Discussion of Evaluation Findings 3

As outlined earlier, the research for this project pursued several avenues of inquiry: review of the methods and procedures OSHA normally employs in examining control technologies and regulatory impacts; conduct of a number of retrospective case studies on existing standards (comparing actual post-promulgation outcomes with the rulemaking estimates); examination of OSHA's current resources and organization for its control technology and regulatory analysis work; and comparisons of OSHA's analytic practices with those of other comparable regulatory organizations (in both the United States and abroad). This chapter discusses the major findings in each of these areas.

APPRAISAL OF METHODS AND PROCESS

OSHA's rulemakings vary widely with respect to the specific questions addressed, analytic methods employed, and information bases drawn upon—and, in most respects, the "real action" lies in the details. Nonetheless, the agency's typical examinations of control options and regulatory impacts contain similar elements. The observations in this section are intended to comment on the broad features of the data-gathering and analytic processes the agency routinely employs.

The findings reflect OTA's review of more than a dozen past OSHA rulemakings,[1] discussions with agency staff involved in the preparation and use of the analytic material, review of the scholarly literature on OSHA processes, and comments from other knowledgeable observers.

- ***OSHA's examination of control measures and the impacts of new compliance requirements arises chiefly in preparing the procedurally mandated feasibility determinations and regulatory analyses. Within the confines***

[1] Over the course of this study, OTA and its contractors examined the preamble and docket materials (focusing chiefly on the feasibility and regulatory impact analysis aspects) of more than a dozen OSHA health and safety standards promulgated since the mid-1970s: Vinyl Chloride (1974), Cotton Dust (1978), Occupational Lead (1978), Ethylene Oxide (1984), Formaldehyde (1987), Grain Handling Facilities (1987), Presence Sensing Device Initiation of Mechanical Power Presses (1988), Powered Platforms for Building Maintenance (1989), Air Contaminants (1989), Hazardous Energy Sources ["lockout/tagout"] (1989), Bloodborne Pathogens (1991), Process Safety Management (1992), Cadmium (1992), and Confined Spaces (1993).

of these tasks, the broad elements of what the agency prepares are generally coherent and credible. However, there is a "narrowness" in the questions addressed and findings provided that needs to be recognized.

The agency's various analytical findings and estimates are often vigorously disputed in the course of rulemakings by stakeholders and expert advisers on all sides of issues. Nonetheless, the broad evidence of the more than a dozen past rulemakings OTA has examined for this study indicates that OSHA routinely brings analytic processes to bear that are considerably detailed, in line with the established practices of the technical fields involved (whether related to risk factors, engineering considerations, economic impacts, or other relevant dimensions of assessment), and generally credible for the intended purposes.

Control measures and other compliance steps are normally examined in some depth with respect to their operational characteristics and adoption considerations. Estimates of costs and other economic impacts are developed in a serious way—in extensive detail for compliance expenditures, usually with substantial attention to potential effects on productivity and company viability, although more qualitatively with regard to impacts on the structure of affected industries and effects externalized to the larger economy. Estimates of the major benefits associated with hazard reduction also are normally prepared in some detail. Furthermore, the "full cycle" of events implemented for an analysis—commissioned studies, other expert contributions, OSHA staff analyses, findings published in preliminary and final versions, the often extensive comments and technical submissions during the public hearings and comment period (from stakeholders, their representatives, and other experts), and review by external bodies such as OMB—generally provides for an extended and deliberate examination of the major issues affecting a rulemaking.

Nonetheless, there is some narrowness (that is, incompleteness) in the content of the agency's typical analyses that needs to be recognized in judging the findings that result. This circumstance variously reflects the agency's decision-making framework, the practical realities of the rulemaking context, and the specific features of the information needed to promulgate standards.

Perhaps most important, the agency's current estimation process is, by and large, *not* targeted on providing a "most likely" forecast of the mix of control actions, costs, and other economic impacts to arise as the various establishments making up an affected industry act to comply with a hazard reduction requirement established by the agency. Rather, the analytical effort is chiefly aimed (in keeping with the agency's procedural requirements) at providing a defensible demonstration that the compliance provisions specified by the preliminary or final version of a standard are generally achievable across an affected industry. In this way, the majority of attention is usually placed on those control measures deemed essential to the feasibility demonstration at hand, rather than to the full scope of control options that may be available to establishments to comply (which could include significant shifts in production processes or the adoption of advantageous innovations, in addition to the conventional control measures OSHA's analyses tend to emphasize). And, unless binding technological or economic limits are encountered in removing what the agency determines to be an existing "significant risk," the analytic process generally does not take on the task of identifying the most stringent extent of hazard control that is achievable.

In addition, the agency's analyses are usually more comprehensive in charting the cost side of the regulatory equation than the anticipated benefits.[2] Estimates of the reductions of adverse health effects or accidents as a result of affected industry compliance are usually prepared in some detail.[3] But explicit quantification tends to be limited to the most significant endpoints, rather than to the more complete set of health and safety improvements expected.[4] Benefits in the form of directly avoided costs (e.g., reduced insurance premiums—because the risk levels experienced are lower) also are often quantified and included. But here again, the agency has not generally sought to be exhaustive.[5]

- ***Typically, the considerations most influential in shaping feasibility and impact findings require substantial factual information about the characteristics of affected industries. Data collection to meet these needs is generally among the most challenging aspects of the agency's analytic effort for a rulemaking.***

OSHA usually draws on a sizable array of information from diverse sources to prepare the necessary feasibility and impact analyses for rulemakings—although the specifics vary widely according to the nature of the standard and the industries involved.

Published materials from government and private sources are often used—materials such as Department of Commerce data characterizing the establishments and employees in particular industries, the industry financial indicators available from various on-line sources (e.g., Dun & Bradstreet), and various scientific/engineering studies (e.g., on production process issues or control options) in the scholarly or industrial trade literature. Technical studies prepared by other agencies, when relevant, are often drawn upon, for example, the Health Hazard Evaluations (HHEs)[6] prepared by NIOSH or industry-specific analyses from agencies such as EPA prepared in support of their own regulatory activities. Databases routinely maintained by OSHA often provide relevant information for rulemakings, notably, from the Integrated Management Information System (IMIS), Fatalities/Catastro-

[2] Nevertheless, OSHA's "imbalance" in this regard is not unlike the circumstances for other agencies with regulatory analysis requirements. Directly incurred costs are usually reasonably identifiable, amenable to estimation, and readily valued in a common economic metric (i.e., dollars). On the benefit side, the chief sources can usually be reasonably identified. However, credible quantitative estimation is often quite difficult—because, for example, of limits in the scientific foundation for relating causes to effects or because benefits with the character of an amenity are involved. And translation into a common economic metric poses a quagmire of conceptual issues of proper valuation.

[3] On occasion, OSHA does report a monetization of its benefit estimates. For the most part, however, the agency has sought to avoid the controversy of identifying a specific value for a statistical life saved or injury avoided. As a result, the benefit projections are generally presented in their native physical terms.

[4] OSHA often identifies a substantial list of acute and chronic health effects and hazard factors it expects will be removed or reduced by a new regulation. But quantification is usually limited to the most predominant effects (e.g., excess deaths from cancer over a working lifetime) and to situations in which there is a reasonable scientific and evidentiary basis for preparing estimates.

[5] For example, for health standards, OSHA has generally not quantified the economic benefits expected to accrue to industry from improved worker health. Furthermore, the agency has not yet sought for any standard to estimate the benefits from reduced workers' compensation premiums or reduced payouts (for companies that self-insure) for medical expenses and forgone earnings or reduced risk premiums paid to workers to accept hazardous workplace conditions (to the extent workers currently receive such premiums).

[6] NIOSH conducts industrial hygiene monitoring studies at specific industrial sites (when requested by the Secretary of Health and Human Services, by an employer, or an authorized worker representative) through a technical assistance program called Health Hazard Evaluations (HHEs). Normally, an HHE assembles detailed information on exposures, existing control measures by job classification, and related matters. For a further discussion, see J. Froines, D. Wegman, E. Eisen, "Hazard Surveillance in Occupational Disease," *American Journal of Public Health* 79 (Supplement): 26-31, Dec. 1989.

phes database (FATCAT), and, on occasion, the record of prior rulemakings.[7]

Data, analyses, and other materials submitted by stakeholders and other interested parties during the hearings and public comment period also often represent a sizable source of information. The agency is obligated to consider all serious submissions of this nature, and often a large fraction of a rulemaking's preamble section is taken up in acknowledging and responding to this material. While the potential for self-serving representation is clearly a consideration, it is apparent that OSHA has often been able to use this information to advantage.

Nonetheless, the considerations typically most central in making feasibility and impact determinations involve fairly detailed information about the features of affected industries. The most notable factors include: the existing distribution of exposures (or injuries or fatalities) among the workforce; the production processes and work practices in place, and the protective controls already being used; the likely efficacy of potential new compliance measures in reducing principal risk factors; and the various unit costs to be incurred in taking particular compliance actions. These factual and technical matters usually cannot be adequately resolved by consulting "off the shelf" or otherwise readily available information. Rather some form of primary data collection and original analysis of engineering, economic, and risk factors must be mounted for most rulemakings.[8]

OSHA and its research contractors have approached these data needs in various ways. Site visits (to willing establishments) in affected industries have been a typical feature of the empirical foundation for most rulemakings. Also, in recent years, the agency has conducted a number of large-scale surveys of affected industries (using statistical sampling methods and telephone interviews or written questionnaires or some combination).[9] (And, as noted earlier, in some cases, the information generated from such surveys has served to substitute in part for extensive original data collection in later rulemakings.[10]) On occasion, the agency has relied on a working panel of experts, with participants contributing information and judgments on affected industries about which they are particularly knowledgeable.[11]

OSHA appears to have used all of these approaches to advantage in the past. However, each has strengths and weaknesses. Site visits have provided substantial useful data on such matters as existing plant processes and control

[7] The Integrated Management Information System is OSHA's principal database characterizing workers' exposures to hazardous substances or conditions (see also Froines, Wegman, and Eisen, December 1989). IMIS maintains the monitoring results from both programmed and complaint inspections performed by the agency's field compliance officers—although, to date, around three-quarters of IMIS data relates to only a dozen or so chemicals. OSHA's Fatalities/Catastrophes database is a part of IMIS and records data from the mandated reports on workplace incidents involving fatalities or hospitalized injuries. A discussion of the major surveys of industrial establishments OSHA has conducted to support some past rulemakings follows in footnote 9 below.

[8] Some commentators knowledgeable about OSHA's rulemaking tasks observe that much of the functional content of a standard can be shaped without exhaustive evidence about the features of affected industries—and that even extensive research efforts will be unlikely to remove all pertinent uncertainties in key parameters such as those just outlined above. Nonetheless, it is essential to recognize (as a subsequent finding emphasizes) that the agency's feasibility and impact analyses are performed at least as much to satisfy the evidentiary guidelines specified by the courts and other government actors and to provide a record capable of withstanding future challenges, as to support the agency's internal policy design effort. However, information on the nature of impacts is also obviously essential to the agency's engagement of stakeholders in rulemakings.

[9] For example, to support the 1989 Air Contaminant rulemaking, OSHA collected data (regarding chemicals and processes used, existing engineering controls and work practices) from 6,500 establishments (sampled at a 4-digit SIC level of detail, but statistically representative only at 2- and 3-digit levels). In 1990, a survey with similar characteristics was conducted to support the Personal Protective Equipment Rulemaking; it involved a sample of 5,500 establishments. Survey data from around 3,000 establishments was collected across nearly 20 industries for the 1991 Bloodborne Pathogens standard.

[10] In the 1992 Process Safety Management standard, for example, OSHA relied extensively on the information available in the previously completed (and aforementioned) Air Contaminants and Personal Protective Equipment surveys.

[11] In the 1993 Confined Spaces rulemaking, for example, OSHA relied heavily on inputs from a 57-member panel of experts, each with specific expertise on one or several of over 100 industries determined to be affected.

measures, possible avenues for enhanced hazard control, insights on the feasibility issues likely to arise, and the chief considerations affecting compliance expenditures. But given the constraints of available budget, available work calendar, and the external review and approval specified by the Paperwork Reduction Act,[12] usually only a small fraction of the establishments potentially subject to an intended standard can be visited in the course of any given rulemaking. This fact and the potential unrepresentativeness of those facilities willing to be surveyed make it difficult to construe the data derived through this means as an adequately representative sample.

Large-scale surveys can address the statistical representativeness issue but usually cannot collect the detailed data on relevant plant features that site visits provide. In addition, such surveys are expensive and time-consuming to implement, and at present face the need for external review and sign-off by government personnel outside OSHA. These surveys have also been subject to the criticism that they provide essentially unverified data. Expert panels, when competent and balanced, can be an efficient mechanism to consider complex issues (particularly when standards are expected to require a technology-forcing component).[13] Nevertheless, the often judgmental character of the findings of such advisory bodies (in contrast to more conventional "hard" numerical analyses) can be a source of later vulnerability, should a challenge be mounted.

As a practical matter, OSHA must balance the needs of a particular rulemaking with the strengths and weaknesses of the methods available and the operating constraints of tight budget, constrained work calendar, and external oversight. In most rulemakings, therefore, OSHA has had to piece together as much relevant published information as is accessible, supplemented with original empirical work to the extent allowed by the prevailing constraints. As is evident in existing rulemaking records, the data and other information assembled by the agency are usually quite extensive. Nonetheless, as a matter of practice, an exhaustive assembly of all relevant evidence, such as would satisfy normal scientific research canons, is a difficult, if not impossible, objective in most cases.[14]

- ***A closely related point is that OSHA's feasibility and regulatory impact findings are often criticized as lacking empirical depth. This matter is not easily dismissed, given the procedural importance of the findings and the threat of subsequent judicial remand, but it is an analytical challenge with few simple solutions.***

[12] Under the OSH Act's existing requirements, where more than nine industrial sites are to be visited for data collection purposes in a rulemaking, OSHA must receive OMB's advance approval of the data collection and sampling plan. OSHA has successfully completed these steps with its past large-scale industry surveys, but OSHA staff indicate that the problem can be more troublesome when smaller-scale industry data collection efforts are involved.

[13] For example, OSHA has the option to appoint special advisory committees to assist with standard setting—which it has used in the past. In addition, the statutorily established National Advisory Committee on Occupational Safety and Health (NACOSH) could be used as a forum to discuss compliance options. However, OSHA has not made use of either of these information gathering tools for some time.

[14] With even the largest of the industry field surveys the agency has mounted in the past, the sampling of establishments has been too limited to yield statistically reliable projections at an industry-by-industry level, that is, at a 4-digit SIC level of disaggregation.

Criticisms about "data limitations" in OSHA's findings and estimates have come from several quarters. The courts have periodically reminded the agency of the importance of an adequate record and due treatment of relevant distinctions among industries in developing feasibility determinations. The U.S. Court of Appeals (11th Circuit) did this most recently in a 1994 remand of a portion of the 1992 Cadmium standard, which arose from a perceived deficiency in the field data supporting a feasibility determination for one of the affected industries.[15] A few years earlier in 1992, the same court rejected portions of the rationale of OSHA's 1989 Air Contaminants rulemaking, affirming (among other considerations) the need for substantial industrial detail in technological and economic feasibility determinations.[16]

In addition, stakeholders comment with some frequency that the agency makes decisions without a detailed understanding of the relevant existing features of establishments (exposures, in-place controls, practical constraints on control measures, etc.).[17] Whether or not such assertions are self-serving or fair in recognizing the practical constraints the agency routinely faces in collecting data, they represent a vulnerability for OSHA in completing and ultimately sustaining a rulemaking.

The problem would be substantially diminished if OSHA could routinely mount primary data collection (of a site visit nature) from a statistically representative sample of establishments in most all affected industries. However, such an effort would entail a budget, a work calendar, and access to affected industries that are generally beyond the agency's practical reach. Agency policymakers and research managers are left to resolve the tensions between analytic needs and incumbent constraints as best they can, case by case.

- ***Explicit benefit-cost comparisons are not at present a formal basis for OSHA's rulemaking actions. Nonetheless, the agency normally assembles substantial information on the benefits and costs of an intended standard—and, as a practical matter, stakeholders' competing perceptions about the benefit-cost balance likely to result are often a major focus of debate in the course of a rulemaking.***

One of the enduring critiques of OSHA's rulemaking procedures (typically coming most vigorously from economists, industry representatives, and others concerned about the effects of government interventions in the workings of the economy) has been that standards are set without due consideration of whether the benefits to be

[15] In 1994, in *Color Pigments Manufacturers Association, Inc.* v. *OSHA* (CA 11, No. 92-3057), the appeals court remanded the Cadmium standard (promulgated in 1992) for a specific inquiry into the feasibility of the standard for the dry color formulator industry (one of the nearly 100 industries affected). Here, despite the considerable analytical detail of the rulemaking as a whole, the agency's feasibility finding was deemed insufficient, because the companies and operations used to make the determination were not adequately representative of the dry color formulators industry as a whole.

[16] In 1992, in *AFL-CIO* v. *OSHA* (965 F.2d 962), the appeals court (again the 11th Circuit), reviewing the Air Contaminants standard (which had been promulgated in 1989, and sought to revise *en masse* the existing PELs for some 425 hazardous chemicals and substances in line with the latest American Conference of Governmental Industrial Hygienists recommendations), declared OSHA's technological and economic feasibility findings insufficient, on the ground that the agency had not demonstrated a general presumption of feasibility for each affected industry. OSHA's final analysis had presented feasibility findings classified at a 2-digit SIC level of detail (i.e., in considerably aggregated "major groups"). The court concluded that such a demonstration of feasibility was wholly inappropriate when disparate industries were involved whose production technologies or compliance costs were unrepresented by gross sectoral averages. What was needed instead was industry-specific information, i.e., at a 3-digit or 4-digit SIC level, as relevant differences among industries dictated.

[17] See, for example, L.P. Halprin, Keller & Heckman, Washington, DC, "Re: Proposed OSHA Survey on Ergonomic Hazards and Prevention Programs" (and supporting appendix material), unpublished letter to Secretary Lynn Martin (U.S. Department of Labor) and Acting Assistant Secretary Dorothy Strunk (Occupational Safety and Health Administration), Washington, DC, Dec. 28, 1992.

achieved are justified by the new costs incurred.[18] Indeed, in being subjected to this criticism, OSHA is not unlike most other regulatory agencies with responsibilities in the health, safety, and environmental risk arenas.

Nonetheless, as discussed earlier, OSHA routinely assembles substantial information related to both costs and benefits for its rulemakings, and does so largely irrespective of the anticipated magnitude of the cumulative impact on the national economy.[19] Some of this effort reflects compliance with the executive order mandate for conduct of "regulatory analyses." But it also reflects the practical reality that perceptions (if not competing figures) pertaining to the balance of benefits and costs to result from an intended regulation are often a focus for vigorous policy debate among principal stakeholders and in the agency's interaction with oversight bodies such as OMB.

It is true that the agency does not now set and justify its standards (of either a health or a safety nature) directly in accordance with the benefit-cost marginal analyses and net comparisons normally recommended by those advocating the "benefit-cost approach" to public policymaking. This circumstance is not, however, an unconsidered oversight. The roles of benefit and cost estimates in the agency's policy decisions have been the subject of substantial past attention by both Congress and the courts in defining the legal basis for the agency's regulatory actions.

In rulemakings on health standards, the agency has understood its procedural mandate to involve removing "significant risk" subject to technological and economic feasibility. In addition, the courts, interpreting Congress's legislative intention in the 1970 OSH Act, have directly precluded benefit-cost comparisons as a basis for setting health standards—particularly in the U.S. Supreme Court's 1980 decision in *American Textile Manufacturers* v. *Donovan* (see chapter 2, box 2-1). For setting safety standards, the agency has concluded (at least, to date) that much the same significant risk and feasibility analysis procedures provide an adequate procedural basis.

Nevertheless, there is room in the foreseeable future for these features to change in important ways—the result of actions by either the courts or Congress—and with potentially substantial implications for the agency's analytical procedures.

First, the role of benefit-cost considerations in safety-related rulemakings has become less clear in the wake of a 1991 U.S. Court of Appeals (DC Circuit) opinion, related to challenges to OSHA's 1989 Hazardous Energy Sources ("lock out/tag out") rulemaking, where questions about the breadth of OSHA's discretion in safety rulemakings were raised and the agency was asked to consider more explicitly incorporating benefit-cost balancing procedure in this type of regulatory action. The court expressed concern that the agency's existing basis for setting safety standards (chiefly, findings of "significant risk" and feasibility demonstrations—just as for health standards) provided unreasonably broad discretion, which, in the absence of systematic benefit-cost balancing, could yield very costly but minimally protective compliance requirements.[20] On this basis, OSHA's prevailing interpretation of

[18] A useful primer on the benefit-cost concept and associated analytical methods is E. Stokey and R. Zeckhauser, *A Primer on Policy Analysis*, New York: W.W. Norton, 1978, pp. 134–158. For a more specific discussion of the approach with regard to OSHA see M. Connerton and M. McCarthy, *Cost-Benefit Analysis and Regulation: Expressway to Reform or Blind Alley?* (Washington, DC: National Policy Exchange, October 1982); P.W. Kolp and W.K. Viscusi, "Uncertainty in Risk Analysis: A Retrospective Assessment of the OSHA Cotton Dust Standard," *Advances in Applied Micro-Economics*, 4: 105–130, 1986; and C.R. Sunstein, "Valuing Life," *The New Republic*, Feb. 15, 1993, especially pp. 38–40.

[19] Since the late 1970s, executive orders have generally mandated preparation of regulatory impact analyses where a cumulative national impact of $100 million or more annually is expected. Some bills in the present "regulatory reform" debate have proposed substantially tightening this threshold—to as low as a $25 million annual effect. However, OSHA has for some time been preparing the regulatory impact analyses as a routine element of the record, regardless of the expected level of economic impact.

[20] See U.S. Court of Appeals (DC Circuit) 1991 decision in *International Union, UAW* v. *OSHA*, 938 F.2d 1310 (particularly pp. 1318–1321).

its section 3(8) procedural requirements (the portion of the OSH Act governing safety standards) was remanded for further consideration—with the suggestion that benefit-cost analysis (although not the only possible approach to "balancing" benefits and costs) provided a means to resolve the problem.

In its subsequent safety rulemakings to date, OSHA has basically affirmed the adequacy of its existing procedures (i.e., significant risk findings, feasibility analysis, documentation capable of withstanding "substantial evidence" review, consideration of all serious comments in the record, and the need to identify cost-effective measures) for meeting the court's concerns and has *not* acted to incorporate more explicit benefit-cost balancing procedures in its rulemaking steps.[21] But it is unclear whether this issue has reached a point of policy stability—and is a matter to which the DC Circuit (or other court, for that matter) could return at some future point.

A second and more encompassing command to revise the role of benefit-cost considerations in OSHA's rulemakings—affecting health and safety standards alike—could come from the "regulatory reform" debate now underway in Congress.[22] Elevating the influence of explicit benefit-cost analyses in safety, health, and environmental regulatory rulemaking generally is a primary consideration in many of the present House and Senate proposals that have been submitted.

The specifics of any such new guidance from the courts or Congress are, of course, speculative at present. Nonetheless, it seems apparent that a mandate for more explicit benefit-cost consideration would press OSHA to deepen its control technology and regulatory analysis procedures in a number of significant respects. First, there would be a strong incentive to seek to quantify a fuller scope of estimated regulatory benefits, including those that are usually itemized now in more qualitative terms (particularly those in the health benefits arena, and the economic benefits accruing to industry as a result of hazard reductions). Second, the logic of the balancing comparison—whatever it proves to be—would no doubt press the agency to seek to more nearly prepare *expected* outcome forecasts of the costs from an intended regulation. This is a substantially more demanding analytical task than that necessary for the prevailing feasibility demonstration test, because the diversity of possible responses among the various establishments in affected industries and the prospect for significant shifts in production technologies (e.g., adoption of regulation-induced product/process innovations, accelerated replacement of plant equipment to use leading-edge technology, substitutions to alternate materials and products) would need to be more carefully considered.

- ***For the most part, OSHA's current feasibility analyses devote little attention to the potential of advanced or emerging technologies to yield technically and economically superior methods for achieving reductions in workplace hazards. Much of this circumstance reflects the procedural priorities of the existing rulemaking process, as well as the nature of the hazard reductions the agency has targeted since the early 1980s. But a good case can be made that a lack of continuing insights on the potential of leading-edge technology hinders the agency in performing its mission.***

[21] See OSHA's statement on this matter in the preamble to the 1994 Electric Power Generation, Transmission, and Distribution safety standard, 59 *Federal Register* 4427–4429, Jan. 31, 1994.

[22] A number of bills affecting almost all health and safety regulatory agencies were introduced in both chambers in the present (104th) Congress. At the time this report is being completed (late summer, 1995), the House has passed a comprehensive regulatory reform measure as part of H.R. 9 (the Job Creation and Wage Enhancement Act of 1995). Among other provisions, this bill mandates that all major rules must demonstrate that the benefits resulting from implementation "justify and [are] reasonably related to" their costs. Extensively documented risk assessments and detailed consideration of regulatory alternatives are also required. In the Senate, several bills, with widely varying provisions, are now under consideration, notably, S. 343 (the "Comprehensive Regulatory Reform Act of 1995). Competing bills include S. 291, S. 333, and S. 1001.

Another substantial criticism of the agency's rulemaking analyses (coming most vigorously from those advocating the aggressive adoption of stringent workplace health and safety protections) is that ordinarily there is too narrow a focus on conventional, well-established control measures—such as increased ventilation, added enclosure of existing machines, and improved housekeeping based on existing technologies and work practices. According to this view, opportunities are missed to harness leading-edge or innovative production technologies (including input substitutions, process redesigns, or product reformulations) to society's collective advantage, and to achieve greater worker protection with technologically and economically superior means.[23] Moreover, a narrow emphasis on only the clearly apparent means of control at the time of a rulemaking can fail to provide a sound basis for estimating the actual burden an affected industry may bear in accommodating compliance provisions at any given level of stringency—because industries (or some of the establishments therein) may be able (and have an incentive) to exploit accessible opportunities for substantial product or process changes to achieve compliance.[24]

OSHA's preoccupation in the course of rulemakings with a "static state" characterization of affected industries and clearly available control measures is widely apparent in the existing standards OTA has reviewed (which consisted, for the most part, of rulemakings in the 1980s and early 1990s). In fairness, OSHA's examinations of "feasible technologies" do sometimes comment on control methods potentially available but not yet adequately demonstrated, and on the implications of potentially emerging technological capabilities. Nevertheless, the vast majority of attention in demonstrating feasibility and estimating the costs and other impacts of compliance is placed on conventional control measures (most often involving retrofits of in-place production equipment) with reasonably well established records of performance.

A good deal of this narrowing of the analytic inquiry reflects the formal procedures and operational pressures of the existing rulemaking process. As discussed in the previous chapter, the agency's considerations of control options and economic impacts enter chiefly as matters of confirming a presumption that the compliance actions necessary to achieve the targeted hazard reduction goal are generally feasible for the affected industries. Given the contentiousness that often marks OSHA's rulemakings, there is obvious strategic value in providing such a demonstration based on actions (engineering controls, work practice modifications, etc.) that are already evident in the affected industry (or in other industries with reasonably analogous processes). This is because concrete documentation of applicability, cost, and hazard reduction efficacy is reasonably likely, and the capacity of the record to withstand later judicial scrutiny is at its strongest.

Of course, a need to examine other possible steps, e.g., measures which do not yet have an established track record or may require further experimental development, arises in the circumstance that these existing, established means are not sufficient to enable attaining the extent of hazard reduction targeted by the agency's

[23] There clearly have been occasions in the past when businesses facing OSHA requirements (with or without "technology forcing" objectives) for more stringent controls responded in ways that relied substantially on process innovations. See, for example, the 1974 Vinyl Chloride standard discussed in the next section. For a broader discussion, see Nicholas A. Ashford, Christine Ayers, and Robert F. Stone, "Using Regulation to Change the Market for Innovation," *Harvard Environmental Law Review*, 9 (2), 419-466, Summer 1985. See also Ruth Ruttenberg, *The Incorporation of Prospective Technological Change into Regulatory Analysis Which is Used in the Planning of Occupational Safety and Health Regulations*, Ph.D. dissertation, University of Pennsylvania, 1981.

[24] For example, in OSHA's 1978 Cotton Dust standard, eroding competitiveness against producers abroad and the need to comply with the more stringent dust control requirements prompted many U.S. cotton textile manufacturers to aggressively modernize their plants; as a result dust control was achieved in a less costly way, and productivity and product quality benefits were reaped at the same time. (This case is discussed later in this chapter.)

"significant risk" findings.[25] But, more generally, the agency's analytic task does not require charting the maximum extent of hazard reduction feasible. And the logic of a feasibility demonstration does not depend on cataloging and ranking all possible means available to establishments to comply (including the use of new technologies that might be superior with appropriate further development) or estimating the share of affected establishments that may choose to respond through means other than those identified in the agency's rulemaking analyses.[26]

Another significant influence on the scope of the control options inquiry is the stringency of the hazard reductions targeted. Critics of OSHA's regulatory priorities, particularly since the early 1980s, observe that the agency has been regulating to risk levels that are *less* protective by one to several orders of magnitude than the targets EPA has used in its environmental regulations covering the public at large.[27] In addition, for much the same period, OSHA appears to have had diminished interest in setting standards involving technology forcing to any significant degree.

Both of these circumstances have contributed to a rulemaking context in which a comparatively narrow discussion of control measures has largely satisfied the prevailing procedural and evidentiary needs. Obviously, the nature of the control measures necessary to invoke in any particular rulemaking is a case-by-case empirical matter. But it seems likely that an agency policy decision to target substantially more stringent hazard reductions or a return to technology-forcing standards—or both—would drive the need for a wider and more explicit consideration of control technology options beyond conventional measures.

Yet even without such shifts in the agency's hazard reduction targets, there are several reasons why the narrow consideration of control options that has prevailed for some time now should be viewed in a critical light.

First, findings of *in*feasibility (due to constraints of a technological and/or economic nature) do arise in rulemakings (particularly in the health standard arena) and have led to the promulgation of compliance provisions that the agency acknowledges are not expected to completely remove significant risk. In such a circumstance, it is only reasonable to question whether the feasibility analysis has been based on too limited a concept of the available control measures. OTA has not, in the course of this study, been able to review all of OSHA's rulemakings in this respect. However, in at least one of the eight existing standards (and perhaps one other) examined in the retrospective case research (see next section), consideration of improvements in technological capabilities that could have been reasonably anticipated might have supported a more stringent standard than was ultimately promulgated.

Second, and equally important, it would seem only common sense that OSHA ought to be a progressive supporter of innovation and the adoption of advanced technologies to the extent that such enhanced capabilities could expand the set of feasible options for improving workplace

[25] As observed in the previous chapter, the courts have long affirmed the agency's authority to establish such "technology forcing" requirements, conditional on acceptable evidence of feasibility.

[26] That such developments should be observed in affected industries' compliance responses is not all that surprising. The agency's provisions involving technology for health standards have long been *performance* based (as opposed to specification based). And the provisions for new and amended safety standards are increasingly moving in this direction. As such, there are no barriers in the compliance requirement (other than the normal generic priority on engineering and work practice controls) that prevent an industry from adopting or inventing a better way to comply, regardless of whether or not such means were discussed in the course of the rulemaking.

[27] See Harvard Center for Risk Analysis, "The Role of Significant Risk in OSHA Reform" *Risk in Perspective* 1(3): August 1993, Harvard School of Public Health, Cambridge, MA. See also, AFL-CIO, Department of Occupational Safety and Health, "The Workplace: America's Forgotten Environment—A Comparison of Protections Under U.S. Workplace Safety and Environmental Laws," Washington, DC, April 1993. The AFL-CIO report (pp. 13–15) notes that with cancer-causing substances, whereas OSHA regulates to a risk level of 1 death per 1,000 workers, EPA regulates to a level somewhere between 1 death per 10,000 to 10,000,000 persons under the Clean Water Act, and 1 death per 10,000 to 1,000,000 under Superfund and the Clean Air Act.

safety and health. There is certainly ample evidence in the record to date that intelligently directed effort can yield hazard control options that provide greater protections at reduced cost, compared with conventional measures—attributes that would, no doubt, enhance the "win-win" (for regulated industries and their workforces) character of OSHA's compliance requirements in many cases and support the achievement of greater hazard reduction.[28] Arguably, some of the agency's attention could usefully be devoted to promoting (e.g., through experimental variances or new technology demonstration projects) the longer-term development and application of hazard reduction measures that are technologically and economically superior.

To play such a supporting role well, however, OSHA needs to have an up-to-date and informed perspective on the nature and relevance of new technological opportunities on the horizon—in the control technology industries and among regulated sectors and their competitors and suppliers. Yet the analyses of control technologies now routinely being performed in the course of rulemakings do not basically provide this function. Indeed, to have real impact, such knowledge will no doubt need to be available and salient before the terms of the standard-setting "contest" among the stakeholders become too solidified.

Lessons from the Retrospective Case Studies

For eight of OSHA's past rulemakings, OTA collected data on the post-promulgation outcomes in affected industries. Five health standards were considered in this way: Vinyl Chloride (1974), Cotton Dust (1978), Occupational Lead (1978), Ethylene Oxide (1984), and Formaldehyde (1987). Three safety standards were similarly examined: Grain Handling Facilities (1987), Mechanical Power Presses (1988), and Powered Platforms (1989). This effort was designed to examine the nature of the match between the rulemaking estimates of compliance response, costs, and other impacts with the corresponding actual outcomes, and to gain a further basis for appraising the analytic efforts supporting the agency's rulemakings.[29]

[28] See N.A. Ashford and G.R. Heaton Jr., "Regulation and Technological Innovation in the Chemical Industry" *Law and Contemporary Problems* 46:109–157 (1983). See also N.A. Ashford, C. Ayers, and R.F. Stone, "Using Regulation to Change the Market for Innovation," *Harvard Environmental Law Review* 9 (2), 419–466, Summer 1985.

[29] To stretch the modest resources OTA had for this project, credible, already published case studies were used were possible. This practice accounts for the Vinyl Chloride, Cotton Dust, and Ethylene Oxide standards in the case study set. (The Vinyl Chloride and Cotton Dust standards are also widely considered "classic cases" in OSHA's rulemaking history.) Original research efforts by qualified researchers (see citations in Appendix B) were commissioned in the other five cases. The Occupational Lead, Formaldehyde, and Grain Handling Facilities standards were included because of their controversial nature and prominent roles in OSHA's rulemaking history in the 1980s. The Mechanical Power Presses and Powered Platforms rulemakings were selected more or less at random from among the full group of safety standards promulgated by OSHA after 1985.

The essential regulatory elements of these eight standards are presented in table 3-1. Tables 3-2 and 3-3 summarize the comparative information (estimated vs. actual post-promulgation outcomes), with particular attention to the nature of the industry's compliance response and the economic impacts.[30] In some cases, to make the research feasible within OTA's resources for the study, the comparisons were focused on a limited number of affected industries. (An expanded summary for each of the cases appears in appendix A of this report. More detailed reviews of the rulemaking histories, analytical estimates, and outcome findings are provided in a comprehensive project working paper and in the individual case study research reports—see citations in appendix B.)

The eight cases OTA examined reflect a preponderance of rulemakings among the more controversial and challenging in OSHA's history. The sample is also a relatively small fraction of all the standards and all the industries covered by OSHA's rulemakings to date. Nonetheless, OTA believes that, as a whole, the set of cases considered reasonably illustrates the analytical challenges the agency has faced, and now faces, in promulgating health and safety standards.

[30] Each of the case studies provides an indication of the apparent change in targeted hazard levels realized in the post-promulgation period. However, the (important) issue of the benefits derived from regulation was not a principal topic for this study, and has not been addressed to any substantial detail.

TABLE 3-1: Features of the Case Study Standards Considered by OTA's Retrospective Evaluations

Standard	Principal features
Health rules	
Vinyl Chloride	■ Promulgated in October 1974. Among other provisions, the action reduced the prevailing time-weighted average exposure over an 8-hour workshift (TWA8) permissible exposure limit (PEL) from 500 parts per million (ppm) to 1 ppm. The case study considered both of the principally affected industries—vinyl chloride monomer synthesis and polyvinylchloride polymerization. ■ Although conducted in what is now an "earlier era" of OSHA's rulemaking, the Vinyl Chloride standard is widely remembered for the steepness of the reduction in exposure required, the difficulty that compliance was perceived to pose for key affected industries, and the agency's reliance on a "technology-forcing" PEL.
Cotton Dust	■ Promulgated in June 1978. In addition to other provisions, the action tightened the existing TWA8 PEL from 1,000 micrograms per cubic meter (g/m^3) to 200 µg/m3 for yarn manufacturing operations, 750 µg/m3 for slashing and weaving, and 500 µg/m3 for other operations where airborne cotton dust was generated. The case study examined the textile manufacturing sector—the half-dozen or so industries principally affected by the rulemaking. ■ Cotton Dust also is widely remembered because of the widespread fears of "high and burdensome compliance costs" and the sizable role that plant modernization played in the affected industries' eventual compliance response.
Lead—Occupational Exposures	■ Promulgated in November 1978. The existing TWA8 PEL was tightened from 200 $\mu g/m^3$ to 50 $\mu g/m^3$, in addition to various other provisions. The case study focused on the secondary smelting industry—one of the more than three dozen industries affected by the standard, and one of the few that had high existing exposure levels and was expected to have to make major changes in existing process equipment for compliance. ■ Lead exposures, which were (and remain today) widely regarded as a serious health concern, have been the subject of a long-running series of rulemakings by OSHA (and by EPA, with respect to environmental sources of exposures). The case study focused on one of the sectors where the feasibility of control was particularly challenging and controversial.
Ethylene Oxide	■ Promulgated in June 1984. Among other provisions, the existing TWA8 PEL was reduced from 50 ppm to 1 ppm. The case study examined hospitals—one of a half dozen industries identified as affected, and the sector in which the vast majority of directly exposed employees existed. ■ The EtO rulemaking is illustrative of the substance and approach of the agency's rulemakings in the first half of the 1980s that dealt with suspected carcinogens.
Formaldehyde	■ Promulgated in December 1987. The action tightened the existing TWA8 PEL from 3 ppm to 1 ppm, among other provisions. (Note: OSHA amended the PEL to 0.75 ppm on May 27, 1992. The case discussed here, however, considered only the 1987 action.) The study focused on metal foundries—one of more than three dozen industries or industry groups identified as affected, and the industry with a large number of workers with existing exposures above 1 ppm and compliance costs that were expected to be high. ■ Formaldehyde proved a particularly controversial rulemaking, but otherwise is illustrative of the substance and approach of the agency's rulemakings on suspected carcinogens in the mid- to later 1980s.

(continued)

TABLE 3-1: Features of the Case Study Standards Considered by OTA's Retrospective Evaluations (Cont'd.)

Standard	Principal features
Safety rules	
Grain Handling Facilities	■ Promulgated in December 1987. Along with more than a dozen other provisions, all grain elevator and grain mill facilities were required to develop and implement housekeeping plans to reduce dust emissions and to provide for the periodic removal of accumulated dust. The case study considered all the principally affected industries. ■ The rulemaking sought a wide range of improvements in equipment, work practices, and safety procedures to deal with a sharply rising incidence of destructive fires and explosions at grain-handling facilities. The action was quite controversial in respect to its anticipated economics.
Mechanical Power Presses	■ Promulgated in March 1988. The action amended the existing standard to allow voluntary adoption of an electronic presence-sensing device (instead of operators who manually moved a switch) to actuate power press strokes. Various other provisions to ensure the maintenance of safe conditions for use also were specified. The case study considered all the principally affected industries, which were widely spread across the manufacturing sector. ■ The rulemaking sought to relax an existing constraint, with the expectation of substantial economic benefits to industry and improvements in workplace safety. The rulemaking contained some (at the time) novel procedures intended to ensure the continuing maintenance of safe conditions for power press operations (particularly certification/validation by a qualified and independent outside organization of the engineering design, installation, and ongoing operational adequacy of the mechanical and control systems involved).
Powered Platforms for Building Maintenance	■ Promulgated in July 1989. The action widened the acceptable technologies for the horizontal stabilization of work platforms for maintenance activities on high-rise buildings and specified other provisions concerning the performance capabilities of the equipment used and the work practices employed. The case study considered all the principally affected industries, which chiefly included high-rise building owners/developers and the establishments providing various building maintenance services. ■ The rulemaking sought to accommodate the ongoing changes in the high-rise building designs with the need to ensure that safe conditions were maintained at building service sites. Generally, the rulemaking and the resulting compliance provisions are illustrative of the substance and approach of the agency's safety rulemakings in the later 1980s.

TABLE 3-2: OSHA's Rulemaking Estimates vs. Actual Outcomes

Content of Affected Industries' Compliance Response

Vinyl Chloride

- Promulgated in 1974
- Industries examined: vinyl chloride synthesis and polyvinyl chloride polymerization

In contrast to industry's vigorous contrary arguments during the rulemaking, full compliance was achieved handily within 18 months after the standard was enacted. Most of the actions implemented to reduce exposure levels were those anticipated by OSHA during the rulemaking—including reducing leaks and fugitive emissions, improved ventilation systems, modified reactor designs and chemistry, and process automation. A significant production improvement not foreseen, however, was the proprietary "stripping" process commercialized within a year of promulgation, which provided a substantially improved means for producing PVC resin while reducing vinyl chloride exposures.

Cotton Dust

- Promulgated in 1978
- Industries examined: focus on textile manufacturing sector

Most all of the engineering controls envisaged by OSHA throughout the rulemaking as central for reducing dust levels played a role in achieving compliance: retrofits of existing production machinery, such as expanded enclosure, added local exhaust ventilation, enhanced general ventilation and filtration. But this group of measures missed the sizable extent to which dust control was achieved as a by-product of an aggressive drive to rapidly modernize the industry's production base. The industry's existing, older equipment was either rebuilt with modern functions or replaced outright with modern equipment—all of which enabled improved production speeds, consolidation of operations, more effective use of floor space, reduced labor, and better product quality, along with lower dust levels.

Occupational Lead Exposures

- Promulgated in 1978
- Industries examined: focus on secondary smelting

To date (early 1994), the secondary smelting industry's compliance response has differed considerably from the control concept on which OSHA's promulgation of the standard was based. Most producers have adopted some additional engineering controls (particularly for point and area ventilation, along with increased automation). But the greater emphasis has been on respiratory protection programs (which virtually all producers now use) and improved employee hygiene (protective clothing, change houses, personal hygiene practices). Despite the final rule's mandate, few producers have invested in engineering controls to the full extent anticipated to be needed for PEL compliance. Airborne lead levels in plants, while lower now than in the late 1970s, still remain substantially above the PEL—with decades of further progress needed, given the slow rate of improvement that has prevailed to date. Furthermore, the "new technologies" envisaged at the time of rulemaking for compliance in the blast furnace area of plants have not progressed; the single U.S. secondary smelter using the Bergsoe process went bankrupt in the mid-1980s, and hydrometallurgy still remains "on the horizon." The new capacity coming on line in recent years (which has been substantial since the mid-1980s, particularly in the "integrated" end of the business, where old batteries are broken, smelted, and used to manufacture new units) has all relied on conventional control technologies—although, with closer attention to plant layout, material transfer/handling, and process operability vis-a-vis emission and exposure considerations.

Ethylene Oxide

- Promulgated in 1984
- Industries examined: focus on the hospital sector

In the main, the compliance steps taken by hospitals were well in line with what OSHA emphasized in the rulemaking's feasibility analysis, chiefly, retrofits of both post-cycle evacuation systems and local exhaust devices to the existing stock of sterilizer units, and various straightforward changes in existing work practices. Nonetheless, some hospitals did pursue other courses of action, such as exploiting existing equipment and facilities (e.g., relocating sterilizer equipment to a room with a high rate of ventilation) or constructing entirely new facilities with stringent exposure reduction capabilities. In addition, a sizable proportion of hospitals (including some already in compliance) acted to reduce exposure levels to a point well below the new PEL—the result chiefly of continuing concerns about the health risks of long term, low level ethylene oxide exposures and managers' desires to minimize vulnerability to future tort liability claims. A number of substantial improvements in control technology did emerge after the rulemaking, particularly the integration of control features into new sterilizer units and significantly expanded exposure measurement capabilities. But these advances occurred a good deal later than the main period of the sector's adjustment to the new standard's compliance requirements.

(continued)

TABLE 3-2: OSHA's Rulemaking Estimates vs. Actual Outcomes (Cont'd.)

Formaldehyde

- Promulgated in 1987
- Industries examined: focus on metal foundries

In the course of the rulemaking, OSHA identified a variety of engineering controls already commercially available for reducing exposure levels in the metal foundry industry; these included additional ventilation (fresh air curtains, general dilution ventilation, local ventilation), enclosure (e.g., ladle covers, side baffles, ventilated cooling enclosures), changes in resin and catalyst formulations (to reduce the level of free formaldehyde present in resin binders or released in curing), and isolation of scrap materials. To demonstrate economic feasibility, the agency assumed that compliance would be achieved predominantly through added ventilation and enclosure. But as events turned out, only a few foundries adopted the "ventilate and enclose" strategy. Most opted for low-formaldehyde resins, which were available at the time of the rulemaking, and successively improved in the post-promulgation period.

Grain Handling Facilities

- Promulgated in 1987
- Industries examined: grain elevators and grain mills

Housekeeping activities to clean and remove accumulations of grain dust are now clearly recognized throughout the grain-handling sector as an essential work practice. Pneumatic dust control systems also are widespread, although manual cleaning with brooms is still used and continues to be regarded as an effective method to control dust. Treating grain with edible oils, to reduce dust generation and flammability, also is fairly frequently employed. Office facilities, welding activities, and employee smoking have generally been relocated away from prime dust generation areas. Designs for new elevators and plants now incorporate a range of fire/explosion safety features, but there have been relatively few new facilities constructed in recent years. At the time of the rulemaking, all of these avenues for control were anticipated to result from the compliance provisions of the new standard.

PSDI Power Presses

- Promulgated in 1988
- Industries examined: various in manufacturing sector

Prior to OSHA's rulemaking action, presence-sensing device initiation (PSDI) had already been successfully used on compatible mechanical power presses in Western Europe, where it provided evidence of sizable productivity gains and improvements in workplace safety. Nonetheless, to date (1994), and despite the rulemaking's formal allowance of PSDI operations, there has been little if any U.S. adoption of the technology. As events turned out, one of the safety-related procedural provisions—periodic certification/validation of PSDI power presses and their associated safety equipment by an outside organization—has proved unexpectedly to be a serious impediment to adoption. Also it appears that the market for PSDI is currently being eroded by alternate technology, particularly "quick trip" light curtains with no-touch sensors, which provide safety and productivity improvements and can be adopted without certification/validation by an independent party.

Powered Platforms

- Promulgated in 1989
- Industries examined: high-rise building owners/developers, building maintenance service providers

The amended standard has had the intended effects of widening the options for stabilization methods available to building owners/developers and of increasing the incidence of safe work practices. The overall number of alternate stabilization systems installed to date, however, has been well below OSHA's expectation at promulgation, chiefly because the number of new high-rise buildings constructed has been considerably under the estimate on which the regulatory impact calculations were based.

SOURCE: OTA, drawn from the case study retrospective research findings (see Appendix A).

TABLE 3-3: OSHA's Rulemaking Estimates vs. Actual Outcomes

Economic Impacts of Compliance

Vinyl Chloride

- Promulgated in 1974
- Industries examined: vinyl chloride synthesis and polyvinyl chloride polymerization industries

In promulgating the final rule, OSHA did not provide its own estimate of the compliance costs for affected industries. The most credible figures put forth at the time were those of the agency's technical consultant, which estimated total costs at around $1 billion (1974 dollars), including capital expenses for new equipment, replacement of lost capacity, and incremental operating expenses. According to the post-promulgation survey of industry members, however, actual spending amounted to only about a quarter of this estimate, $228 million to $278 million.

Arguments made during the rulemaking debate suggested that the standard would greatly increase business costs and threaten the viability of the vast majority of the establishments in the industries. As events turned out, costs did increase and production capacity was eroded, but only modestly. Furthermore, there was little evidence that the financial status or ability to respond to customer needs in the affected industries had been strained.

Cotton Dust

- Promulgated in 1978
- Industries examined: textile manufacturing

OSHA's estimate in the Final Regulatory Impact Analysis placed the textile manufacturing sector's cost of compliance at $280.3 million annually (1982 dollars, for amortized capital spending, incremental operations and maintenance, and other new spending). However, actual spending is estimated to have been only about a third of this amount, $82.8 annually (also 1982 dollars), chiefly because of the advantageous economics of the plant modernization push that was widely undertaken across the sector.

Concern was expressed in the rulemaking that smaller textile firms could encounter substantial constraints in raising capital for compliance-related improvements, and that the standard would tilt the sector's competitive center toward newer and more modern plants. (Neither of these circumstances, however, was considered large enough to warrant a "thumbs down" economic feasibility judgment for the industry as a whole.) Also, control equipment suppliers argued during the rulemaking that serious bottlenecks would arise in trying to retrofit the industry's equipment in short order. Nonetheless, the actual effects in all these respects proved to be modest and generally bearable.

Occupational Lead Exposures

- Promulgated in 1978
- Industries examined: focus on secondary smelting

At promulgation OSHA did not provide a specific cost estimate for compliance with the 50 g/m^3 PEL—indicating that "the industry face[d] several options for long-run compliance." OSHA did, however, outline an outer bound of about $91 million (1976 dollars) in total capital spending, based on a complete rebuilding of the industry using the Bergsoe smelter technology (then considered to be the most cost-effective option). In an early 1980s revision of the estimates, OSHA placed the cost of PEL compliance at a capital requirement of $125 million (1982 dollars), or 1.3 cents annually per pound of production ($150 million and 1.6 cents/lb, respectively, in 1992 dollars). Nevertheless, the industry's actual spending to date (through early 1994) has been far below these levels. Cumulative capital investment appears to total no more than $20 million (1992 dollars), and some of this overlaps with expenditures to meet the various environmental requirements to which the industry has also been subject. Annual compliance spending appears to be averaging 0.5 cent/lb to 1.0 cent/lb (1992 dollars), and perhaps as low as 0.3 cent/lb, i.e. well below OSHA's expectations at the time of the rulemaking and largely reflective of the industry's strategy of minimizing expenditures on engineering controls and relying much more heavily on respirator and hygiene programs to reduce exposures.

The real price of lead dropped sharply and unexpectedly after 1979, not returning to a similar level until late in the 1980s. Numerous smaller, independent smelters, that had limited financial resources and faced the combined effects of increased costs for both EPA regulations (emission controls and liabilities for future cleanups) and OSHA requirements, elected to exit the industry. The remaining producers benefited from increased use of capacity but had to aggressively trim labor costs and improve productivity to compensate for the upward cost pressures. Today the industry is smaller, and, indeed, the most productive in the highly competitive global market. At the time of the rulemaking, OSHA acknowledged the limited extent to which most secondary smelters could pass on new compliance costs and correctly judged that some consolidation would occur after promulgation, as producers with high marginal costs exited the industry. But OSHA did not anticipate the steep drop in lead prices that occurred. It now appears likely that the industry's consolidation would have been a good deal more severe had the level of compliance spending the agency estimated at promulgation proved to be nearer the actual circumstance. *(continued)*

TABLE 3-3: OSHA's Rulemaking Estimates vs. Actual Outcomes (Cont'd.)

Ethylene Oxide

- Promulgated in 1984
- Industries examined: focus on the hospital sector

OSHA's final estimates placed the sector's total compliance costs at $23.7 million annually (1982 dollars), $12.5 million of which related to amortized capital spending for the necessary control equipment. Available field evidence suggests that OSHA's estimated unit cost figures for the presumed control technologies were reasonably accurate. However, the sector's actual overall spending appears to have at least modestly exceeded the agency's estimate, because of some spending on modifications to existing ventilation systems not anticipated in the rulemaking estimate and many hospitals acted to reduce exposures to a level substantially below the promulgated PEL.

There was little concern at the time of the rulemaking that the standard would entail substantial financial or economic consequences for the industry or the national economy, because average spending for compliance per hospital was estimated to total no more than $1,500 to $3,500 annually. There is no evidence that the outcome differed from these expectations.

Formaldehyde

- Promulgated in 1987
- Industries examined: focus on metal foundries

OSHA's final estimate placed the industry's compliance costs at $11.4 million annually (1987 dollars). (Cost savings of $1.7 million annually from avoided medical expenses also were identified.) Actual spending appears to have been about half this level, $6.0 million annually. Part of this result reflected the industry's adoption of low-formaldehyde resins (which avoided the need for major new capital expenses) rather than added ventilation and enclosure. But in some important components of the cost calculations (particularly the improvements to ventilation systems that some companies installed to achieve compliance), OSHA's rulemaking figures substantially *underestimated* the actual spending.

The industry continued to consolidate in the second half of the 1980s, with the number of establishments in the business declining rather quickly. There is no evidence, however, that more than a few foundries closed as a consequence of the more stringent control of formaldehyde. This finding vindicates the basic accuracy of OSHA's feasibility determinations and rebuts the arguments that the industry made during the rulemaking.

Grain Handling Facilities

- Promulgated in 1987
- Industries examined: grain elevators and grain mills

OSHA estimated the sector's total compliance costs in the range of $41.4 million to $68.8 million annually (1985 dollars; spanning the incremental need for equipment and actions across the 13 separate provisions) and avoided property losses at $35.4 million annually (as compliance reduced the number of facility explosions and serious fires). These calculations yielded an estimated net cost of compliance in the range of $5.9 million to $33.4 million annually. The agency went on to monetize the expected benefits from reduced employee injuries and deaths at $75.5 million annually, which, from a societal perspective, more than balanced the new costs imposed on the affected industries. Unhappily, the case study was not able to derive enough information from the field to directly check these estimates—an unfortunate circumstance, because these figures were intensely debated in the course of the rulemaking.

Now that nearly five years have passed since full compliance with the terms of the 1987 standard was mandated, the evidence is that few if any facilities have ceased operation as a result of the standard—an outcome contrary to the economic impact estimates the industry submitted to the rulemaking. (The sector has, however, been subject to substantial economic pressures over this period for reasons not related to OSHA actions.)

PSDI Power Presses

- Promulgated in 1988
- Industries examined: various in the manufacturing sector

OSHA's final estimate projected the total cost of adopting PSDI (among both existing and new power presses) at $49 million to $77 million annually (1984 dollars; for equipment modifications or enhancements and compliance with the other provisions of the standard, including for the various certifications and validations). Cost savings from productivity improvements were estimated at about $182 million annually, i.e. substantially greater than the new costs. However, little has happened thus far in the industry to allow an evaluation of these estimates, except, of course, that OSHA (and most of the other parties to the rulemaking) failed to foresee the unfavorable economics of the independent party certification/validation role in the "later 1980s and on" world. *(continued)*

TABLE 3-3: OSHA's Rulemaking Estimates vs. Actual Outcomes (Cont'd.)

Powered Platforms

- Promulgated in 1989
- Industries examined: high-rise building owners/developers, building maintenance service providers

OSHA's final regulatory analysis estimates placed the total incremental costs of the amended standard at somewhat over $1.4 million annually (1987 dollars, including the various incremental expenses for both building owners and contractors). However, the greater flexibility in choice of stabilization system conferred an estimated cost savings to building owners/developers of about $3.1 million annually. Thus adoption of the standard was projected to provide direct cost savings of around $1.7 million annually.

With one significant exception, the case study research largely confirmed the reasonableness of most of the unit compliance cost figures OSHA used in the regulatory analysis calculations—the exception being a considerable underestimate of the cost of one of the several competing stabilization systems on one of the trio of principal building materials in the marketplace. A more significant disparity, however, is the unexpected slowdown in new high-rise building construction, with the actual annual pace since the beginning of the 1990s only 20 to 40 percent of the rate OSHA expected. To date, the overall *net savings* appear to have been substantially lower than expected—$600,000 annually, assuming the higher side of the range in the pace of new building construction, or perhaps even a *net cost* of $400,000 annually, assuming the lower side of the range.

During the rulemaking, industry expressed concern that some erosion of productivity could accompany the widespread use of the stabilization system particularly favored by the amended standard (the intermittent tie-in system), although OSHA's analyses did not conclude this effect would be significant. The outcomes thus far have generally confirmed the agency's expectation on this matter.

SOURCE: Office of Technology Assessment, drawn from the case study retrospective research findings (see appendix A).

- ***Straightforward comparisons of the industry response and regulatory impact circumstances that have actually occurred with those projected by OSHA in promulgating standards exhibit both "hits" and "misses." But almost all of the cases contain at least some significant disparities.***

The case study comparisons indicate that OSHA's rulemaking analyses have reasonably grasped many of the essential features of the affected industries and the principal issues posed by compliance with a new standard. In addition, the hazard control measures receiving primary attention in rulemakings did, in most cases, play a role in the compliance actions actually taken. At the same time, it is clear that one or more significant disparities were present in almost all of the eight standards examined.

These disparities are tabulated together in table 3-4. As is apparent, they stem from different sources:

- unexpected discontinuities in the business environment affecting the content of compliance adjustments,
- failure to correctly anticipate the predominant compliance responses of affected industries,
- deliberate conservatism in assumptions about the control technology (also yielding an incorrect estimate of the actual compliance responses),
- misjudgment of affected industries' ability to adjust to more stringent compliance requirements, and
- significant errors in measuring key parameters.

The limitations in the 1988 Mechanical Power Presses and 1989 Powered Platforms rulemakings arose chiefly from discontinuities that OSHA did not anticipate in the operating environments of the affected industries. The problem appears to have been avoidable in the former case, but probably not in the latter. (As discussed further below, an unexpected change in a key economic variable, beyond the control of the affected industry, was also a consideration in the 1978 Occupational Lead standard.)

TABLE 3-4: OSHA's Rulemaking Estimates vs. Actual Outcomes

Major Disparities Apparent in Direct Comparisons

	Significant features of industry compliance adjustment not accurately anticipated
Vinyl Chloride (all principally affected sectors)	■ Actual compliance spending totaled about a quarter of the rulemaking's most credible estimate (but, in the flow of events back then, these figures were not officially put forward by OSHA). ■ The industry compliance response included significant unanticipated process innovations. ■ Compliance proved considerably easier for the principally affected industries than the rulemaking debate implied.
Cotton Dust (all principally affected sectors)	■ Actual industry compliance spending amounted to about a third of OSHA's final estimate. ■ A major reason for the overestimate of costs was a failure to anticipate the textile industry's aggressive retooling with modern production equipment.
Occupational Lead Exposures (secondary smelters)	■ The industry's control response to date has differed considerably from the rulemaking's expectations: only a small fraction of the engineering controls mandated by PEL compliance has occurred. ■ The expected "new technologies" for control—one basis for the "technology forcing" nature of the standard—have generally not panned out commercially. ■ Compliance spending to date has been well below the rulemaking's expectation, but not surprisingly so, given the very slow pace of adoption of engineering controls.
Ethylene Oxide (hospitals)	■ Unit costs of the principal engineering controls were, for the most part, correctly gauged—although the spending on general ventilation system improvements was more than what OSHA had estimated. But overall industry spending appears to have been at least modestly more than projected, because a substantial fraction of the sector acted to reduce exposure levels well below that required by the PEL.
Formaldehyde (metal foundries)	■ Most of the industry achieved compliance by adopting control measures that differed considerably from the rulemaking's conventional "ventilate and enclose" assumptions. ■ Overall actual spending appears to have been about half OSHA's final estimate, but the spending on ventilation system improvements by those companies that made this kind of change was considerably *under*estimated.
Grain Handling Facilities (all affected sectors)	■ No significant disparities exist; much of what OSHA described in the final regulatory analysis concerning the control steps and the economic feasibility of the standard has taken place. (However, insufficient post-promulgation data were available to the case study to fully examine the balance of benefits and costs, which was a particularly controversial aspect of the rulemaking's economic estimates.)
PSDI Power Presses (all affected sectors)	■ The standard's requirement for certification/validation by an independent outside party has unexpectedly proved to be a serious impediment to adoption of the PSDI technology, because of the sizable risk of large liability litigation expenses and a perceived lack of an adequate business opportunity.
Powered Platforms (all affected sectors)	■ The unit cost of one of the key stabilization options appears to have been substantially underestimated. ■ The estimated balance of costs and savings differs substantially from what has occurred to date; the principal source of error is that the pace of new building construction has been well below that assumed by OSHA in the rulemaking.

SOURCE: Office of Technology Assessment, summarized from tables 3-2 and 3-3 earlier, and from Appendix A.

In amending the Mechanical Power Presses standard, OSHA anticipated considerable adoption of the electronic technology for initiating power press stamping cycles (including both retrofits of existing presses and in newly installed machines) in the several years immediately following enactment. This assumption was based on the clear evidence available then that these systems significantly improved manufacturing productivity while maintaining or even enhancing the existing level of workplace safety. The scant adoption of the technology to date appears to have resulted primarily from the limited business viability of the outside ("third") party certification/validation (of the engineering design, installation, and ongoing operational adequacy of the mechanical and control systems involved) mandated by the standard. The analysis underpinning OSHA's feasibility and impact findings for the rulemaking was prepared (by a contractor) in the first half of the 1980s, but was not updated to adjust for the circumstances prevailing nearer the time of the standard's promulgation in 1988. In the mean time, the perceived threat of large liability litigation expenses apparently escalated to the point that the expectations for earnings became too small to entice an independent party to take on the role. This development was not anticipated by OSHA at the time of the rulemaking, nor for that matter by the many parties providing testimony and comments to the rulemaking record. However, it now seems likely that had the agency re-examined the feasibility of the provision nearer the time of promulgation, the prospect of a serious constraint would have been apparent.

In the Powered Platforms rulemaking, OSHA correctly gauged the intrinsic feasibility of the amendments (which expanded the options available to building developers/owners for horizontal stabilization of operating platforms, and mandated the adoption of additional safety-related equipment and procedures). However, OSHA's assumptions in the course of the rulemaking considerably overestimated the pace of construction of new high-rise commercial buildings. As the calculations worked out, this rate was a critical determinant of the overall balance of benefits and costs (building owners/developers and building maintenance suppliers combined) to result from compliance with the standard. Here again, the economic analysis published by the agency with the promulgated standard in 1989 derived largely from an analysis prepared a number of years earlier (in 1983). Nevertheless, even a reworking of this analysis in 1988 probably would not have more accurately forecast this parameter—as many capable analysts of the real estate, construction, and financial sectors of the national economy failed to predict the sharp downturn in commercial building construction beginning late in the 1980s.

A second generic source of the disparities evident across the cases involves incorrectly anticipating the control response choices of affected industries. This circumstance accounts for much of the outcome observed in the 1984 Ethylene Oxide standard.

OSHA's analyses for this rulemaking correctly gauged the feasibility of the tightened PEL and other compliance requirements and correctly anticipated most of the specific characteristics (engineering controls, work practice changes, and their unit costs) of the control measures implemented. Yet hospitals' overall spending for control appears to have at least modestly exceeded OSHA's final estimate in the rulemaking. A chief source of this disparity was the decision by a substantial proportion of hospitals to install equipment and make other changes to achieve exposure levels substantially more stringent than what the new standard required. Despite the considerable lowering of the PEL, concerns about the possible adverse effects of chronic low-level ethylene oxide exposures remained salient. Concomitantly, even with compliance with the new OSHA standard, some hospital managers perceived the need to take aggressive steps to reduce vulnerability to future tort liability claims. Looking back, it is not difficult to see that some hospitals had an incentive to undertake such action. Nonetheless, this kind of outcome is not a circumstance for which a typical regulatory analysis would normally search.

And, for the most part, the costs and benefits involved cannot directly be attributed to the OSHA standard.

A third class of estimation problems on display in the cases relates to the frequent "conservatism" in OSHA's assumptions about the predominant control measures that affected establishments will use to achieve compliance (see discussion earlier in this chapter, and also in chapter 2, box 2-3). Most of the disparities between the rulemaking estimates and actual outcomes in the 1978 Cotton Dust and 1987 Formaldehyde standards are explained by this circumstance.

In each of these cases, the affected industries achieved compliance through adopting control measures that differed considerably from those that OSHA's rulemaking analyses presumed in confirming feasibility. Substantial measurement errors were present in both cases—a large understatement of the spending on ventilation controls (in the companies where they were implemented) in Formaldehyde and a sizable overstatement of the number of exposed employees in Cotton Dust (with the errors in each case mainly attributable to insufficient breadth in the field data collection effort). Nonetheless, most of the overestimates of actual overall compliance spending in both rulemakings arose from the alternate paths the industries followed to achieve compliance: the textile manufacturing industry's aggressive plant modernization, and the metal foundry sector's shift to low-formaldehyde resins. In fact, the control actions actually adopted were clearly identified in the agency's discussion of control options (and were the subject of testimony during the hearings). OSHA elected in both cases, however, to base its analytical findings and estimates on conventional control measures (but which, in fairness, under the circumstances then prevailing, were clearly relevant options for the hazard control problems at hand).

Misjudgment of affected industries' capabilities to adapt to new compliance requirements is another generic source of the disparities apparent in the cases. This was the case with the 1974 Vinyl Chloride rulemaking and perhaps also with the 1978 Occupational Lead standard.

In the Vinyl Chloride rulemaking, OSHA policymakers pegged the intrinsic feasibility of the vastly tightened PEL better than is often appreciated. The rulemaking was conducted early in OSHA's history, and the agency did not present its own technology assessment or compliance cost estimates in the course of the policy debate. The estimates that proved most erroneous were those submitted by OSHA's consultant and by representatives of the principally affected industries—both of which were submitted to the record after the hearings and not subjected to substantial public review. Against this counsel, OSHA policymakers concluded that the standard was in all likelihood feasible—which subsequent events unequivocally confirmed. To be sure, some significant features of the industries' compliance responses were not anticipated, particularly the commercialization of the innovative "stripping" process for PVC synthesis. Nonetheless, much of the post-promulgation reduction in exposure levels occurred through the widespread adoption of steps that had been identified in the course of the rulemaking.

What OSHA did not gauge well was the relative ease with which the affected industries could comply; compliance took about 18 months, in sharp contrast to the seven years liberally provided in the final rule to accommodate the "expected difficulties" of the industry to fully adopt the necessary engineering controls. The rulemaking's lack of a more independent analysis and of substantial outside review (procedural problems the agency has subsequently addressed) no doubt made OSHA vulnerable to the industry's representations at the time about "the difficulties" of compliance. Nonetheless, there was no real field evidence available then showing how industry plants could achieve the PEL, and it is not clear that this miscalculation could have been straightforwardly remedied at the time.

OTA's examination of the 1978 Occupational Lead standard focused on an industry sector (secondary smelting) where compliance was particu-

larly challenging (given the relatively high level of existing exposures, the substantial extent of process and work practice changes required, and the highly competitive nature of the industry). The PEL and associated mandate for compliance chiefly through engineering controls were recognized to be technology forcing—but for which OSHA sought to compensate with a relatively long time allowance for compliance, five years.

To date, comparatively few of the engineering controls expected—and, in fact, commanded—by the 1978 standard have been adopted. The level of lead in workers' blood has come down markedly since the late 1970s, the result of both a systemic reduction in environmental lead levels (driven by various EPA standards) and the adoption by secondary smelters of OSHA-mandated controls such as protective clothing, respirators, and measures enabling improved personal hygiene. Nevertheless, airborne levels of lead in the industry's workplaces still remain quite high relative to the promulgated PEL, reflecting the very slow rate of progress in adopting engineering controls.

OSHA recognized at the time of the rulemaking that PEL compliance based on engineering controls would be a challenge for the secondary smelters sector (particularly in blast furnace areas). Also, the agency's field enforcement of the standard to date has been "complex"—pressing for exposure improvements on a case-by-case basis, but apparently tolerant of the difficulties encountered in adopting engineering controls to the full extent literally specified by the standard.

Still, there is little in the record to suggest that OSHA's feasibility analysis in the rulemaking sufficiently appreciated the implications of the largely *simultaneous* compliance burden imposed by the OSHA standard and the aforementioned EPA regulations. Moreover, the unexpected steep drop in the market price for lead (which remained depressed throughout much of the 1980s) made the kind of spending on engineering controls anticipated by the rulemaking for PEL compliance all the more difficult. Furthermore, the expected "new technology" that provided part of the rationale for the "technology forcing" character of the standard proved evanescent—the single U.S. secondary smelter using the Bergsoe process went bankrupt in the mid-1980s, and hydrometallurgy still remains "on the horizon" (much as it was characterized in the late 1970s).

Knowledgeable observers disagree in their appraisal of the adequacy of the rulemaking's feasibility analysis for the secondary smelters sector. Clearly, the outcomes to date differ from the rulemaking's expectations in significant respects. The rulemaking's analysis appears to have understated the challenge that compliance would pose for this sector. Yet the large and sustained drop in the market price of lead was obviously an influential and largely unexpected factor in this difficulty.

- ***Nonetheless, if the cases examined are judged on the basis of the accuracy with which feasibility was determined, OSHA's rulemaking estimates appear in a more favorable light.***

As already discussed, OSHA currently conducts its rulemaking examinations of control technology and regulatory impacts chiefly to demonstrate that the provisions of an intended standard are generally feasible, both technologically and economically, for affected industries. Hence examining whether or not feasibility was correctly judged and whether the analytical foundation was adequate to withstand judicial scrutiny arise naturally as criteria for evaluative comparisons.

As table 3-5 summarizes, OSHA correctly judged technological feasibility in seven of the eight cases examined. A similar scoring of economic feasibility showed six correct judgments out of the eight cases examined. Furthermore, in all four of the cases subsequently challenged in court, OSHA's promulgation determinations were affirmed.

TABLE 3-5: OSHA's Rulemaking Estimates vs. Actual Outcomes

Accuracy When Estimates Are Judged as Feasibility Determinations

	Did OSHA correctly judge the technical feasibility of final rule?	Did OSHA correctly judge the economic feasibility of final rule?	Did OSHA's rationale and evidence withstand subsequent judicial review?
Vinyl Chloride (all significantly affected sectors)	Yes	Yes	Yes
Cotton Dust (all significantly affected sectors)	Yes	Yes	Yes
Occupational Lead Exposures (secondary smelters)	Unclear—the events to date confirm the agency's rulemaking expectations in some aspects but not in others	Unclear—but as events have unfolded, costs seem to have been a more serious burden in some respects than expected	Yes
Ethylene Oxide (hospitals)	Yes	Yes	Not challenged
Formaldehyde (metal foundries)	Yes	Yes	Not challenged (at least, not on feasibility grounds)
Grain Handling Facilities (all significantly affected sectors)	Yes	Yes	Yes
PSDI Power Presses (all significantly affected sectors)	Yes	No—but only because of one very significant oversight	Not challenged
Powered Platforms (all significantly affected sectors)	Yes	Yes	Not challenged

SOURCE: Office of Technology Assessment, drawn from tables 3-2 and 3-3 earlier, and from Appendix A.

NOTE: In rulemakings, OSHA is obligated to provide evidence that an intended standard is generally feasible (both technologically and economically) for the establishments in an affected industry to successfully undertake (see Chapter 2, box 2-1). In this chart, a "yes" rating indicates that OSHA's final estimates provided a favorable appraisal of feasibility at promulgation and the post-promulgation evidence indicates that the industry predominantly did successfully adjust to the compliance requirements.

The exceptions are obviously few. As indicated earlier, the erroneous economic feasibility determination regarding the 1988 amendment to the Mechanical Power Presses standard stemmed principally from an unexpected discontinuity in one key aspect of the business environment. However, it appears likely this oversight could have been avoided if portions of the analysis had been more up-to-date. The verdict on the feasibility judgment in the 1978 Occupational Lead standard is less conclusive (and, perhaps, less representative), because the rulemaking was atypically complex both in the making and in the subsequent implementation.

Some further comment is needed, however, on matters beyond what is directly apparent in the table. In three of the cases—the 1978 Cotton Dust, the 1984 Ethylene Oxide, and the 1987 Grain Handling Facilities standards—there was substantial debate in the course of the rulemaking regarding the feasibility of control requirements more stringent than what the promulgated rule finally contained.

In the Cotton Dust rulemaking, some stakeholders argued for a substantially more stringent PEL (100 $\mu g/m^3$, rather than the 200 $\mu g/m^3$ established) in yarn-manufacturing operations (the earlier and dustier stages of production). OSHA

recognized that some plants had indeed achieved the more stringent exposure limit in some operations. The agency concluded, however, that there was no evidence that such a PEL could be realized consistent with the "most plants, most operations, most of the time" threshold normally employed in setting standards—and, on this basis, rejected the 100 $\mu g/m^3$ PEL as technologically infeasible.

The available post-promulgation evidence is generally regarded to confirm OSHA's rulemaking judgment on this matter. The retrospective research conducted in the early 1980s (several years after the standard took effect), which examined the textile industry's ongoing adjustment to the standard, could not find evidence that new control capabilities had become available in the interlude that would have made a substantially tighter PEL widely achievable.

In both the Ethylene Oxide and Grain Handling Facilities rulemakings, OSHA acknowledged that the compliance requirements that were promulgated did not fully remove significant risk, because of feasibility constraints. OSHA's rulemaking judgment in Ethylene Oxide was narrowly accurate at the time, but was eroded by improvements in (exposure measurement) technology comparatively shortly after the standard's enactment. In Grain Handling Facilities, political influences abruptly truncated the policy options considered, and the limit of control feasibility was only preliminarily examined, despite the continued existence of a substantial safety risk. Both of these circumstances illuminate policymaking weaknesses that are intrinsic to the agency's feasibility analysis procedures—and are discussed at greater length later.

- ***A number of larger lessons are suggested by these comparative findings:***

Based on the cases examined here, OSHA's rulemakings are not generally imposing an unworkable compliance burden on industry. In six of the eight cases considered (Vinyl Chloride, Cotton Dust, Occupational Lead, Ethylene Oxide, Formaldehyde, and Grain Handling), industry stakeholders and their representatives argued in the course of the rulemaking (modestly to vigorously, depending on the case) that compliance would pose unworkable problems. The stated reasons included such arguments as the requirements were not technologically feasible; were likely to impose unworkable production cost increases; were likely to force many establishments out of business or unhinge the competitive structure of the industry; or were likely to impose a significant inflation penalty on the national economy.

For the most part, the post-promulgation reality observed in this project's case study standards proved much the opposite of these representations.[31] In almost all these cases (the Occupational Lead standard excepted), the industries that were most affected achieved compliance straightforwardly, and largely avoided the destructive economic effects invoked by their rulemaking arguments. Very few companies left the industry chiefly because of the new compliance requirements. And, in a good many of the cases, the actual cost burden of compliance proved considerably less than OSHA's final estimate—about one-quarter the estimate in Vinyl Chloride, one-third in Cotton Dust, and one-half in Formaldehyde (metal foundries).

Furthermore, in half of the eight cases examined, the standard stimulated changes in the production technology of affected industries that yielded benefits beyond a means for health and safety hazard compliance. In Vinyl Chloride, several of the principal industry members capitalized on the altered business and regulatory setting to commercialize innovative processes for polyvinylchloride polymerization, which enhanced manufacturing productivity, allowed

[31] Again, given the nature of the selection process employed, it is not appropriate to view the sample of cases examined by this study's retrospective research as necessarily representative of all OSHA's rulemakings to date. Nonetheless, the set of cases oversamples both standards which were anticipated to be comparatively costly and pose difficult control challenges and industries where such concerns were more or less at their worst. Thus, if anything, the general import of this section's findings is all the stronger.

better rationalization of material inputs, largely eliminated the need for manual reactor cleaning (a prime source of high exposures for the workforce), and provided a new source of income to the technology's developers through licensing arrangements. In Cotton Dust, OSHA's mandate for greater dust control, combined with a strong need for more competitive production capacity, drove much of the textile industry to accelerate investments in modern production equipment—this modernization yielded improvements in manufacturing productivity and product quality while providing a more cost-effective means to bring dust levels within the terms of compliance.

In the hospital sector, the considerable concern about occupational Ethylene Oxide exposures triggered by OSHA's rulemaking prompted the eventual development and commercialization of a number of significant improvements in control technology, including substantially improved devices to measure low-level worksite exposures and a new generation of sterilizer units with built-in exposure control functions (at little real increase in cost). In the metal foundries industry, the need to lower formaldehyde exposures in line with OSHA's revised requirements promoted a continuing effort by the industry's principal suppliers to improve both curing processes and the resin and catalyst formulations used. This effort yielded processes with greatly reduced formaldehyde emissions and provided the suppliers with the expertise and products to build successful markets abroad for low-formaldehyde resins, improved foundry processes, and the plants based on them.

Admittedly, however, the experience of the secondary smelting sector's adjustment to the Occupational Lead standard has run much in the opposite direction of these generally favorable circumstances. The "new technology" invoked in the Lead rulemaking has not yet been a serious force. The bare fraction of the anticipated compliance spending that has resulted to date reflects chiefly the slow pace of the industry's investment in the mandated engineering controls. Overall, the compliance challenge appears to have been more difficult than OSHA's feasibility findings in the rulemaking suggested. It can be argued that this standard is atypical of OSHA's rulemakings—because of the highly competitive and economically mature character of the industry, the substantial extent of the controls required, and the "soft" nature of the agency's enforcement effort. Nonetheless, the case makes the point that OSHA's compliance requirements are not always easily dispatched or deftly turned to business advantage.

OSHA's present procedures for estimating compliance responses and the associated economic consequences provide considerable room for actual adjustment outcomes to differ. As already discussed, the methodological and pragmatic features of OSHA's usual analytic approach yield an emphasis on conventional control measures with wide applicability across an affected industry and relatively little attention to the options and incentives that the individual establishments comprising the industry may have to take one or another of the various compliance avenues available. By their nature, OSHA's analyses usually do not seek to explicitly consider the incentives that an industry's companies could have to minimize the economic burden of compliance requirements on the prevailing cost and profit functions by "working smarter." Such actions could include substantial and/or innovative shifts in production processes, via input substitution, process redesign, or product reformulation.

Because the agency's normal assumptions about control measures are usually "conservative" in this way and because the "work smarter" prospect is not normally explicitly accounted in analytic estimates, it is reasonable, in principle, to expect that the actual costs of compliance (for the "average" establishment or the industry in aggregate) will in many cases be somewhat (or even substantially) less than what OSHA's rulemaking estimates imply.[32] And, indeed, such a circumstance is evident in the outcome of several of the cases just reviewed above.

Nonetheless, there is another potentially significant effect also at play in the analysis process. The agency's cost estimates are typically an extended and interrelated series of calculations that depend on characterizations of the process equipment, work practices, and hazard controls in place; the incidence of exposures by job categories; the engineering issues involved in reducing exposures; and the unit costs incurred in making necessary changes. Yet, because of constraints on budget, work calendar, and access to the industry (as discussed in an earlier section), OSHA cannot in many cases reliably estimate all these factors as they are actually distributed across affected industries and must instead move ahead with "working averages" and stylized model plants. Under such conditions, *both* overestimates and underestimates are conceivable outcomes (with corresponding biasing effects on impact calculations). And OTA's case studies provide evidence of such errors in both directions.

These two effects—the often "conservative" assumptions about the control measures adopted and the prospect of errors in the measurement of pertinent industry characteristics—make it reasonably likely that actual outcomes (for the "average" affected establishment or in total across the industry) will differ from OSHA's rulemaking estimates in at least some respects. But, importantly, measurement errors could either offset or add to the "conservative" assumptions bias, thus making it a challenge (in the general case) to fathom in advance the likely overall direction of bias in OSHA's estimates.

Too narrow a concept of the feasible technology can hinder the agency in establishing justifiable health and safety protections. Among the cases OTA considered, the 1984 Ethylene Oxide standard illustrates a shortcoming of the agency's current feasibility analysis procedures that can arise when apparent constraints in available technological capabilities are a critical policymaking determinant and there is not an effort to anticipate reasonably near-term improvements in relevant technologies.

Health concerns and "significant risk" argued for a tighter PEL than the 1 ppm level that was ultimately promulgated. (In the early 1980s, NIOSH had recommended a 0.1 ppm PEL, in light of the seriousness of the potential adverse health effects). The less stringent exposure limit specified by the standard, which OSHA explicitly recognized in issuing the final standard as not removing all significant risk, reflected a binding technological constraint. The exposure detection capabilities of the day were not able to measure ethylene oxide with acceptable reliability at substantially lower levels. However, only a few years (1986/87) after the effective date of the standard, detection methods that removed this constraint had been demonstrated, the result of targeted development efforts by NIOSH scientists and others.

There is little evidence in the record of this rulemaking that the prospect of reasonably near-term improvements in this obviously important capability had been examined. Had this apparently imminent technological development been more directly considered, the argument of those

[32] As discussed earlier in Chapter 2, the controls on which OSHA bases its regulatory impact estimates are normally the least-cost measures among all the controls which can clearly be shown to be feasible for the industry as a whole. Of course, for those establishments perceiving the menu of available control choices as coincident with OSHA's feasible set, it is reasonable (by virtue of being least-cost) to expect OSHA's assumed measures to be the most likely outcome. Nevertheless, the compliance terms of OSHA standards generally do not prevent an establishment from exploiting opportunities to adopt (or invent) a less costly way of complying.

pushing for a tighter PEL in the course of the rulemaking would, no doubt, have been strengthened.

Feasibility analysis can be short of influence in driving the consideration of competing policy options. Aspects of the rulemaking for the 1987 Grain Handling Facilities standard illustrates the intrinsic weakness of the agency's normal feasibility analysis routine in compelling the examination of risk reduction targets that may merit consideration on objective risk reduction grounds but are hobbled by other considerations.

Between the first consideration of proposals for the grain handling standard (circa 1983) and the coalescence of the content of the final rule (1985-86), the rulemaking shifted, under substantial external pressures (from OMB and, indirectly, from the industries that were principally affected), from seeking to remove "significant risk" to the substantially lesser objective of addressing a level of risk that all parties agreed was unacceptable. Earlier in the rulemaking, the feasibility analysis examined options for risk reduction over a fairly wide range of stringency (particularly with regard to the level of dust buildup that triggered cleanup and removal actions)—from the modest level of hazard reduction finally promulgated, down to a level where removal of "significant risk" began to be engaged.

Shortly after the proposal for the standard was published, strong political influences limited the examination of options chiefly to verifying the feasibility of the (not all that stringent) standard that was ultimately promulgated. OSHA's analyses performed this task acceptably, and indeed faced vigorous criticisms from industry stakeholders over the basis for its findings. But the feasibility analysis routine, by itself, was obviously not able to compel an even-handed, "on the merits" consideration of more stringent policy targets that might also have been feasible.

This case is a useful reminder that the agency's feasibility analysis process is far more a "confirming" exercise, oriented toward showing that a hazard reduction target is generally achievable, and much less an analysis "engine" capable of driving a search for optimal policy across a fairly comprehensive set of options with varying trade-offs. The agency's current feasibility analysis procedures are certainly consistent with the statutory mandates. Nonetheless, the aforementioned circumstances in the grain handling rulemaking point to a shortcoming that would appear to warrant OSHA's further examination, and perhaps some changes in the accepted norms or procedures to assure that the policy analysis effort provides all due support for the agency's overall health and safety mission.[33]

- ***One additional lesson from OTA's case research for this project is that it is surprising how little systematic information on the actual outcomes and impacts of the agency's standards is available.***

OSHA has long operated in one of the most controversial realms of public policy. Given the seemingly unending public debate over the burdens and benefits of health and safety regulations and the likely value in future rulemakings of a sound understanding of past outcomes, it is surprising how little systematic information documenting the actual effects of the agency's standards on regulated industries is available. There is no end of anecdote and speculation, but not nearly enough hard data.

[33] The aforementioned U.S. Court of Appeals decision in 1991, addressing petitioners' challenges to the 1989 Hazardous Energy Sources safety standard (*International Union, UAW* v. *OSHA*) provides some useful commentary on this apparent limitation—at least, by parallel construction. In the 1991 case, the court expressed concern that in the absence of procedural attention to balancing the expected benefits and costs of a rulemaking, OSHA's wide policymaking discretion could lead to costly and minimally protective standards. Nonetheless, the other extreme ought to be an equal concern on the same grounds, that is, more stringent protections achievable through justifiable additional costs. The essential point is that OSHA's feasibility analysis—at least as now conducted—does not really have the "backbone" to drive a search for the "balance" to which the court points.

Industry's spending for occupational health and safety compliance is not covered in the Pollution Abatement Costs and Expenditures (PACE) survey, administered annually since 1972 by the Department of Commerce's Bureau of Economic Analysis.[34] The information OSHA collects in the course of its enforcement activities (maintained primarily in IMIS files) provides some field data on outcomes. But this information is relatively narrow in the scope of hazards covered; addresses chiefly exposure levels; sheds no real light on actual compliance costs; and often does not provide a representative sample of an affected industry.[35] OSHA's FAT/CAT reports (documenting workplace incidents involving fatalities or hospitalized injuries—see discussion earlier in this chapter) and the periodic national surveys conducted by the Bureau of Labor Statistics and others (see discussion in chapter 1, box 1-1) provide useful (if not entirely complete) time series data on workplace fatalities, illnesses, and injuries. Nonetheless, OSHA does not, in general, have mechanisms in place to systematically describe (or estimate) the actual control actions taken by an affected industry in response to promulgated standards, the new costs experienced and the effects on productivity, and the benefits realized (reductions in hazard exposures and adverse health effects, costs avoided, and improvements in employee behaviors).

This situation is understandable in many respects. Good answers to these questions involve substantial data collection at the establishment level and considerable analysis of such information. Attention must be given to measuring the specifics of the new costs incurred (including the actual financial effects, appropriately allocating any joint spending for health/safety compliance and production improvements), the effects on productivity and resource requirements, the impacts on industry structure and competition, and the benefits realized from hazard reduction. Outcomes attributable to OSHA compliance need to be distinguished from those arising chiefly from other influences. Furthermore, the number of industries affected under contemporary OSHA standards is often quite sizable. These various features of the evaluation problem imply staff and resource requirements for research that are quite sizable, and probably could not be achieved, within the confines of the agency's present (tightly constrained) budget, without undesirably diverting resources from other, higher-priority activities.

Nevertheless, OSHA would, by all appearances, gain considerably from having informed answers to provide—to Congress, to the public, to those with a stake or influence in future rulemakings—regarding the hazard reductions achieved, the costs truly imposed and avoided, and other benefits realized. In this vein, it deserves to be carefully explored whether there are avenues within the agency's reasonable grasp that could be pursued to build a more substantial base of information than presently available on actual post-promulgation outcomes.[36]

This might, for example, involve monitoring the information available in trade journal articles documenting control experiences, drawing on other agencies' studies (such as from NIOSH or EPA), and conducting discussions (through focus groups or more informal one-on-one conversa-

[34] The PACE survey annually collects company-level data on new capital expenditures and annual operating expenses incurred for environmental protection (i.e., EPA regulations) through pollution abatement and related control of wastes. This information is collected by the Bureau of Economic Analysis chiefly to incorporate pollution abatement expenditures into the U.S.'s National Income Product Accounts.

[35] OSHA's IMIS provides computerized information on a large cumulative number of samples over time, but its utility for new rulemakings is limited since around three-quarters of all these samples concern around a dozen chemicals. In addition, the sampling of establishments reflects, for the most part, the logic of the agency's enforcement efforts, rather than a representative sample of the establishments in any given industry. Furthermore, the data collection provides information on job classifications, exposures, and in-place control technology, but little on economic considerations.

[36] To be sure, OSHA has recently begun to think about this matter. See, for example, Savant Associates, Inc., Princeton, NJ, "Design of a Prospective Method to Review the Impact of an OSHA Standard," unpublished draft contract report, prepared for the Office of Program Evaluation, Occupational Safety and Health Administration, U.S. Department of Labor, Washington, DC, Oct. 21, 1993.

tions) with knowledgeable participants in affected or related industries (such as the suppliers of production or control equipment). In addition, OSHA could make a more regular effort to conduct retrospective case studies akin to the few that are presently available (such as those performed or drawn upon for this report). Furthermore, there may be ways to establish acceptable mechanisms for more systematically collecting data on outcomes (including control measures adopted, compliance spending, changes in hazard exposure levels) as a component of the compliance content and implementation of new standards .37

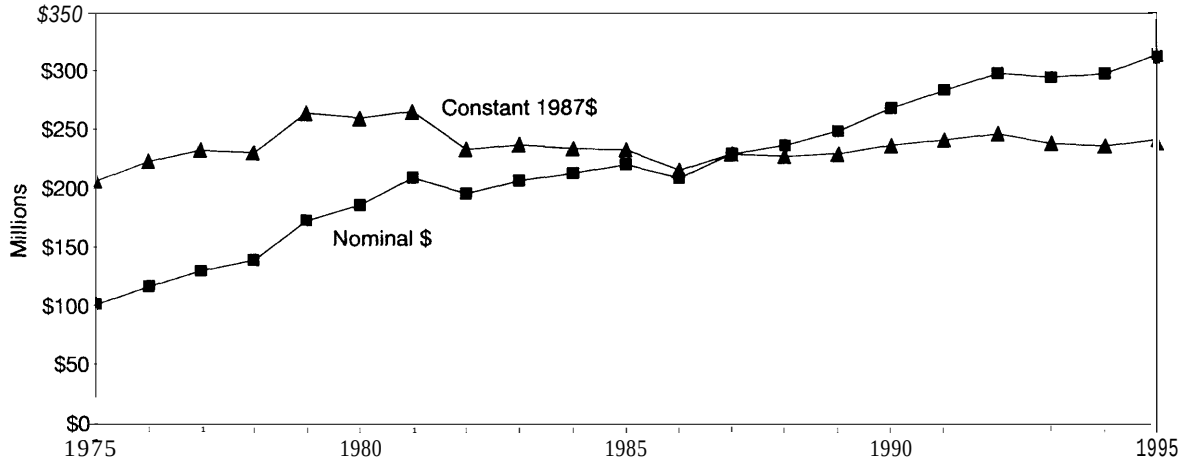
Organizational and Resource Considerations

OTA devoted some effort in the course of the study to examining OSHA's internal organization and budget resources, as they relate to the conduct of technology and regulatory analyses. The findings reported below derive chiefly from a series of interviews with current and past OSHA staff and with other observers familiar with the agency's tasks and procedures, and from an examination of internal and public information on the agency's budget.[38]

- ***The level of resources supporting the agency's technology and regulatory analysis efforts is hard to precisely pin down, but it is apparent that demand has long been substantial and the resources thin.***

Congress's annual appropriation to support OSHA's various activities (standard setting, enforcement, education/assistance, statistics, administration, and so on) shows a progressive expansion over the past 20 years on a current-dollar basis—from around $100 million in 1975 to somewhat over $310 million in 1995 (figure 3-1 and table 3-6). Nevertheless, when the figures are adjusted for inflation, it is evident that the agency has had to operate under a generally tighter budget since the funding "high water mark" of the late 1970s and very early 1980s. Expressed as constant 1987 dollars (see figure 3-1), the agency's annual appropriation was some-

FIGURE 3-1: OSHA Budget Approp



SOURCE: Budget of the United States, various years.

37 This possibility is considered in more detail in Savant Associates' 1993 report for OSHA, pp. 42-46.

38 For a more detailed discussion, readers should consult the project research paper prepared on this topic: Robert F. Stone, Econotron Inc., Framingham, MA, "An Evaluation of OSHA's Resources for Regulatory Analysis," unpublished contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, March 1995.

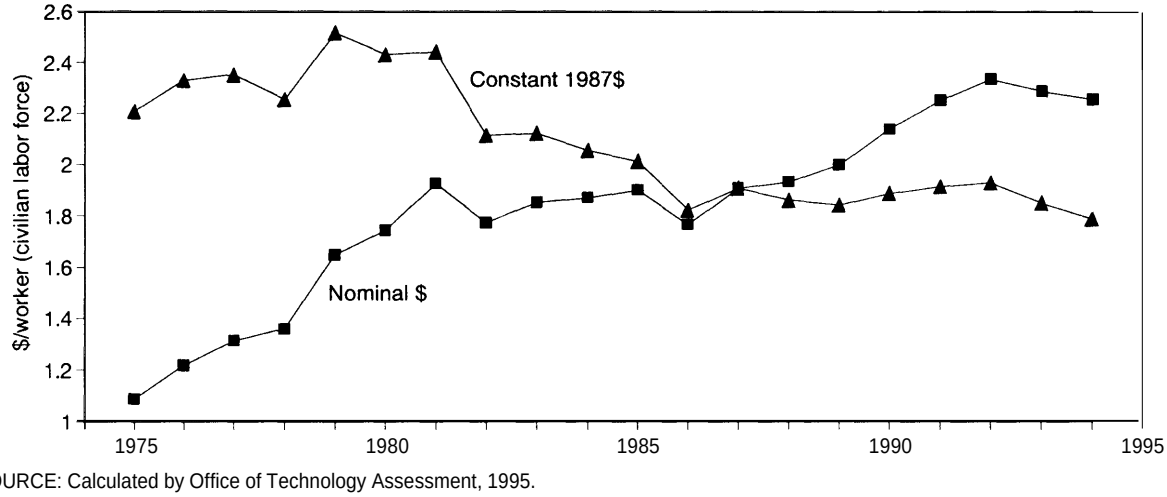
what above $260 million in the 1979-81 period, but has dropped to the $230 million to $245 million range since the later 1980s. In addition, the agency's permanent staff has declined from a total of around 3,000 full time equivalent (FTE) employees in 1980, to about 2,300 at the end of 1994-a cumulative decrease of about 23 percent.

As this report is being completed OSHA's budget for fiscal year (FY) 1996 remains a matter of vigorous debate. The President's February 1995 budget proposal outlined an appropriation of about $347 million (see table 3-6), a current-dollar expansion over the FY 1995 level of around 11 percent, or 7 to 8 percent on an inflation-adjusted basis. However, substantial *reductions* over the FY 1995 level have been proposed in Congress. In August 1995, the House committee responsible for the funding of labor, health and human services, and education programs passed an appropriations bill placing OSHA's FY 1996 funding at $264 million—about a 16 percent reduction from the level in FY 1995 and, in inflation-adjusted dollars, a level somewhat below that prevailing in 1975. Nevertheless, Senate and conference committee action on this matter remains in the future.

Put in a broader perspective, the growth of OSHA's budget since 1980 in inflation-adjusted dollars has not kept pace with the expansion of the U.S. workforce. The agency's budget per worker (across the civilian labor force) increased throughout 1970s, peaking at approximately $2.50 per worker (1987 dollars) in 1979 (figure 3-2). Since then, it has dropped steadily, to less than $1.80 per worker (1987 dollars) in 1994—a cumulative decline of almost 30 percent.

Tallying the annual resources the agency devotes to regulatory analysis activities is not entirely straightforward, given the wide involvement (as noted in the previous chapter) of various agency and DOL offices in the process. In addition, on several past occasions, OSHA has secured some supplementary funding for its rulemaking-related research from other agencies, via interagency budget transfers (e.g., from the Department of Energy for the ongoing Ergonomics rulemaking and from EPA for the 1989 Hazardous Waste Operations and Emergency Response Standard).

FIGURE 3-2: OSHA Budget Per U.S. Worker



SOURCE: Calculated by Office of Technology Assessment, 1995.

TABLE 3-6: OSHA Budget Allocations

Appropriations, Direct Programs, Selected Years, 1980-1996

$ (thousands)

Authority	1980	1985	1990	1995E	President 1996P	House 1996P
Safety & health standards	6,510	5,483	7,581	9,221	9,471	8,354
Enforcement						
Federal	78,048	86,452	119,138	145,323	155,854	98,000
State programs	42,360	53,021	59,827	70,615	75,915	65,319
Technical support	13,024	12,285	16,467	19,068	21,668	17,467
Compliance assistance	32,176	36,242	35,272	45,189	55,332	53,601
Safety & health statistics	6,906	21,036	21,945	15,640	20,669	14,707
Executive direction & administration	7,370	5,125	6,838	7,444	7,594	6,537
Total	186,394	219,644	267,068	312,500	346,503	263,985

SOURCE: 1980, 1985, 1990: Budget of the United States. 1995: estimate from President's FY 1996 Budget (Feb. 1995). 1996: fiscal 1996 proposals available to date—President's FY 1996 Budget, U.S. House committee bill (Aug. 1995).

If only the funding for OSHA's Office of Regulatory Analysis (ORA) is considered, however, the agency's principal resource for regulatory analysis, the overall level of available resources in inflation-adjusted dollars (including funding for ORA's staff and for outside research contracting) has ranged from somewhat under $2 million to somewhat over $5 million annually since 1980 (figure 3-3). Obviously, this represents a small fraction of the agency's $230 million to $260 million total annual budget over the same period. Since the later 1980s, moreover, it is apparent that ORA's resources have dropped sharply. In addition, over the same period, ORA's professional staff (chiefly economists) has declined from 16 or 17 FTEs to less than a dozen.

The observers with whom OTA spoke (all long familiar with the agency's operations) characterized the resources available for technology and regulatory impact analysis as "too thinly spread" and the necessary work often undertaken "on a shoestring."[39] The general appraisal provided was that this situation has inappropriately limited the scope of the analytical effort that can be mounted in any given rulemaking. Reportedly, the resource constraint, on some occasions, has forced some undesirable "triaging" of the available budget according to the estimated degree of controversy associated with a rulemaking and, in a few cases, prevented otherwise appropriate analyses from being undertaken.

- ***The existing resource constraints notwithstanding, developments on the horizon portend the need for an even larger regulatory analysis effort.***

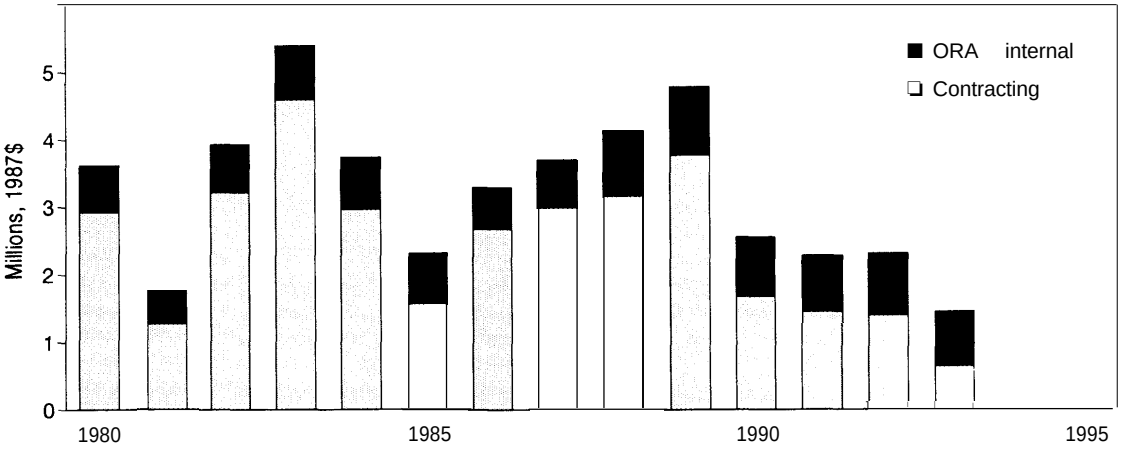
[39] Meaningful comparisons with the circumstances in other agencies that have health, safety, and environmental regulatory responsibilities are not easy, as differing statutory and programmatic mandates prevail (and thereby differing analytic requirements). However, one of the reasonably parallel cases OTA could identify is OSHA's 1992 Process Safety Management standard and EPA's Risk Management Plan to comply with the 1990 Clean Air Act Amendments. Here OSHA relied on 3 full-time staff and $200,000 for outside contract research to conduct its regulatory analysis; EPA, by considerable contrast, has, to date, used 10 full-time staff and $4 million for outside contracts.

Increased pace of rulemaking. From its inception in 1971 through 1992, OSHA has completed an average of about four rulemakings a year (a rate roughly true for the 1985-1992 period as well). However, the agency's present director has envisioned a more ambitious schedule—a pace closer to 10 final rules and 10 proposed rules per year. Whether such a goal can still be pursued, given the large shift of the political balance in Congress in January 1995, is unclear. But meeting such a schedule, without dropping below the threshold of acceptable analysis defined by the courts, will, by all appearances, compel the agency to commit significantly greater resources to the existing regulatory analysis effort.

New analytic support for priority setting. OSHA's present senior management has indicated a strong desire to establish an ongoing system for setting future rulemaking priorities. (Such a system would respond to what many observers have identified as a long-standing deficit in the agency's policy-planning capabilities.) The system will need substantial data resources to identify and compare the levels of risk associated with various existing workplace hazards. There may also be a role for some initial, "big picture" regulatory assessments, examining the availability of technologically and economically feasible opportunities for removing/reducing significant risks. Such pre-rulemaking analysis activities, should they be pursued to any substantial extent, would represent an addition to the agency's existing technology assessment and regulatory analysis efforts.

Increased rulemaking controversy. OSHA is obliged to consider all credible statements submitted to the rulemaking record. In the case of comments on the agency's regulatory impact findings and estimates, handling this task has often required considerable effort from ORA staff, and can create the need for significant review and potential revisions in the agency's analytical findings and estimates. In the past, most of the agency's rulemakings elicited fewer than 1,000 comments. Until recently, the 1991 Bloodborne Pathogens standard held the record, with approximately 3,000 written comments, but the ongoing rulemaking on Indoor Air Quality could ultimately total some 45,000 to 50,000 comments. Before the "hold" recently established by the agency's director (in June 1995), the Ergonomics rulemaking also was generating a large volume of comments. Should these recent cases prove to more nearly define the norm for future rulemakings, the added strain on the resources available for regulatory analysis is obvious.

FIGURE 3-3: Office of Regulatory Analysis Spending



SOURCE: OSHA, Office of Regulatory Analysis, 1994

An enlarged scope for judicial review. Congress could well soon choose to enlarge the scope of the agency's rulemaking findings and analyses open to review by the courts, through changes to the terms of the 1980 Regulatory Flexibility Act or a broadly encompassing scope for review established for all federal agencies' regulatory impact analyses as an outgrowth of the ongoing "regulatory reform" debate.

To date, OSHA's analyses of regulatory impact on small businesses (and other relevant small organizations), in line with the Regulatory Flexibility Act, have been specifically excluded as a possible topic for attention by reviewing courts. Legislation to remove this restriction was introduced but unsuccessful late in the 103rd Congress; differing versions passed both the House and Senate, but joint action died in conference as the term ended. Nevertheless, similar bills have again been introduced in the current Congress.[40]

OSHA's regulatory impact documents already provide rather detailed analyses of the expected impacts on small businesses.[41] But should such legislation become law, the threat of "substantial evidence" review by the courts extended to this area of analysis could drive OSHA to enlarge the analytic procedures or documentation, to ensure the ability of a rulemaking's record to withstand this widened scrutiny.

The "regulatory reform" efforts now underway in both the House and Senate also could expand the scope of the court's review of agency rulemakings (see earlier discussion in this chapter). The specific provisions vary in the several bills forwarded thus far, but most seek (among other objectives) to codify provisions on regulatory impact analysis provisions in line with what the various executive orders have long required, and to make the findings and policy conclusions from these analyses fully subject to potential scrutiny by the courts (which has not been the case to date with the executive order-mandated analysis requirements).

OSHA already prepares most of its analyses at a considerable level of detail and with substantial documentation. But widened judicial review clearly brings with it the prospect of additional agency analysis and documentation to ensure the adequacy of a rulemaking's record in this revised procedural setting.

Expanded analysis of control options and impacts. The various earlier observations in this report commenting on the "narrow" content of the control option and impact analyses that OSHA now prepares for rulemakings imply a number of avenues along which existing procedures might be enlarged, including more comprehensive quantification of the full range of regulatory benefits expected, greater emphasis on forecasting expected outcomes in preparing feasibility and regulatory analyses, and a systematic effort to monitor the potential of advanced and innovative technologies in providing options for reducing workplace hazards.

Various events could drive the agency to embark on such improvements—such as a new judicial or congressional push toward greater attention to benefit-cost balancing in setting compliance requirements, an increase in rulemakings involving a technology-forcing component, or the emergence of a combined effort with

[40] *United States Code*, Section 611(b) of Title 5 places Regulatory Flexibility Act-related analyses off-limits to judicial review. In the 103rd Congress, H.R. 830 and S. 490 both proposed removing this restriction and made their way to conference—but a corresponding new law did not eventually emerge. Similar bills were placed early in the current Congress (104th)—H.R. 937 (introduced February 1995, and referred to the Committee on the Judiciary and the Committee on Small Business), S. 350 (introduced February 1995, and referred to the Committee on the Judiciary). In addition, removal of the judicial review constraint and some expansions in the required content of Regulatory Flexibility analyses have been addressed in many of the various proposals for "regulatory reform" now being considered in both chambers.

[41] For some time, OSHA's feasibility and regulatory impact analyses, in line with the "regulatory flexibility" mandate, have typically distinguished establishments with fewer than 20 employees from larger ones. (Some analyses have examined a larger number of size classifications.) Normally, the agency conducts its economic feasibility and industry impact analyses in each of these size-stratified groups and considers the differential results (if any are found to exist) in its final rulemaking actions.

EPA to examine the frontier of technological options available for joint "pollution prevention" and safety/health hazard reduction in the workplace. Nonetheless, most such expansions in the inquiry represent a deepening (in concept, methodology, and data collection) of the scope of analysis now implemented, and, as such, would require significant expansion of the agency's existing analytic effort.

- ***A number of ways to improve the agency's existing procedures for conducting and using regulatory analyses appear to merit consideration. (Indeed, some are already the focus of ongoing agency initiatives.)***

Improved interoffice integration. In principle, OSHA has always used a team approach for rulemakings (typically consisting of a health or safety scientist, an engineer, a lawyer, and an economist), with members cooperating in designing and analyzing the intended regulatory action, and bringing the resources of their respective directorates or offices to bear as needed. In recent years, however, this integration has been less inclusive than intended, with ORA staff (mostly economists), on occasion, operating in some isolation.

According to some insiders with whom OTA spoke, this circumstance has contributed to tensions among various agency offices over the preparation of rulemaking actions and has impaired the design and conduct of the regulatory analysis effort. Although, conversely, others noted that some tension was inevitable between those agency staff chiefly responsible for defining standards and those charged with considering regulatory impacts, and that a key leadership task is to manage these differences constructively and to the general advantage of the rulemaking.

OSHA's current senior management, apparently appreciating the significance of these matters, has recently affirmed the importance of the integrated team approach and seems to recognize the need to better manage the coordination among staff with contrasting responsibilities.

Expanded interaction with NIOSH. NIOSH is widely regarded as a capable and credible resource in the technical and scientific aspects of the industrial health and safety arena. OSHA has long made use of NIOSH research in its rulemakings—chiefly through the Institute's Health Hazard Evaluations (HHEs), which, for the most part, are conducted and published independent of, and in advance of, OSHA's rulemakings.

In the past, there have been a number of reasons why OSHA has not been able to draw more substantially on NIOSH's research capabilities. In part, schedules did not coincide; NIOSH typically required two to three years of lead time to prepare a report on a specific hazard, whereas OSHA was unable to provide information on its rulemaking schedule any further than six months in advance, and required products with a much shorter calendar for completion. Moreover, for much of the 1982-92 period, the OSHA Administrator and the NIOSH Director clashed frequently on policy matters; as a result, interagency communication and cooperation were limited. Furthermore, the geographic distance (until its recent relocation to Washington, DC in 1993, NIOSH's main office was located in Atlanta, Georgia; whereas OSHA is in Washington, DC) and executive branch separation (NIOSH is formally a part of the Department of Health and Human Services and OSHA resides within the Department of Labor) have not helped.

For the past two years, however, OSHA and NIOSH have been working to improve cooperation. OSHA is also trying to make better use of NIOSH's research capabilities during the course of standard setting. And NIOSH has been seeking to expand its research activities in the important area of control technologies.

Links with new-technology research at EPA. One seemingly productive area for expanded OSHA interaction with EPA is in the general area of "pollution prevention." The ongoing efforts to encourage industry to adopt technologies in this vein have a natural integration with efforts to reduce workplace safety and health hazards. The Office of Pollution Prevention in EPA's Office of Pollution Prevention and Toxics has become a rich source of data on inherently

cleaner (less polluting) technologies, through information generated by EPA labs (in Cincinnati and Research Triangle Park) and industry. Opportunities to expand OSHA's use of and participation in such efforts deserve to be more substantially considered.

Inputs from the DOL Policy Office. Several experienced observers of OSHA noted to OTA that in past rulemakings, the Department of Labor's Office of Policy (see figure 2-1 in the previous chapter) had been a useful reviewer of OSHA's regulatory impact analysis drafts, and had provided valuable technical advice on regulatory and economic research issues. However, deep and successive budget cuts have reduced this Office's research budget from close to $5 million annually early in the 1980s to less than $150,000 more recently. The result has been that the much diminished technical staff is now able to provide only minimum technical support, and drafts of regulatory analyses can be reviewed only in exceptional cases. Although this is apparently not yet a major item on the OSHA leadership's action list, there seems to be significant support within OSHA for restoration of enough of the budget to enable the office to reassume its past advisory and review roles concerning matters of regulatory analysis.

Interdisciplinarity at the Office of Regulatory Analysis. There was some comment on the overwhelming predominance of economists on ORA's professional staff. Clearly, a good deal of this is warranted, because a primary thrust of ORA's role in rulemakings involves examining the economics of proposed standards on affected industries and the larger economy. Nonetheless, a portion of the responsibility also involves assessing control technologies—an activity that would certainly appear to benefit from staff with skills in engineering disciplines (industrial, chemical, mechanical, and so on) or, ideally, combined skills in engineering and economics/business. Even if outside contractors, NIOSH, or staff from the Safety or Health Directorates continue to be used to analyze compliance technology, it would be an advantage for ORA to have an in-house staff capable of designing and evaluating research on technology-related topics. Furthermore, should ORA seek to become more substantially involved in gauging the potential of advanced technologies and industrial innovations to address workplace safety and health hazards, this kind of multidisciplinary mix would surely be essential.

Observations from Benchmarking

As a basis for comparison and a source of suggestions on possible avenues for improvement, OTA examined what other government organizations undertake in the way of assessments of control technologies assessments and analyses of regulatory impacts to support their rulemaking actions. This inquiry compared OSHA with other federal rulemaking agencies and with the government safety and health organizations of some of the major international trading partners of the United States.[42] The findings reported in this section are based chiefly on discussions with agency staff involved in the preparation and use of the analytic material, review of relevant scholarly literature, and various inputs from other knowledgeable commentators.[43]

- ***OSHA's regulatory analysis tasks are, in some respects, more complicated than those of its counterparts elsewhere in the U.S. federal bureaucracy. Nonetheless, the agency's work is generally comparable with the best***

[42] The other U.S. regulatory agencies considered by this analysis included the Consumer Product Safety Commission (CPSC), Environmental Protection Agency (EPA), Federal Aviation Administration (FAA), Food and Drug Administration (FDA), Mine Safety and Health Administration (MSHA), National Highway Traffic and Safety Administration (NHTSA), and Nuclear Regulatory Commission (NRC). The foreign nations examined included Canada, France, Germany, Japan, Britain, and the European Community.

[43] OTA's findings on this topic are discussed at greater length in a project working paper prepared on the topic: D. Butler, "OSHA's Brethren—Safety and Health Decisionmaking in the U.S. and Abroad," Office of Technology Assessment, U.S. Congress, Washington, DC, September 1995.

practices of other health and safety regulatory agencies.

In many ways, OSHA's experiences as a health and safety regulatory agency are not unusual. The other agencies OTA examined have similarly stringent requirements for technical and economic feasibility analysis, imposed by statute and its judicial interpretation, executive orders, or internal agency policy.[44] The scrutiny OSHA has received from the Congress, the courts, the executive branch, and regulated parties also is unremarkable. Many agencies have been specifically instructed to promulgate regulations, have had their budgets made contingent on particular actions, or have been subjected to great pressures to modify or abandon proposed regulations. Furthermore, two particular agencies (the Consumer Product Safety Commission and the National Highway Traffic and Safety Administration) appear to have changed their overall regulatory focus in response to judicial interpretation of their statutes.[45]

Nevertheless, some aspects of OSHA's statutory mandate do make its job more complicated than that of many other U.S. health and safety regulatory agencies. Three particularly significant differences are discussed here.

OSHA is one of the few agencies that *regularly* promulgate regulations applying to a wide range of businesses, from industrial giants to "mom-and-pop" operations. This situation complicates the task of evaluating the impact and feasibility of proposed regulations. It can also result in standards that may be feasible and acceptable to a majority of regulated parties but unworkable or otherwise unacceptable to a few—a statutorily permissible, but nonetheless procedurally problematic, situation. EPA regulations under the Toxic Substances Control Act (TSCA) can have a similarly broad impact, but very few regulations have been issued under the act's authority, and those that have, have been litigated and delayed in a manner analogous to that experienced by OSHA.

None of the other agencies examined by OTA are required to demonstrate that exposed populations face a "significant risk" before promulgating a regulation to address the hazard. Some analysts of the agency's policy decision processes have characterized this requirement (which was imposed by a 1980 Supreme Court interpretation of OSHA's enabling statute—see chapter 2), as "a significant impediment to the effective implementation of OSHA's statutory mandate."[46] CPSC and EPA regulations under TSCA have a similarly stringent requirement ("unreasonable risk"), but both of these agencies have other regulatory instruments they can bring to bear.

Finally, in many circumstances, OSHA cannot use a regulatory tool that other agencies may apply when hard-to-control hazards are identified. Although the option can be difficult to implement, other agencies often can choose to directly eliminate a hazard by having it prohibited, recalled, or otherwise withdrawn from use. This "banning" option provides a means to deal with a hazard when no technically and economically feasible alternative can be identified. However, banning is simply not possible for many hazards under OSHA's regulatory purview. Lead processing and cotton milling, working outside high-rise buildings, and fixing broken industrial equipment cannot be banned, eliminated from the workplace, or made so costly as to no longer be practical. OSHA has no choice but to find an approach that is both achievable and protective of worker health and safety.

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[44] Indeed, some form of feasibility analysis appears to be routinely carried out for the vast majority of health and safety regulations. Where there are agency-to-agency differences, they more nearly relate to the extent to which the enabling statutes allow feasibility considerations to be factored into regulatory decisions.

[45] See, for example, J.L. Mashaw and D.L. Harfst, "Regulation and Legal Culture: The Case of Automobile Safety," *Yale Journal on Regulation* 4(2):257–316, Spring 1987.

[46] S.A. Shapiro and T.O. McGarity, "Reorienting OSHA: Regulatory Alternatives and Legislative Reform," *Yale Journal on Regulation* 6(1):1989, p. 46.

OTA did not conduct an exhaustive review of the practices that other health and safety regulatory agencies use to conduct regulatory impact analyses, but our broad survey suggests that OSHA's work is generally comparable with the best practices of other agencies in the U.S. federal government with similar missions. However, as elaborated more fully later, OTA believes that some of the more innovative approaches EPA is now pursuing may be worth OSHA's consideration.

- ***OSHA's regulatory analysis tasks are far more demanding than those of its foreign counterparts because the United States requires far more detailed economic and technical feasibility analysis to promulgate occupational safety and health regulations.***

The U.S. approach generally is based on the principle that quantitative analysis provides an objective basis for regulatory policymaking. U.S. regulators must prepare and defend detailed empirical justifications for regulations in order to demonstrate that the choices meet statutory intent and are rationally related to the facts at issue. These analyses also provide the basis for defending the decision should a later challenge in court arise. Such justifications can not only be costly and time consuming, they are also vulnerable to second guessing because the science and analyses underlying them cannot usually be made airtight. While this second-guessing may be motivated by disagreement over the soundness of an analysis, it may also be used as a means of disputing an outcome or delaying implementation of a decision for political, economic, or social reasons.

One or another of a pair of contrasting approaches is used in the other nations OTA examined. Some grant greater autonomy to regulators to make occupational safety and health decisions, typically with the advice of elite authorities designated by the government. Others employ some form of consensual mechanisms for promulgating occupational safety and health standards. In this second system, stakeholders—business, labor, and at times, other groups—work with government regulators to identify the level and manner in which hazards are controlled. Feasibility (technological and economic), while an important consideration in such proceedings, tends to be dealt with qualitatively rather than quantitatively. Where regulators act autonomously, feasibility is more nearly treated as a matter of professional judgment than as an analytical determination. In stakeholder-based systems, participants assess feasibility in order to inform their bargaining positions and in order to be able to factor feasibility constraints into their negotiating stances and into the compromises they are willing to accept. Explicit engineering and economic analyses do not, however, drive the decisionmaking process under either regime.

- ***Occupational safety and health regulators in other nations seem to be able to promulgate standards more quickly than OSHA and without the discord and rancor that often arise in OSHA proceedings. However, applying the means used elsewhere to limit conflict in U.S. rulemakings is problematic.***

The form and operation of each nation's regulatory governance are functions of a complex set of interrelated political, social, historical, and cultural factors. In the United States, these influences combine to create a system that emphasizes public accountability for decisionmakers and respect for an individual's right to question the actions of the state. The other countries studied by OTA employ regulatory mechanisms that are based on either respect and deference for government authority, or emphasize consensus and cooperation among the parties most affected by regulation.

Several practical implications flow from the differences in the structures of the regulatory systems. The means used to constrain bureaucratic autonomy and to maintain oversight in the United States—promulgating prescriptive legislation, imposing administrative procedures on rulemaking, overriding bureaucratic decisions through legislation or executive order, examining agency actions in public hearings, and using the budgetary process to compel or end actions or to

indicate preferences—are seldom employed among the major trading partners of the United States. These procedures limit the ability of unelected officials to carry out policies that are contrary to the wishes of the elected branches, but they do so at the expense of speed and flexibility, two characteristics often identified as advantages of other regulatory systems. Oversight mechanisms also provide avenues for judicial intervention in decisionmaking. This intervention allows a wide range of individuals and groups to have a voice in regulatory policy and conduct, but it also delays regulations without regard to their usefulness and necessitates the creation of extensive records to document the rationale underlying agency decisions. The time spent and paperwork generated in these exercises are often decried as weaknesses of the U.S. system.

Constraints on bureaucratic authority appear to be less important in some foreign nations because of long-standing traditions of respect for government authority, and in other foreign nations because key stakeholders are an explicit part of the regulatory decisionmaking process. By giving stakeholders a seat at the table, these governments eliminate a prime motivation for strict oversight. By vesting them with part of the responsibility for standards and highly constraining their ability to challenge regulatory decisions once they are made, the nations encourage good-faith negotiations among stakeholders and promote support of the agreements reached.

Thus some of the perceived weakness of occupational safety and health decisionmaking in the United States (and of the U.S. regulatory approach in general) can also be viewed as an outgrowth of principles that citizens value. It is certainly worth considering whether other systems for formulating regulations—in particular, cooperative approaches like those used in Britain and some Canadian provinces—may have utility here. It is important to remember, however, that one reason that such regulatory strategies may work elsewhere is that they are rooted in different beliefs about the various checks and balances needed between government and the citizenry.

- ***Some of the initiatives related to setting safety and health standards now under way at EPA, an agency with similar regulatory analysis requirements, may merit OSHA's attention and consideration.***

EPA's ability to conduct regulatory analyses is enhanced by its size, resources, and some of its enabling statutes. The agency's budget was more than 20 times that of OSHA in fiscal 1993, and its full-time-equivalent employment was more than 5 times larger. Undoubtedly, these greater resources allow EPA to maintain more staff and more internal expertise on control technology and economic issues, and to tap outside sources of information more easily. Some of the statutes under which EPA operates also help the agency obtain reliable information on which to base standards. The Clean Air Act, for example, permits EPA to compel industry to provide it with data or to enter facilities to obtain information relevant to potential regulatory initiatives. EPA's Science Advisory Boards (SABs), created by statute, have the task of reviewing the technical adequacy of proposed standards. SAB reviews serve as an internal check on the merit of feasibility analyses and provide an imprimatur that may enhance their credibility to the courts and stakeholders.

That said, EPA has shown a willingness to use some innovative approaches to formulating standards and assessing their feasibility that may be worth consideration by OSHA. OTA has not conducted a thorough examination of EPA regulatory reform initiatives or of the agency's typical technological and economic analysis methods, and draws no conclusions regarding the initiatives or the quality of EPA's work. But this report has identified several EPA efforts, many at the pilot stage, which appear promising. In the realm of setting standards, these include:

- improving consultation with stakeholders;
- giving greater attention to "pollution prevention" measures, that is, approaches that seek to directly reduce, rather than control, emissions (hence exposures)—including changes in pro-

cesses and changes and substitutions of materials;
- providing information and technical assistance to state and local governments and to businesses seeking to accelerate the development and deployment of innovative technologies; and
- selectively promoting technologies that achieve compliance goals at low initial or long-term cost.

As for control options assessments, EPA analyses have included consideration of speculative technologies based on adaptations of currently available devices, and have examined cutting-edge foreign research that might produce greater reductions in hazards at lower cost. EPA has also used contractors to obtain, analyze, and summarize compliance cost information without compromising manufacturers' confidential business information. OTA has not conducted the research to determine how widely these methods are applied across EPA's various regulatory activities, but the available evidence certainly indicates that more encompassing approaches to examining control options are possible.

It appears that OSHA could benefit by carefully monitoring EPA's success and failures with these efforts as they unfold.