

ARTICLES

PROTECTING THE ENVIRONMENT: FINDING THE BALANCE BETWEEN DELANEY AND FREE PLAY

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1. INTRODUCTION

The challenge in developing a strategy for managing environmental risk is in finding a balance between extremes. One extreme is exemplified in a Delaney-like Clause¹ that bans any activity which creates pollution. The other extreme is in permitting unrestrained free play.

The purpose of this Article is to propose a set of principles and guidelines for determining an appropriate course of action that recognizes the impracticability of zero risk while at the same time considering the costs of private market transactions without

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¹ The Delaney Clause was enacted by Congress in 1958 and absolutely prohibits the use of food additives found to induce cancer in man or animals. See 21 U.S.C. § 348(c)(3)(A) (1994). It has been interpreted as a "zero risk" philosophy. See, e.g., Cass R. Sunstein, *On the Costs and Benefits of Aggressive Judicial Review of Agency Action*, 1989 DUKE L.J. 522, 523 (1989). For more details on the implications of the Delaney Clause for risk assessment, see Joseph Rodricks & Michael R. Taylor, *Application of Risk Assessment to Food Safety Decision Making*, in READINGS IN RISK 143 (Theodore S. Glickman & Michael Gough eds., 3d ed. 1993).

any restrictions. To begin with, this Article contrasts the relevant tradeoffs facing companies where there is central government control with those that have property rights. These two scenarios suggest a conceptual framework for alternative policy programs to deal with environmental problems.

This Article then examines these programs under regimes where firms have property rights and where they do not. Using an analogy regarding how a city provides parking for vehicles, this Article evaluates the costs and benefits of alternative strategies that may be relevant in dealing with environmental risks. This Article concludes by arguing for a system of more closely specified standards and regulations for managing environmental risks.

2. SETTING THE SCENE THROUGH SCENARIOS

Our story begins with the following scenario:

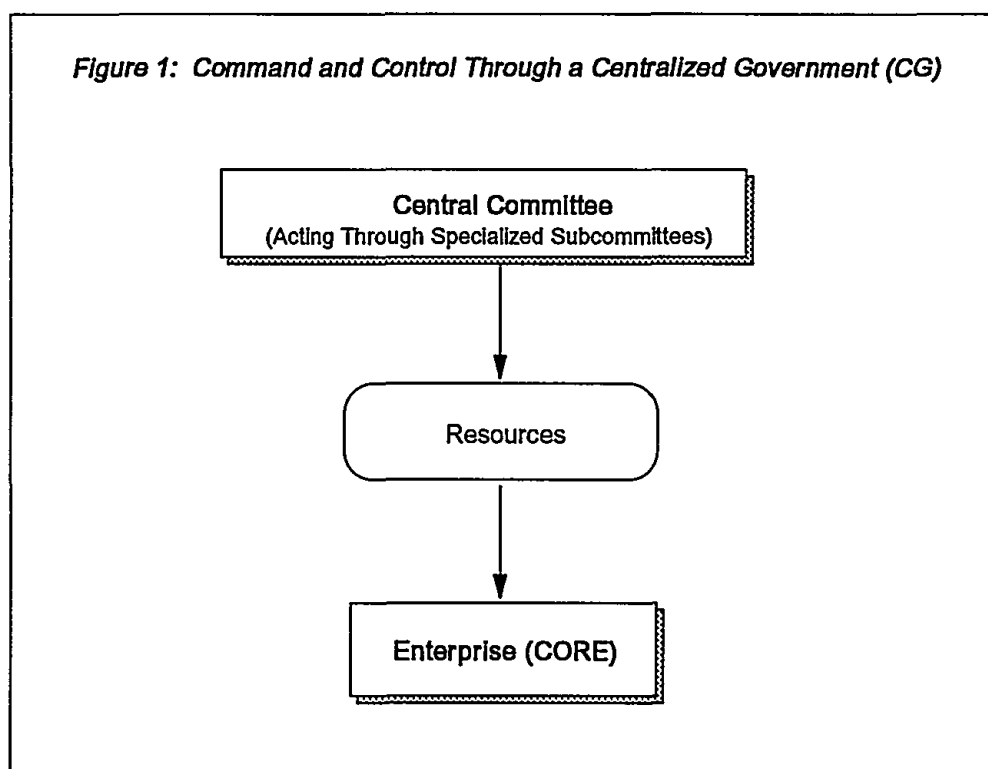
The Complete Oil Refinery Enterprise ("CORE")² is producing a variety of different hydrocarbon fuels that help to power internal combustion engines. These engines in turn provide motion power for vehicles and energy for the generation of electricity. The vehicles—trucks, trains, and aircraft—carry people and commodities to and fro. The electricity produces machines that simplify many chores that had previously been undertaken by hand, such as cultivating and harvesting crops, and washing clothes in the river.

These labor-saving and liberating benefits are dependent on the availability and use of fuel. The benefits, however, need to be balanced against the adverse environmental impacts of pollution, which affect both the groundwater, through leaks from underground storage tanks, and the ambient atmosphere through emissions into the air. This impact on the environment can affect both current and future generations. Moreover, it will be difficult to reverse some of the environmental damage that has already been incurred.

² All names of enterprises, government bodies, and legislative acts in this Article are designed to be fictional.

2.1. *Version 1: Central Government Control*

One way to balance risks with benefits is through a command and control procedure where a centralized government ("CG"), acting through a central committee and specialized subcommittees, designs and implements strict procedures for limiting the pollution of the refinery. Resources are allocated to CORE by the central committee and its specialized subcommittees. This arrangement is depicted in Figure 1. Such a world involves no property rights, with no significant rights in corporate property for organizations such as CORE; no rights in contract; and no right to complain about invasions of corporate enterprise by government inspectors or expropriators, or by other concerned parties. The central committee retains the right to restrict and punish such "private" initiatives by groups such as popular activists or terrorists.



This is a substantially accurate description of state socialism in practice as illustrated by the former Soviet Union, the Eastern European economies under the prior regime, and the current regimes in China and Cuba. In such a system, the CG can impose any sanctions it desires without the management or employees of the refinery having any formal right to protest the action. Thus,

if the leaders of the CG want to limit the pollution-generating activities of CORE in any way, or wish to close down CORE altogether, it would have the right to do so.

Under this type of centralized control there are limited immediate transaction costs between the government and business enterprises in determining what actions should be taken.³ Decisions are made from the top without any obligation to receive input from those who are directly involved in the relevant activities. Authority to use information and knowledge resides with the heads of government. Learning from those more familiar with the risk is incidental and unsystematic. By the same token, monitoring costs are high, since it is the responsibility of the CG to exercise command and control procedures.⁴ Employees at CORE have every incentive to engage in activities that conceal risks for which they would be held responsible. Midnight dumping of waste, for example, would be prevalent.

In more formal terms, the CG would be viewed as the *principal* and CORE would be considered the *agent*.⁵ There would be asymmetric information between these two parties. The CG has control over the means of dealing with pollution problems, but CORE has a near monopoly of information indicating the specific kind, variety, and magnitude of the pollution effects. There is no binding contract for undertaking specific tasks, since CORE has no property rights and no autonomy in its interaction with the CG.

To the extent that the agent has special knowledge or the ability to undertake activities that the principal cannot detect, the outcome of the process will be suboptimal. Learning about the risks over time is restricted, since the agent has every incentive to reveal only information that bolsters its position. The costs of ferreting out such data may be very high.

³ For a discussion of these transaction costs and their impact in a regulatory context, see Richard B. Stewart, *Beyond Delegation Doctrine*, 36 AM. U.L. REV. 323, 329-35 (1987).

⁴ For a discussion of this process in an environmental context, see Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 DUKE L.J. 1, 29 (1991).

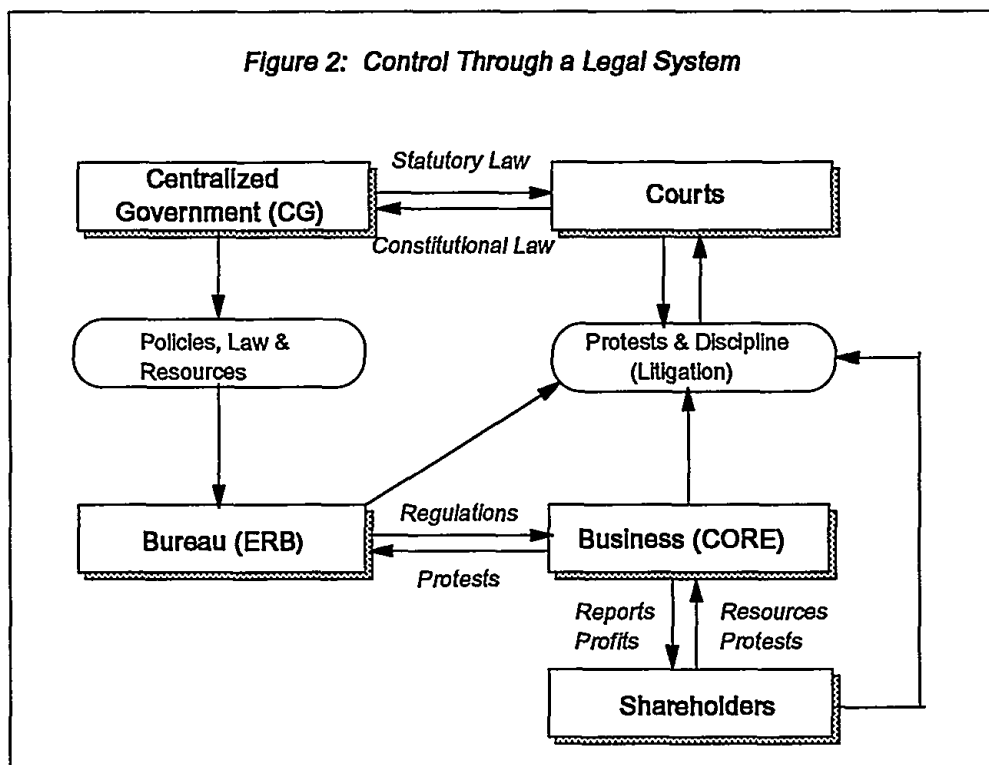
⁵ For more detail on the structure of principal-agent problems, see Cass R. Sunstein, *Problems with Rules*, 83 CAL. L. REV. 953, 1012-15 (1995).

2.2. *Version 2: Enterprises With Property Rights*

Under this version there would still be a centralized government that has the responsibility of balancing the benefits and costs of environmental risks to society. However, CORE and other enterprises have property rights and recourse to the courts through a legal system should they feel they have been treated unfairly. CORE's managers and other operators have a legal identity that is distinct from both CG and CORE and are accountable both as employees of CORE and as citizens. The dynamics of the relationship between government and business are, as a consequence, radically different from those under the CG system.⁶

CORE is owned by shareholders who have an interest in seeing that the enterprise is profitable, whereby they earn a high enough return on their investment to justify maintaining their equity in the firm. They thus have an interest in monitoring the activities of the refinery, even if in an indirect fashion. The government specifies a set of rules and regulations that address the environmental risk issues and administers them through a government agency. For illustrative purposes, suppose that the Environmental Responsibility Body ("ERB") is created for this purpose. The forms of interaction between these different groups and entities is shown in Figure 2.

⁶ See *id.* at 1014.



The procedures of ERB could take on a number of different forms that would be sanctioned by legislation, such as the Oil Pollution Prevention Act ("OPPA").⁷ At one extreme, ERB could issue a rule that prohibited CORE from emitting any pollution. If any violations were detected, ERB could invoke procedures to close the refinery. If the managers of CORE or its shareholders felt the ruling was unfair, they could protest this action and take the case to court.

Such a system would require expensive monitoring and control procedures on the part of ERB to determine whether the refinery had been responsible for any pollution. In fact, no refinery can operate without generating some adverse environmental effects. If the rule indeed prohibited all environmental pollution, then CORE would be shut down. Hence, the result of this ruling would be no refinery products, no vehicles, and no electricity.

A more modest option for ERB would be to issue a regulation that limits pollution from CORE's activities. If the refinery exceeded the limit imposed, then ERB would have the authority to penalize CORE. For example, the penalty for exceeding the

⁷ 33 U.S.C. § 1321 (1994).

proscribed limits could range from a fine of \$1000 (for a first offense) to closing the business (for a third or fourth offense). The refinery could challenge these penalties if it could provide evidence showing that it had not exceeded its limits.

CORE could also challenge the regulation by producing scientific data that the environmental risk from pollution was minimal, so that the magnitude of the penalties imposed were extreme and unfair. The court system would have to rule on this question. In any event, there would be a need for ERB to determine whether CORE had exceeded specific pollution limits and to defend its position in court. CORE would have a right to produce its own counter evidence. This could involve substantial costs to both the government and the refinery.

A third option would be to establish a liability system that holds CORE responsible for any illnesses, deaths, or damage to the environment from its pollution. If there were well-specified penalties associated with these consequences, and if the risks associated with different levels of pollution could be computed, then CORE would undertake some type of cost-benefit analysis in determining the nature of its activities. Cost-benefit analyses of this kind have been examined at the theoretical level in the law and economics literature.⁸

The use of this form of legal liability for controlling environmental risks requires that it be feasible to estimate the risks associated with pollution from the refinery. More specifically, it requires the ability to prove to a tolerable degree of plausibility the existence of a casual link between pollution from CORE and environmental damage and harm to humans.⁹ The devil lurks in the details of defining and proving a standard such as "tolerable degree of plausibility." For example, there will very likely be long delays between exposure to pollution and the onset of illness, such that other factors besides the pollution from the refinery

⁸ For a detailed treatment, see WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF TORT LAW* (1987); STEVEN SHAVELL, *ECONOMIC ANALYSIS OF ACCIDENT LAW* (1987). An illuminating set of papers on the role of cost-benefit analysis in evaluating regulations can be found in *RISK, COSTS, AND LIVES SAVED: GETTING BETTER RESULTS FROM REGULATION* (Robert W. Hahn ed., 1996).

⁹ For an explanation of the difficulty in establishing this causal link, see Dale Hattis & David Kennedy, *Assessing Risks from Health Hazards: An Imperfect Science*, in *READINGS IN RISK* 156, 157-59 (Theodore S. Glickman & Michael Gough eds., 3d ed. 1993).

may be responsible for negative environmental impacts. The method of proof is expensive, and to some degree indeterminant, as demonstrated, for example, in the case of asbestos.¹⁰

A liability system may create a role for insurance as a fourth option for dealing with the pollution risk. By estimating the risks associated with pollution, the insurer could provide CORE with coverage against harm and damage in return for a premium. The terms of the insurance contract would be specified in advance. For an insurer to be willing to offer a policy, it would have to be able to estimate the likelihood of adverse environmental events and their consequences, so as to be able to determine what premium to charge. If the insurer felt that the probabilities of certain events were highly ambiguous, or that the amount of liability for which CORE would be responsible was uncertain, then it might want to charge a premium that would exceed what the refinery is willing to pay. In such a case, the pollution risk would be considered uninsurable.¹¹

We can examine the relationship between CORE and ERB in Version 2 using the concepts of principal-agent theory. The roles of the two parties are identical to those described in Version 1, but their behavior is likely to be very different. ERB, the principal, is now mindful that the refinery has property rights and recourse in the courts should ERB try to enforce policies that CORE feels are excessively harmful to its operation.

Both ERB and CORE are at some risk if ERB undertakes to promulgate a regulation that the courts might hold excessive, or to enforce a regulation on the basis of evidence that the courts might consider inadequate.¹² If a proposed regulation is held by the courts to be too stringent, or enforcement denied for lack of adequate proof of violation, ERB will have failed in its regulatory

¹⁰ See PAUL K. FREEMAN & HOWARD KUNREUTHER, *MANAGING ENVIRONMENTAL RISK THROUGH INSURANCE* 55-62 (1997).

¹¹ There are a number of conditions that must be met for a risk to be insurable, such as absence of adverse selection and moral hazard, which are beyond the scope of this paper. For a more detailed discussion of these conditions in the context of environmental risk, see *id.* at 37-48.

¹² For example, in 1992 the Federal Court of Appeals for the Ninth Circuit set aside an EPA final order which allowed the use of four carcinogenic pesticides, holding that this action violated the Delaney Clause. See *Les v. Reilly*, 968 F.2d 985, 990 (9th Cir. 1992).

mission and could well suffer political embarrassment as a result.¹³

By the same token, if the regulation is upheld by the courts, or proof of violation is deemed to be adequately established, then CORE will suffer corresponding financial embarrassment, and perhaps political embarrassment as well. In cultures where the media play an active role, companies found to be pollution violators can suffer severe consequences, not only financially but also in "public opinion."¹⁴ In any event, the litigation and legislative processes that are involved will entail substantial transaction costs to both ERB and CORE.

Given the existence of a legal system, there are incentives for the refinery and the government to share information on the risks and to develop formal contractual or quasi-contractual relationships to deal with negative events. Both parties have incentives to reduce the monitoring and transaction costs associated with determining the risk and settling their differences. The refinery is likely to have information on its operations and the generation of pollution that may be difficult for the government to obtain without considerable expense. The challenge for ERB is to develop a set of incentives to induce CORE to behave in a way that meets the objectives of ERB without having to engage in costly policing activities.

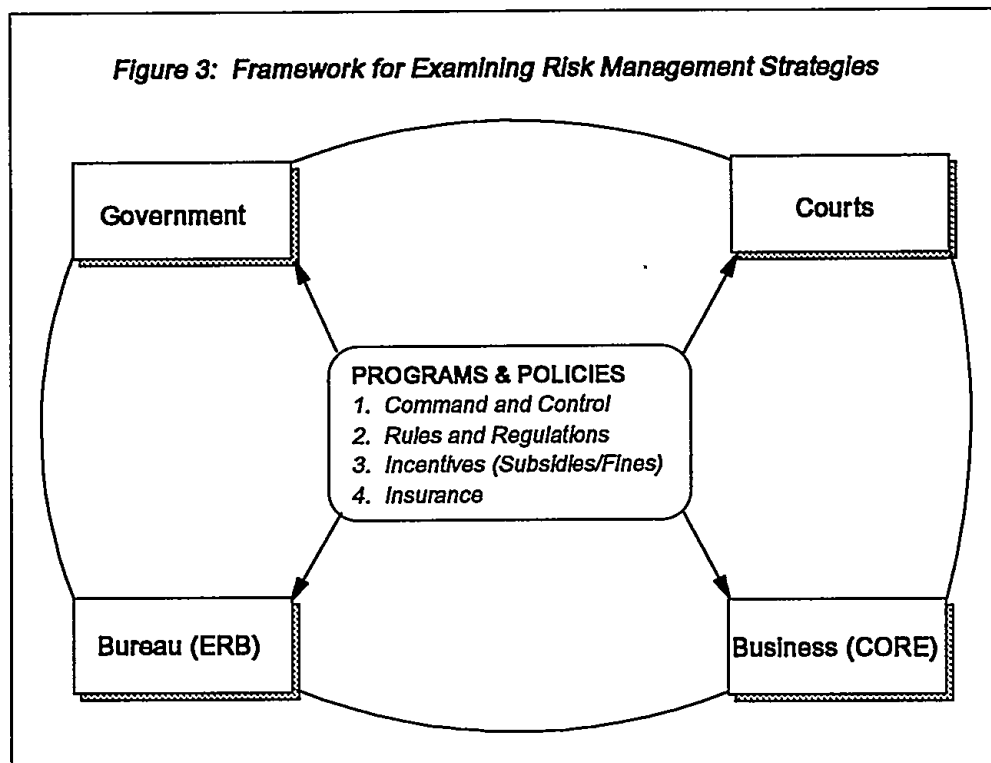
3. HOW SHOULD ENVIRONMENTAL RISK BE MANAGED?

3.1. *A Conceptual Framework*

The above two scenarios suggest the following simple conceptual framework for managing environmental risks, as depicted in Figure 3. In the center of the diagram are a set of programs and policies ranging from command and control procedures to incentives and insurance. There are four stakeholders who must either follow or evaluate these programs and policies: the government, regulatory agencies as represented by ERB, businesses such as CORE, and the courts.

¹³ Political embarrassment can translate into legislative restrictions on ERB or cuts in its budget.

¹⁴ Pertinent recent examples include Exxon's experiences after the grounding of the *Exxon Valdez* in Prince William Sound, and Union Carbide's experiences after the mishap at its plant in Bhopal, India. See *Bhopal: Ten Years On*, THE ECONOMIST, Dec. 3, 1994, at 78.



3.2. *No Property Rights*

As we have seen, there is a set of potential programs that can be administered by the government in conjunction with the affected business enterprise. When a business does not have any property rights, and its executives have no autonomy apart from their role as managers, then government has complete legal authority and will use command and control procedures to enforce its will.

One way of understanding the environmental disasters in the East countries under the Communist system is to recognize that managers of enterprises — the steel and chemical factories; the atomic energy plants, oil wells and pipelines — did *not* have control of the operations of these enterprises. Rather, the operations were controlled by distant planners wielding authority over output.¹⁵ The socialist theory contemplated that the costs involved in achieving output would be transparent. In fact, these costs indeed appeared to the highest level of authority to be reasonable, but only because they were concealed by under-

¹⁵ U.S. GENERAL ACCOUNTING OFFICE, ENVIRONMENTAL ISSUES IN CENTRAL AND EASTERN EUROPE: U.S. EFFORTS TO HELP RESOLVE INSTITUTIONAL AND FINANCIAL PROBLEMS, GA1.13:RCED-94-41 (1994).

reporting, non-reporting, or simply lying.

It is well known that management of enterprises in the Soviet system faced relentless requirements for fulfilling nominal quotas, regardless of quality. An immediate and obvious way of cutting cost was to disregard environmental consequences.¹⁶ In effect, the distant planners had no responsibility with respect to limiting the external costs of achieving output. By the same token, local management had no means of planning and budgeting against environmental pollution, any more than they could plan and budget for other long term needs of the enterprise.

It should not be assumed that managerial irresponsibility leading to adverse environmental consequences is unique to a socialist system. Similar problems can arise in property-based systems such as our own, either between the Government and private enterprise or within business enterprises. That is, private enterprises have incentives to under-report or to lie to the Government. Divisions within business enterprises have similar incentives in relation to top corporate management.¹⁷ The unique feature of the socialist systems was their inability to recognize the problem.

In the theory of state socialism there was "objective truth" about the world, including such tedious details as the effluents from refineries and factories, etc. The acquisition of this information involved no transaction costs, or merely negligible ones. Objective truth was accessible to anyone in the social system, and therefore could be obtained as easily at lower levels as at the top. Any discrepancy between the perception of reality at the top and perceptions at lower levels would be attributable to inadequate comprehension — that is, "error" — at the lower levels.

3.3. *Property Rights*

In a capitalist system, given that enterprises have property rights, it is necessarily presupposed that there is a legal system to recognize and enforce those rights. "Property" — whether in a

¹⁶ See, e.g., *Cleaning Up Russia*, J. COM., Nov. 14, 1994, at 8A.

¹⁷ A 1992 survey of corporate counsel found that sixteen percent of companies surveyed had altered reported environmental audit information, in the absence of a federally recognized corporate environmental self-audit privilege. Marianne Lavelle, *More Lawyers Expect to Urge Their Clients to Examine Compliance*, NAT'L L.J., Mar. 16, 1992, at S6.

refinery, a factory building, or in shares of a company that owns such a facility — is a legal relationship. Ownership confers the right to use the facility and the right to exclude others from interfering with it, subject of course various legal controls on the ways the facility may be used. Also presupposed is a judicial system in place that will settle disputes between government and business over regulations and their administration. Regulations and incentive programs are now an integral and familiar part of a strategy for managing environmental risk.¹⁸

The decision-making process of the company, in response to a set of environmental regulations and incentives, is guided by corporation and contract law. Under corporation law, management's activities are subject to review by the board of directors and to intervention by the shareholders or by creditors in extreme situations. Execution of company programs and policies is carried out through a complex matrix of contractual arrangements. The directors carry out their authority to hire the CEO and other top executives; top management hires the rest of the staff, in the case of an established business usually by continuing the employment of staff already in place. The staff, under the direction of the legally constituted company management, formulates policy and carries it through by appropriating the funds and deploying the personnel necessary to the task. In short, the management of a business in a capitalist system is a legally constituted regime of private government with its own fiscal and personnel powers.¹⁹

A correlative to corporate property rights is the concept of personal autonomy on the part of corporate officials. Members of a corporate board have personal responsibilities going beyond interaction with management; management has responsibilities going beyond deference to the board of directors.²⁰ Lower echelon personnel have authority and responsibility as citizens as well as employees. The role of a "whistle blower" is simply a

¹⁸ For a discussion of the evolution of this strategy, and a look at the future of managing environmental risk, see Samuel P. Hayes, *The Future of Environmental Regulation*, 15 U. PITT. J. L. & COM. 549 (1996).

¹⁹ The classic exposition is ADOLF A. BERLE & GARDINER C. MEANS, *THE MODERN CORPORATION AND PRIVATE PROPERTY* (1991).

²⁰ See generally, ARTHUR FLEISHER ET AL., *BOARD GAMES: THE CHANGING SHAPE OF CORPORATE POWER* (1988). For an illustration of this concept in the context of a managerial buyout of a public company, see *Smith v. Van Gorkom*, 488 A.2d 858 (Del. 1985).

dramatic illustration of this autonomy.²¹ A less visible but pervasive form of the autonomy of corporate employees is their right to quit if their jobs become unbearable. This regime based on property rights and individual legal autonomy is more complex than a centralized control system. However, paradoxically it is almost certainly capable of greater efficiency.

3.4. *Evaluating Alternative Programs*

Each of the programs outlined in the conceptual framework in Figure 3 requires addressing the following questions:

- What types of data are required to administer the program?
- How costly and time consuming is it to obtain these data?
- How accurate are the data likely to be under the specific institutional structure in place?
- Can the accumulation and transmission of relevant data modify existing programs at a reasonable cost?
- What are the impacts of the program on the different stakeholders? These impacts can include economic, social and psychological factors incurred in the present as well as in future periods.
- How much should each stakeholder pay for the measurable direct costs and transaction costs of the program?

These questions address issues of both efficiency and equity. With respect to efficiency, it is certainly possible to compare alternative political systems as well as programs in terms of their performance and costs borne by different stakeholders. The question as to how much each stakeholder should pay is an equity issue and will be determined by a country's political process.

4. AN ANALOGY: PARKING IN THE CITY

This Article will now illustrate a set of alternative programs

²¹ See, e.g., Lewis D. Solomon & Terry D. Garcia, *Protecting the Corporate Whistle Blower Under Federal Anti-Retaliation Statutes*, 5 J. CORP. L. 275 (1980).

in the context of the following non-environmental problem facing a municipality: determining how to provide parking for vehicles in the city. Several strategies can be followed in dealing with this issue.

4.1. *Command and Control*

The city can post signs on designated streets indicating where cars have a right to park during certain hours of the day (e.g., non-rush hour). Vehicles parked in non-designated spaces, or during times that are prohibited, would be physically removed from the space by municipal authorities. It is up to the city government to decide whether or not to return the vehicle. Owners of the cars would have *no* rights under this type of regime.

Under such a system the only information collected by the city would be on the status of the vehicle with respect to parking spots. There would be no officially recognized data on the needs of the vehicle owners or the reasons why they may have chosen to be in a non-designated space (e.g., whether a person was a doctor making an emergency call). It could be predicted, however, that information of this kind would be transmitted informally and utilized by the authorities through some form of corruption or bribery.

4.2. *Regulatory System*

Another strategy would be for the city to construct parking lots whereby a person paid for the right to leave a vehicle for various lengths of time. Vehicles would be prohibited from parking on the streets. Those found on the streets would certainly be towed, and possibly destroyed. The parking lot would be monitored by an attendant who collected the applicable fee and ensured that vehicles were safe during their stay. Through privatizing parking, the city can control the flow of cars while at the same time collecting revenue for the service it provides. If the city wants to encourage people to come downtown for shopping, it could provide free parking, as is done in shopping malls today.

Under such a regulatory system the owners of vehicles have wider discretion than under a command and control system. They are provided with information on the costs associated with parking and can decide accordingly whether to bring their vehicles into the city or use other means of transportation. They still,

however, have no recourse to the courts if they feel their car has been unjustly removed (e.g., parking on the street if all lots are temporarily full).

4.3. *Incentive System*

Rather than constructing parking lots, the city might install meters. Vehicle owners now have the option to pay for parking or to take their chances by not depositing money in the meter. The decision as to what course of action to follow will be determined by each individual's assessment of the chances of being detected and the magnitude of the fine. In essence, the meter charge can be viewed as an insurance premium that provides protection to the vehicle owner against the much larger, and uncertain, cost of a fine.

Under such an incentive system, there are costs associated with monitoring the vehicles as well as collecting the money deposited in the meters. Vehicle owners have a right to protest the fine by appearing in court and indicating why they feel they may be unfairly penalized (e.g., the meter was broken). Hence, there is also a set of legal processing costs associated with prosecuting those individuals who violate the law.

4.4. *Comparison of Systems*

Each of the above systems implies a set of decisions regarding who should pay and how much. To the extent that one wants to discourage driving in the city, one could construct fewer lots and/or charge high fees to park. If one wants to reduce the time spent monitoring meters, then one could charge extremely high fines so that people would want to pay the relatively small parking fee even if the probability of being caught was known to be relatively small.

5. CONTRASTING THE PARKING AND ENVIRONMENTAL RISK PROBLEMS

5.1. *Formal Similarities*

The parking problem and the problem of dealing with environmental risks are formally similar, but very different in substantive complexity. Both problems can be analyzed in terms of the following factors:

- The various types of institutional mechanisms for dealing

with the problem. These range from centralized government control, at one extreme, to insurance and private contracts enforced through a system of legal rules.

- Cost-benefit analysis. The cost-benefit calculations also can address a range of issues ranging from micro-system determinations of the appropriate charges for specific transactions, such as the fee for parking in a particular garage, to macro-system determination of the social costs and benefits of a particular set of policies.²²

- The incentives and disincentives for exchange of accurate information about conditions and changes within the system. In the case of parking, for example, the lot attendant has a different incentive for noting the presence of a vehicle for which a parking fee should be charged than does a driver calculating whether he can "beat the meter." In the case of environmental risk, the incentives for providing accurate information could be quite different for top level management, whether in a government agency or in a corporation, than for lower level operatives dealing directly with the process.

- The "relevant" parameters of the specific system. In the case of parking, should the definition of the system include alternative means of transportation, such as buses or light rail? In the case of environmental risk, should the definition of the system include the possibility of relocating the refinery in another region of the country or in some other part of the world?²³

- The "relevant" costs and benefits. As is now generally recognized, there is no *a priori* definition of relevant costs and relevant benefits in any system. In the parking problem, what account should be given to the costs involved when a vehicle owner has to walk a block or two after parking? What of the concerns of women who must walk alone after parking at night? Is it a benefit or a cost that abundant parking encourages middle class workers to move to the suburbs? In the environmental risk problem, what account should be taken of the effect that certain

²² For a discussion of the difficulty of valuing such costs and benefits, see Robin Gregory et al., *Valuing Environmental Resources: A Constructive Approach*, 7 J. RISK & UNCERTAINTY 177 (1993).

²³ For a discussion of the issues related to deciding where to site facilities which pose potential threats to the environment, see Ralph L. Keeney & Detlof von Winterfeldt, *Managing Nuclear Waste from Power Plants*, 14 RISK ANALYSIS 107 (1994).

regulations have on the employment of refinery workers? What about the effects on low income families of an increase in the cost of gasoline?

5.2. *Substantive Differences*

The formal similarities between the parking problem and the environmental risk problem reveal substantive differences in the scale and complexity of the two problems. Some of the important substantive differences are:

- The risk and damages associated with pollution are much more difficult to quantify than the costs associated with parking a car in the city. Environmental risk, as we understand it in modern context, is a complicated chain of interactions, in which it is difficult to assign causality to one set of activities.²⁴ If the environmental problem was that of dumping raw excrement into the community water well, it would be relatively simple to calculate the risk from this activity and analyze the costs and benefits of alternative programs. Assessing the environmental risk posed by an oil refinery, however, requires addressing problems of marginal causes and effects (e.g., the impact of refinery effluent given discharges from many other sources); multiple causes of pollution (e.g., refinery effluent compared with ambient automobile exhaust); and of latency of injury (e.g., impaired breathing or certain diseases may occur many years after the exposure to certain types of pollution).

- The problem of identifying compliance or deviance is fairly simple when it depends on a relatively gross event, such as the location of an improperly parked vehicle. Identifying the kind and quantity of particulate emission from a modern factory or refinery is much more complicated.

- The complexity of information transmission increases exponentially as environmental controls endeavor to be more exacting.²⁵ If the environmental problem were simply that of dumping excrement in the local water supply, the circle of

²⁴ For a detailed analysis of the difficulties in dealing with the causality issues for environmental risks, see J. GRAHAM ET AL., *IN SEARCH OF SAFETY* (1988).

²⁵ For a discussion of the difficulty of effectively communicating environmental risk, see Neil D. Weinstein & Peter M. Sandman, *Some Criteria for Evaluating Risk Messages*, 13 *RISK ANALYSIS* 103 (1993).

relevant actors and the number of information interchanges is relatively straightforward. When the environmental problem is that of controls on the amount and timing of exhaust from a modern oil refinery, information transmission is vastly more complicated. What kinds of emission detection devices are reliable and who can certify their precision? Who is to read the meters on the detection devices? What reports need to be written and to whom should they be sent? If there is a breakdown, who is "responsible" and what do they have to do?

- As the complexity of the information transmission system increases, the incentives and disincentives presented to the relevant actors for transmitting and acting upon information are increasingly delicate and difficult to estimate.²⁶ What, exactly, are the appropriate incentives for the head of the regulatory agency and the CEO of the oil company to take preventive actions? What motivates the claims adjusters from an insurance company after an accident occurs? What rewards and punishments are required to motivate the foremen at the refinery site to satisfy the firm's objectives? The costs associated with these incentives are connected with inspection, monitoring, control and policing activities.

- The cost of achieving more exacting standards goes up exponentially for environmental risks. Some environmentalists want a Delaney-like clause that would shut down all refineries. On the other hand, a large segment of the public may think that the prices for gasoline and heating oil are already too high. For this reason the question of "how safe is safe enough" poses difficult and sometimes intractable questions of social equity.²⁷

- The question of benefits also becomes more difficult and controversial when one moves from the parking problem to managing environmental risks. Should our generation take account of health effects on "our" grandchildren, or of the aesthetic effects of preserving a "natural" visual environment?²⁸

²⁶ See *id.*

²⁷ See, e.g., Stephen L. Derby & Ralph L. Keeney, *Risk Analysis: Understanding "How Safe is Safe Enough?"*, in READINGS IN RISK 43 (Theodore S. Glickman & Michael Gough eds., 3d ed. 1993).

²⁸ A current controversy concerns whether there ought to be liability for pollution which causes "aesthetic" damage to natural resources. See Roscoe Trimmer, Jr. & Jay B. Smith, *The Scope of Natural Resource Damage Liability Under CERCLA*, in NATURAL RESOURCE DAMAGES: A LEGAL, ECONOMIC

What benefits are considered relevant and which ones are viewed as inappropriate in developing policies toward managing environmental risks?

6. CONCLUSION

This Article has examined a set of different strategies for managing environmental risk, ranging from command and control to free play. The important question is how to structure the regulations, standards, and incentives — both positive and negative — so that private actors can be expected to respond. We believe that private market institutions such as insurance and third party inspections can play an important role, but that is another article.

The point we wish to make in this Article is that any policy tool for managing environmental risks must be evaluated in the context of the institutional arrangements between the affected parties. A highly centralized system will have one sets of costs and benefits and a system in which there are property rights assigned to enterprises will have another. The devil is in the details of successfully developing a desirable system, as the affected society must simultaneously identify, contrast, and evaluate the costs and benefits associated with implementing a set of programs and policies.

As the above analysis shows, this is not easy to do. In the international context this problem is seriously complicated by the absence of any fully authoritative government structure that can promulgate the rules of the “game.” Nevertheless, the process must inevitably occur if society is to manage environmental risk in an efficient and effective manner that anticipates the role of private parties.