (For examples of this, see 195.)

### Uncertainties

Estimates of both costs and benefits are usually surrounded by uncertainty. The combined effect of these uncertainties and of assumptions made by the cost-benefit analyst, both of which are found at every stage of the estimation of costs and benefits, can produce large differences in the analyses conducted by different people. Thus it is possible for one analyst to take a high estimate of costs and a low estimate of benefits and conclude that the program should not be undertaken, while another analyst can take a lower cost estimate and higher estimate of the benefits and conclude that the program is worthwhile. Often these disputes cannot be resolved. (For a discussion of several kinds of uncertainty, see 175.)

## Discounting

Finally, these analyses require that costs and benefits be made commensurate over time. This usually involves adjusting future costs and benefits at a specified discount rate to calculate the present value of the costs and benefits. The general justification for discounting derives from the fact that resources can be invested to earn interest over time. Thus, in order to compare costs and benefits that occur in different years, all future effects are discounted and expressed in terms of “present values.”

In practice, there is considerable disagreement over what discount rate should be used (539). Moreover, although the logic of discounting is derived from several basic propositions of economic theory, the discounting of future costs and benefits has two effects that create some controversy.

First, the effects (both costs and benefits) on future generations are almost completely ignored with most discount rates. Second, the process of discounting implies that risks that manifest themselves in the very near future are to be prevented before risks 10, 15, or 20 years in the future. This means that, all other things being equal, the risks of occupational injury should be reduced before reducing the risks of occupational cancer. Or, for example, that OSHA should act to reduce the risks of exposure to beta-naphthylamine (which has caused cancer in some workers after a latent period of less than 5 years) before it acts to reduce the risks of exposure to asbestos (which causes various types of cancer with latent periods ranging from 15 to 30 years).

## Distributional Effects

Although cost-benefit and cost-effectiveness analyses were designed to evaluate economic efficiency, they are not very well developed for the evaluation of distributional implications. This is an important problem for the application of these techniques to programs designed to improve occupational health and safety. Usually these programs are aimed at benefiting a group of workers, while the costs of the programs fall largely on employers. In addition, the benefit to the workers often involves the prevention of irrevers-

ible damage to their health or well-being while the costs to employers involve increased expenses and, possibly, reduced profits. This further complicates the comparison of costs and benefits.

## Alternatives to Aggregated Analysis

Some analysts believe that ultimately solutions to these problems can be found. OTA (539) has suggested that the alternative of “arraying” the various effects of a program or proposal should be investigated, rather than trying to reduce all effects to a single “bottom line.” Ashford, et al. (33), for example, have suggested “trade-off analysis.” This approach would involve a comprehensive description of the expected effects of an agency’s actions on three “flows”: economic, environment/health, and legal. To avoid the problems of monetization and valuation, all effects are left in their natural units. To reduce discounting problems, the time pattern of the effects is presented. Finally, the analysis provides a matrix of effects and actors, to present a clear picture of who gains or loses what from the regulatory action.

## Ethical Considerations

The use of cost-benefit and cost-effectiveness analyses also raises ethical considerations. Supporters of the greater use of these techniques point to the limited resources available for improving health and safety. This, they believe, implies that the only moral course of action is to use those resources in a way that maximizes net social benefit. As a moral doctrine, this belief derives from the traditions of utilitarianism (246). The advocates of cost-benefit analysis believe that the use of formal analysis will help achieve the greatest possible level of human welfare (304,446).

. . . estimating benefits and costs is often difficult, especially . . . where the benefits may be in terms of lives saved or pain and suffering avoided. Some say this means putting a value on human pain, suffering, and death, which is not only ludicrous, but downright immoral. If anything, we would argue, the reverse is true. Since resources are limited, we cannot avoid the need to identify—and, in some way, to estimate—benefits and costs. The more compassion we have for our fellow human beings, the more important this becomes (304).

In disagreement, MacLean and Sagoff (281) discuss the philosophical justifications used to support cost-benefit decisionmaking and conclude that these justifications fail. Cost-benefit analysis is not, in their view, a neutral decisionmaking rule because it is unable to take account of many commonly held ethical principles and values. In order to include concerns for equity and justice, a formal cost-benefit analysis would either have to find some way to assign a price to these concerns or ignore them. But justice and equity are not merely matters of consumer preference; they depend on political and moral arguments: "Equity is a matter of right or wrong; it is to be thought over and argued about. It is not a consumer service or a fungible good" (281).

On examining the cost-benefit decision rule presented in President Reagan's Executive Order 12291, MacLean and Sagoff conclude that its unitary yardstick of positive net benefits is

severely limited: How can cost-benefit analysis claim to be either neutral or comprehensive if it cannot deal with a wide range of moral, cultural, aesthetic, and political concerns? There may be some issues that raise few important cultural or moral issues; for example, the commodities markets may be left to determine the prices of hog bellies or potash. This does not show, however, that markets or market analysis can give us an adequate policy for public safety and health. On the contrary, where moral, political, and cultural values—not simply economic ones—are at stake, we need to make moral, political, and aesthetic judgments. Cost-benefit analysis does not replace these "subjective" judgments with "objective" or "neutral" ones. Rather, it distorts or ignores the noneconomic values it cannot handle (281). (See 205,246,277, and 297 for additional discussion of the ethical implications of cost-benefit analysis.)

## SUMMARY

Improving occupational safety and health involves the identification of hazards, the development of control techniques, and the decision to control. The issue of decisionmaking—the question of who is to make decisions and on what basis—is important because interested parties can differ greatly about the nature of occupational hazards and the best means to reduce or eliminate them. Employers' decisions tend to follow the dictates of the competitive market system; public decisions can consider a number of other factors.

Various techniques of economic analysis including cost-benefit and cost-effectiveness analyses have been developed to assist private and public decisionmakers. As decision-assisting *tools*, these techniques can help policymakers to reach sound, well-informed, reasoned decisions about the management of workplace hazards. There is widespread agreement, at least in principle, that decisionmakers need to have some minimal understanding of the important features of the problem to be addressed, the factors involved in the decision, and the implications of various courses of

action. As decision roles, however, formal analysis is considerably more controversial and significantly more limited in its uses.

In 1980, OTA concluded that cost-effectiveness and cost-benefit analyses exhibited too many methodological and other limitations to justify sole or even primary reliance on them in making decisions. That conclusion is still applicable for the analysis of measures to improve occupational safety and health.

These limitations include difficulties in quantifying the magnitude of the expected benefits, in valuing these benefits, in calculating the expected costs of improved health and safety, in performing discounting, and in analyzing the distributional implications of alternative policies. The use of cost-benefit and cost-effectiveness analyses also involves ethical considerations. The advocates of cost-benefit analysis believe that the use of formal analysis will help achieve the greatest possible level of human welfare. Critics of formal analysis, however, argue that cost-benefit analysis is limited because it is unable to take account of

**many commonly held** ethical principles and values.

The history of decisionmaking at OSHA is intertwined with debates over the allowable use of cost considerations. Some of that debate has been over the specific requirements of the OSH Act and whether OSHA must base its decisions on a cost-benefit analysis. When it passed the OSH Act, Congress brought the Federal Government into the field of occupational health and safety. Congress, however, was less clear about the precise decision rules for OSHA to follow when setting health and safety standards. Because of the concern of a number of Congressmen about costs and economic effects, OSHA was required to consider the “feasibility” of its standards. But the final bill also included the goal that “no employee will suffer material impairment . . .” In addition, during the 1970s, a series of Executive Orders and other procedural requirements have affected OSHA’s standard-setting activities.

A number of legal challenges to OSHA standards have brought the courts into this arena. Two of these challenges were decided by the Supreme Court. The Supreme Court has ruled that the

OSH Act does not require that OSHA base its decisions on the results of cost-benefit analyses; instead the agency must base its decisions on determinations of “significant risk” and “feasibility.”

OSHA now uses a four-step process for making decisions about health standards. First, the agency determines that the hazard in question poses a “significant risk.” Second, OSHA determines that regulatory action can reduce this risk. Third, it sets the regulatory goal based on reducing this risk “to the extent feasible.” Finally, OSHA conducts a cost-effectiveness analysis of various options to determine which will achieve this chosen goal in the least costly manner.

OSHA also prepares Regulatory Impact Analyses to comply with the requirements of Executive Order 12291. Because the results of the OMB review of these analyses are not made public, it is difficult to determine if OSHA decisions have been altered by OMB’s cost-benefit review. In addition, one contract report prepared for this assessment suggests that for at least some of the major OSHA health standards issued in the 1970s, the use of a cost-benefit decision rule would have led to less stringent standards.