Engineers And The Environment

(ESSAY #7)

Introduction

Engineering responsibility for the environment is necessarily closely related to the laws governing environmental matters, but environmental degradation was not the subject of serious federal regulation until the late 1960's. Until that time, private litigation and the common law were the principal tools for controlling pollution. Usually, however, no single individual was sufficiently harmed by pollution to be motivated to bring suit against a polluter. Both the states and the Federal government were ineffective in controlling pollution.

As a response to this state of affairs, Congress passed the National Environmental Policy Act (NEPA) in 1969. The Act inaugurated "a national policy which will encourage productive and enjoyable harmony between man and his environment...." One of the best-known provisions of the NEPA is the requirement for an environmental impact statement, which enumerates the effect of a project on the environment. Congress then created the Environmental Protection Agency (EPA) to enforce its mandates. In the ensuing decades Congress enacted legislation to control pollution in four major areas.

In order to protect the air, Congress enacted the Clean Air Act of 1970 and amended it in 1977. The Act set a goal of a 90% reduction for auto emissions. It permitted the EPA to consider economic and technological feasibility in deciding when the goals were to be met, but not in adjusting the goals themselves.

After 1979, the EPA adopted a "bubble" concept as a method of enforcement. According to this policy, an imaginary "bubble" is placed around a plant or even an entire region. Under the bubble concept, industries may reduce those emissions which they can reduce most cheaply. One plant may be able to reduce pollutant A more cheaply, even reducing the level below the minimum level required by law. Another plant may be able to reduce pollutant B more cheaply, reducing it below the level required by law. Then the two plants can engage in trades, whereby the first plant trades some of the "credits" it has in pollutant A for some of the "credits" the second plant has in pollutant B. Since the first plant can reduce pollutant A most efficiently and the second plant can reduce pollutant B most efficiently, the total level of pollution under the bubble can be reduced to designated levels, but in the most economically efficient way.

In 1972 Congress enacted the Clean Water Act and amended it in 1972, 1977, and 1986. The Act, designed to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," makes it unlawful for any person, business, or governmental body to discharge any pollutant into navigable waters without a permit. The Act mandated pollution control measures in two stages. By 1977 all plants were to have installed water pollution control devices that represented the best practicable pollution control technology. By 1989 all plants were to have installed equipment that met more stringent standards. Plants discharging conventional pollutants are to apply the best conventional pollutant control technology. Plants discharging toxic or unconventional pollutants are to apply the best available technology economically achievable.

In 1976 Congress enacted the Resource Conservation and Recovery Act (RCRA), designed to control the transportation, storage, treatment, and disposal of hazardous wastes. The Act requires the generator of a hazardous waste to complete a "manifest," a form that describes the nature of the hazardous waste and its

method of disposal. The transporter must sign the manifest and the operator of the disposal site must do so as well, returning the manifest to the generator of the waste. This procedure is supposed to provide a complete record of the disposal of the waste. The EPA is also required to regulate the disposal sites themselves.

In order to facilitate the cleanup of inactive dump sites, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act in 1980. The Act empowers the President to clean up abandoned hazardous sites and to provide necessary remedial actions in the case of spills.

Finally, Congress has enacted a number of other laws which require businesses to alter products and processes that can have an adverse effect on the environment. The Noise Pollution Control Act of 1972 gives the federal government broad powers to protect the public from excessive noise. The Federal Insecticide, Fungicide, and Rodenticide Act of 1947 and the Federal Environmental Pesticide Control Act that amended it requires manufacturers to register insecticides with the EPA before they can be sold to consumers. The EPA will register a pesticide only if it is properly labeled, does what it claims to do, and will not produce "any unreasonable risk to man or the environment, taking into account the economic, social and environmental costs and benefits of the use of any pesticide." The Toxic Substances Control Act (TOSCA) of 1976 establishes a regulatory mechanism for protecting the public against dangerous chemical materials contained in consumer and industrial products.

These are the principal federal laws that provide the legal context in which decisions regarding the effect of technology on the environment must be made. Many decisions are not covered by the laws, however, so there is the need for individual judgment. These judgments are usually made by business managers, so the attitudes of managers toward environmental laws is also important for engineers.

Business Managers and Environmental Laws

A recent survey gives us insight into the attitudes of managers towards environmental laws. From 1982 until 1985 Joseph M. Patulla, Director of the Graduate Program in Environmental Management at the University of San Francisco, surveyed a number of industries with respect to hazardous waste disposal. He found that he could classify the companies he investigated into three categories. The first type of company, consisting of 29% of the firms surveyed, engaged in what Petulla called "crisis-oriented environmental management." Industries in this group tended to have no full-time personnel assigned to environmental concerns, devoted as few resources as possible to such matters, and fought environmental regulations. As one representative of this group put it, "Why the hell should we cooperate with government or anyone else who takes us away from our primary goal (of making money)?"1 He went on to say that it is cheaper to pay the fines and lobby than to devote resources to environmental matters.

A second group, consisting of 58% of the firms surveyed, adopted what Patulla called "cost-oriented environmental management." Firms in this group accepted governmental regulation as a cost of doing business, but often without enthusiasm or commitment. They usually had established company policies regulating the environmental matters and separate units devoted to them.

A third group, consisting of 9% of Petulla's sample, adopted what he called "enlightened environmental management." In these companies, responsiveness to environmental concerns had the complete support of the CEO. The companies had well-staffed environmental divisions, used state-of-the-art equipment, and generally had good relationships with governmental regulators. One manager said that people in his company saw themselves as good neighbors in the community. "Anyhow," he concluded, "in the long run it's in our own interest, to keep us from lawsuits and generate some good will."2

Petulla's findings must be viewed in the light of the fact that many of the attitudes expressed concerned environmental laws and their enforcement and may not have reflected fundamental attitudes towards environmental matters accurately. Many of the managers in the second group may have had a commitment to environmental preservation, but they may have believed that governmental regulations are an inefficient way to protect the environment. Nevertheless the survey suggests that relatively few managers have a firm commitment to preserving the environment.

Engineering Codes and the Environment

In the light of widespread skepticism on the part of managers, what are the responsibilities of professional engineers with regard to the environment? The first canon of the NSPE code requires engineers to "hold paramount the safety, health and welfare of the public in the performance of their professional duties." Insofar as environmental issues have a clear relation to human safety and health, therefore, the engineering profession has already committed itself to a concern for environmental protection and perhaps even improvement. For example, engineers already have an obligation to concern themselves with pollution, when it affects human health.

The codes give little direction, however, as to how this concern should be implemented. What kinds of policies with respect to the environment should engineers advocate? If engineers have an obligation to promote a clean environment in order to protect human health, how do they determine what is "clean"?

A still wider issue is raised by the fact that some environmental problems do not raise issues of human health. Suppose an engineer is asked to participate in the design of a dam that will destroy a section of "wild river" and flood thousands of acres of farmland. He may believe that this is an unwarranted destruction of a natural state and even bad social policy. If an engineer objects to such, should she do so as an engineer or as a concerned citizen? In other words, should the objection to environmental degradation not involving dangers to human health be a matter of professional ethics or personal ethics?

Consider another example. An engineer may be asked to design a condominium project that will be built in a wetlands area. She may be concerned about the resource depletion that will be accelerated by a chemical process, or the destruction of plant species that will result from an engineering project. Can an engineer object to such projects on the basis of her role as an engineer, or should she make clear that she is objecting as a citizen? Again, should such objections be made on the basis of professional ethics or personal ethics?

One of the most explicit statements on environmental matters to be found in an engineering code is in the code of the Institute of Electrical and Electronics Engineers (IEEE). The first canon of the code commits IEEE members:

...to accept responsibility in making engineering decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment.

The fact that there is an explicit reference to endangering the environment in addition to endangering "the public" might be taken to indicate that environmental concerns go beyond a concern for human health. This inference might, however, be unwarranted. The concern for the environment might be intended to refer only to matters affecting human health.

Furthermore, IEEE members are obligated only to "disclose" possible dangers to the public and the environment. Should such dangers be disclosed only to one's immediate superior? What if one's superior is part of the problem? And does an engineer have any right as a professional to refuse to participate in projects to which she

has strong objections from an environmental standpoint? Again, the codes are silent.

In the next section we shall consider the obligations of engineers to environmental matters when human health is at stake. In the following section we shall consider the obligations of engineers when human health is not directly involved.

Environmental Matters Involving Human Health: How Clean Is Clean?

If we can assume that the engineering profession has already committed itself to a concern for the environment insofar as it is related to human health, how can we ascertain the proper implementation of that commitment? Since this question usually involves environmental pollution, one way to formulate this question is to ask how we can determine an acceptable level of pollution. The question is often asked, "How clean is clean?"

One way of responding to this question is to adopt an approach that is oblivious to costs and keeps the environment as free as possible of pollution. We have seen that the Clean Air Act places safety ahead of the balancing of costs and benefits when dealing with hazardous pollutants. It permitted the EPA to consider economic and technological feasibility in deciding when the goals were to be met, but not in adjusting the goals themselves. The Clean Water Act requires polluters to do the best they possibly can to stop polluting, without reference to cost. The Resource Conservation and Recovery Act requires that standards regulating hazardous waste be based solely on the protection of public health and the environment. The Endangered Species Act is essentially oblivious to cost considerations. Finally, in the famous decision regarding Tellico dam, the Supreme Court forced the dismantling of a dam costing $100 million in order to prevention the extinction of an economically worthless species of perch.3

There are several problems with this cost-oblivious approach to environmental pollution, even where human health is concerned. First, it tends to produce disrespect for the law. Manufacturers know that the law is unrealistic and that its practical significance is determined by the regulators. There is a strong incentive, therefore, to engage in as much deception and hard negotiation as possible, knowing that it may pay off in rich dividends.

Second, in spite of the rigor of the law, the enforcement of the law may be too lax. The disparity between the law and the way it is enforced may be too great. This is because enforcement involves consent decrees with industry. These decrees often allow pollution that is far greater than what the law allows. Thus the net result may be more pollution than an even less stringent law would have allowed.

Third, this approach takes no account of the cost of eliminating the pollution, or the fact that in some cases the threat to human health is unknown or is in dispute. Some pollutants pose far more danger to human health than others, and there are other values which should perhaps be considered as well, such as jobs and the standard of living.

In the light of these objections, some have proposed an approach to the regulation of environmental pollution based on cost/benefit analysis (CBA). CBA is a type of utilitarianism, in that its aim is to maximize human well-being. One aspect of well-being is health, and pollution is a threat to health. Unfortunately, reducing threats to health involves a cost. We cannot improve the environment with respect to human health without devoting resources to the effort, and this requires diverting those resources from other areas. As economist William F. Baxter comments, even though low levels of pollution contribute to human well-being, "so do food and shelter and education and music."4

CBA provides an appealing way of resolving conflict problems between the good of reducing pollution and other competing goods which make demands on social resources: we must divert resources to environmental causes only up to that point at which the resources can produce more overall human well-being if used elsewhere. It would be irrational, by the standards of CBA, to devote resources to environmental causes when the resources could produce more overall human well-being if they were devoted to other uses. Thus the goal of CBA is not a totally "clean" environment, but rather an environment such that making it any cleaner would divert financial resources from other areas, where they could promote more human well-being.

The CBA method for determining optimal pollution involves three steps. First, one must assess the problem in terms that are amenable to a CBA. Second, one must calculate the costs and benefits. Third, one must compare the costs and benefits and determine the proper course of action. We can illustrate this method by means of an example of pollution from a chemical plant.5

Suppose there is a large chemical plant near a residential area. The plant emits a number of noxious odors, some of them posing mild risks to health. How do we determine the optimal level of pollution which the plant should be allowed to contribute to the environment?

First, we must analyze the problem. The plant is emitting pollutants into the air, which is a part of the "commons." The commons are those areas, such as the air, rivers, and oceans, which are not owned by anyone in particular. Economists say that the plant is "externalizing" the cost of the pollution by forcing others, such as the surrounding residents, to pay the cost of the pollution. The costs of the pollution must be "internalized," or charged to the plant that produces the pollution. The other costs and benefits of regulating the pollution must be determined in order to arrive at an optimal pollution level.

Second, we must calculate the costs and benefits. If a manufacturer can dump pollutants into a river or into the air and not be liable for any further costs for their disposal, then we do not know the true costs of eliminating the pollutant. In order to internalize the cost, we must first determine the cost of the pollution.

One way to get a measure of the cost for the obnoxious smells is to compare the costs of homes near the plant with costs of homes in locations which are equivalent, except that the odors are not present. Then some measure of the cost to health would have to be obtained. We would have to estimate the lost earnings from days missed at work, the cost in suffering, and any other costs attributed to poorer health.

There are also costs associated with forcing the plant to eliminate the pollution, because the plant also confers benefits on the community. If the cost of eliminating the pollution produced by a given process is greater than the profits produced by the process, the plant may be forced to terminate the process. This would increase unemployment, and the cost of this increased unemployment would have to be entered into the CBA equation.

Third, we must compare the costs and benefits of regulating the pollution. The plant should eliminate the pollution up to that point at which the advantages to the community of eliminating the pollution are outweighed by the disadvantages to the community of eliminating it. Then the optimum level of pollution will have been reached.

This analysis omits many of the considerations that should be a part of a complete CBA, but it illustrates the method. This same method can, of course, be applied to any other type of pollution. Implementation of policies based on CBA does not guarantee that all pollution will be eliminated, but rather that resources will be used in the most economically efficient way.

There are several objections to the CBA answer to the question, "How clean is clean?" First, the CBA assumes that economic measures of cost and benefit must override all other considerations. CBA encourages only the elimination of pollution that can be eliminated in an economically efficient manner, and this may not be the pollution that is most harmful from an environmental standpoint. Suppose the chemical plant we have been considering is near a wilderness area that is damaged by one of the plant's emissions. It might not be economically efficient to eliminate the pollutant, from the CBA standpoint. Of course the damage to the wilderness area must be included in the cost of the pollution in a CBA, but this cost might still not justify the elimination of the pollution from the CBA standpoint, or even its reduction. In this event, CBA would allow the plant to continue damaging the wilderness area.

Second, it is often very difficult to ascertain the costs and benefits of the many factors that enter into a CBA. If the threats posed by many substances to human health are not known, it is impossible to execute a competent CBA. This problem becomes especially acute if we consider long-term costs and benefits, most of which are impossible to calculate.

Third, CBA often does not take into account the distribution of costs and benefits. Often those who bear the costs of pollution do not share in the benefits. Suppose a plant pays a pollution tax to dump pollutants into a river. By CBA, the costs of eliminating the pollution might not justify its elimination, yet these costs may fall in a disproportionate way to the poor people who often fish in the river and eat the contaminated fish.

Fourth, CBA often leads to conclusions contrary to the moral beliefs of many people. Many manufacturers opposed child labor laws, arguing that the laws would lead to economic inefficiencies. For example, tunnels and shafts in some mines were too small to accommodate adults. Many defenders of slavery made similar arguments based on economic efficiency. Our society did not eliminate slavery and child labor by considering whether or not the practices were cost efficient, but because we found the practices immoral. We shall see in the next section, in fact, that most environmental legislation is based on values that transcend CBA.

This observation does not, of course, show that CBA is wrong. It may be that our moral beliefs that cannot be justified by CBA are themselves wrong. Nevertheless, the counter-intuitive implications of CBA do at the very least raise doubts about its validity as a complete basis for answering the question, "How clean is clean?" Combined with the other problems, this objection becomes even more relevant.

In spite of these problems, CBA is a useful method in determining the proper policies for pollution control. The criticisms show that, taken alone, it is not adequate.

If defining "clean" in terms of either a cost-oblivious approach or CBA are both unsatisfactory, philosopher Mark Sagoff suggests a middle ground between them. Sagoff suggests that what is needed is a policy that:

might permit the agencies to take technological and economic factors into account, on a case-by-case basis, as long as they act in good faith to make progress toward reducing and, it is hoped, eventually eliminating damage to the environment and risks to human safety and health.6

Sagoff believes the move away from a cost-oblivious environmental policy is evident in several court decisions. In International Harvester vs. Ruckelshaus a D.C. circuit court ruled that EPA regulations might have been congruent with the Clean Air Act, but were defective in that they failed to justify their rulings by a consideration of the feasibility and practicality of the technology required.7 A District of Columbia Circuit Court of Appeals rendered a decision with similar import. It interpreted a relevant section of the Clean Air Act as permitting the

EPA to consider costs, but not to impose a cost/benefit test.8 In the famous "Benzene" decision of 1980 a plurality of justices on the U.S. Supreme Court found that "safe" does not entail "risk free." Justice Stevens argued that OSHA could not regulate a chemical simply because it posed some risk. OSHA would also have to show that the risk was "significant."9

In 1986 a tribunal for a District of Columbia circuit court reviewed a decision by the EPA setting a standard for vinyl chloride emissions at levels less strict than industry might achieve at great effort and expense. When the EPA cannot determine a "safe" threshold for a pollutant, it may take not only health but also technological and economic factors into account in establishing emission standards that industry can achieve without paying costs "grossly disproportionate" to the level of safety achieved.10

It is not always clear how Sagoff's suggested policy should be applied, but it may be a useful general guideline in determining engineering responsibilities with respect to environmental pollution. As such, it can be a supplement to the almost total lack of specificity in the codes. It shows a blend of RP and utilitarian considerations that is characteristic of many good moral guidelines. That is, it takes into account both the need to protect human health and the need to balance costs and benefits, within certain limits. It also has the benefit of a background in the law. Now let us turn briefly to a consideration of environmental concerns that go beyond considerations of human health.

Engineering Responsibilities to the Non-Human Environment

Contemporary technologically advanced civilization has made massive changes in the environment. Western society has tended to conceive of nature as passive, as the fit object of human manipulation and control. This view of nature as passive is amply reflected in our language about the natural world. Land is to be "developed." "Raw" land is to be "improved." Natural resources are to be "exploited" and "consumed." Trees are to be "harvested." The rivers are to be "harnessed" to produce electrical power. The wilderness must be "managed." Nature, like the rest of the non-human world, is to be subservient to human purposes.

The environmental movement, so influential during the last twenty-five years, is a reaction against this attitude toward nature, but there is still a question as to whether the concern for non-human nature should be a part of professional engineering ethics rather than an engineer's personal ethics. What are some of the arguments for and against including a concern for non-human nature in the professional codes of engineers?

Those who believe that professional engineering obligations to the environment should not be extended beyond a concern for factors that endanger human health could make the following arguments.

First, the judgments that would have to be made in this area fall outside the area of professional engineering expertise and as such might be considered a violation of professional responsibility. Suppose an engineer is asked to participate in the design of a condominium which will be built on a wetland area. The engineer objects because she believes that the wetland area is especially important for the ecology of the area. This judgment is not a professional engineering judgment, but rather one more appropriately made by a biologist.

The same problem exists in many other areas related to the environment. An engineer may object to a dam that will destroy a wild river or flood hundreds of acres of farmland. Or he may object to designing a sawmill that is to be built in the midst of an ancient forest. In all of these cases the judgments involve considerations outside the engineer's professional expertise. An engineer may well object to these projects, but he or she should not object as an engineer. To do so is to invite public disrespect for the engineering profession.

Such objections might even be considered violations of engineering codes. The NSPE code contains the following statement:

Engineers may express publicly a professional opinion on technical subjects only when that opinion is founded upon adequate knowledge of the facts and competence in the subject matter. (II,3,b)

Many objections to environmental matters are not based on professional engineering competence. Suppose the NSPE code also contained another provision such as this:

Engineers must not participate in projects that are unnecessarily destructive to the environment, even if they do not endanger human life or health.

The judgments necessary to comply with such a provision would often not be professional engineering judgments, so that implementing such a provision might well involve violating section II,3,b.

Second, an extension of professional responsibility for the environment into areas not clearly related to public health or safety might cause considerable problems for engineering societies. Along with other members of society, engineers disagree over environmental issues, especially where human health is not directly involved. Forcing members of professional societies to take policy stands on such issues will introduce a new source of divisiveness into professional societies.

Another aspect of this same objection is that such issues will be especially troublesome for engineering managers who are members of the societies. Management cannot be expected to be sympathetic to policies that will inevitably result in greater expense for industry. The effect of introducing these issues into the societies may serve to weaken industry support for the societies themselves.

There are, however, reasons for believing that engineers should assume a professional responsibility for the effects of engineering work on the non-human environment.

First, a good argument can be made that the very concept of responsibility shows that engineers have a responsibility for environmental problems, even when they do not directly affect human welfare. Philosopher Kenneth E. Goodpaster finds several senses of the term "responsibility," two of which are relevant here.11 In the causal sense of responsibility, we say of a person that he or she is responsible for something when an action or event is brought about at least in part by that individual. By this definition, engineers should share in the responsibility for environmental concerns, because technology has brought about many environmental problems, and it has the capacity to remedy many of them.

Another conception of responsibility is a rule-following sense, referring to socially expected behavior associated with certain roles. Thus parents have responsibility for children. In this sense also engineers have responsibility for the environment, for many members of the public expect engineers to assume this responsibility.

Second, the engineering profession could make a substantial contribution to the protection of the environment. Engineers are, after all, major participants in virtually all of the projects that affect the environment for good or ill. If even a substantial number of concerned engineers refused to contribute their professional skills to some of the most environmentally destructive projects, the result might well be the cancellation of the projects or at least a modification of them so they will produce less environmental devastation.

We shall leave it to the reader to decide whether engineers should have an obligation as professionals to protect

non-human nature. There is, however, another approach to the question. There is a precedent in other professions for allowing professionals to refuse to lend their professional expertise to activities to which they have personal objections. The morality of abortion is an issue outside the professional expertise of physicians. It is a matter for moral philosophy or theology rather than medicine. Nevertheless, physicians are not usually required to perform abortions if they have moral objections to it. Similarly, perhaps engineers should not be required to participate in environmental projects to which they object. Many engineers already have serious reservations about some projects that damage the environment. Without support from the codes, they may find it difficult to register their objections to the projects or to refuse to participate in them. Perhaps a provision in the code could be worded like this:

Engineers should not be required to participate in projects which, in their personal judgment, are unnecessarily harmful to the environment. They also have the right to make their objections known to the proper authorities.

This provision allows a professional engineer to refuse to participate in (and even to object to) projects which offend her personal values regarding the environment.

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