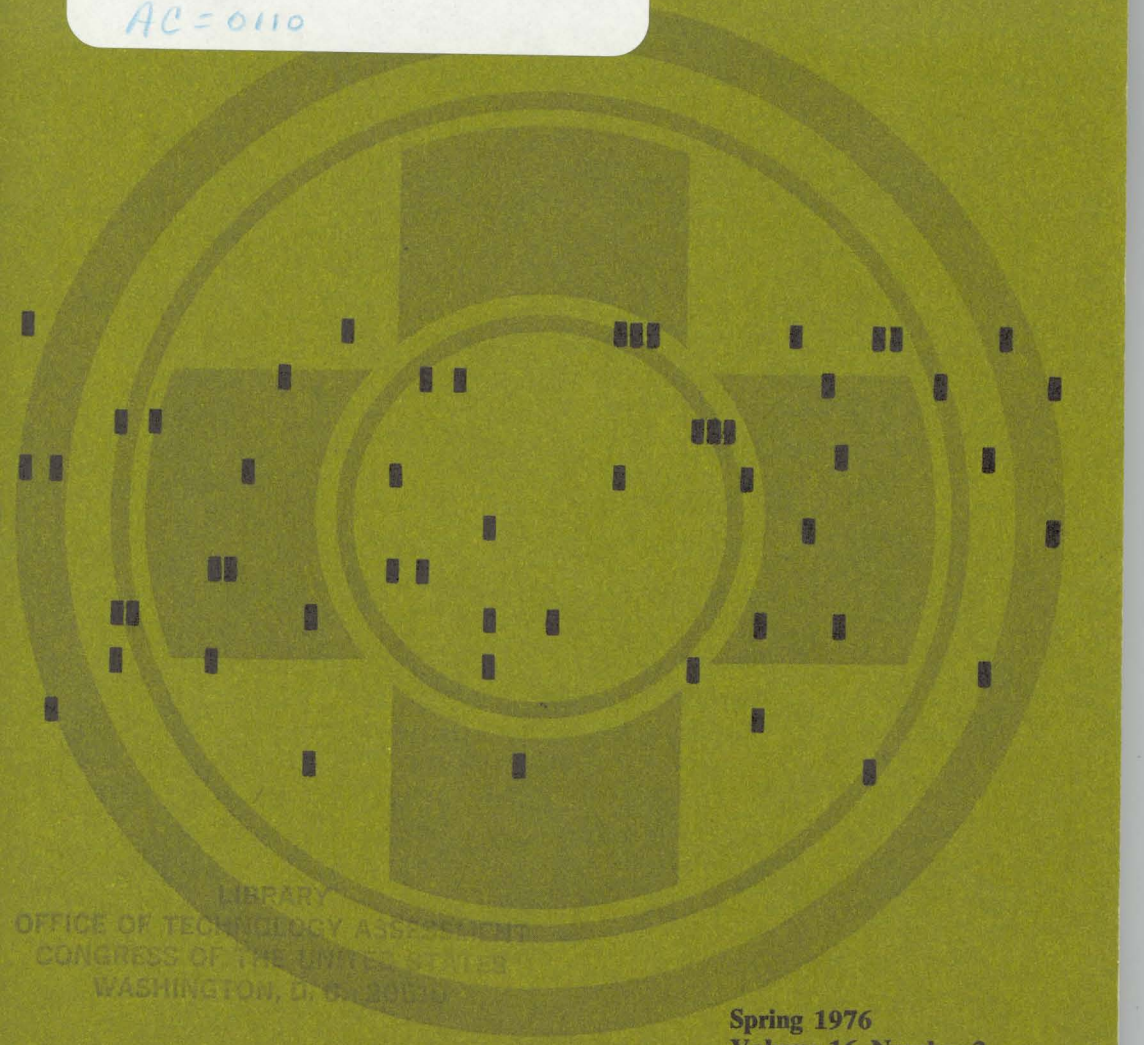
Jurimetrics Journal

Quarterly journal of the
American Bar Association
Section of Science
and Technology



Spring 1976
Volume 16, Number 3

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American Bar Association
Section of Science and Technology Program
held at the ABA Annual Meeting in
Montreal, Quebec on August 11, 1975

Presiding:
Ronald A. May, Chairman, ABA Section of Science and Technology

Panel Moderator:
Dr. Michael S. Baram, Chairman, ABA Science and Technology Section Committee on Technology Assessment and Associate Professor of Civil Engineering at Massachusetts Institute of Technology (Rm. 48-335), Cambridge, Massachusetts 02139

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***These proceedings were organized and edited by Dr. Michael S. Baram.**

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WELCOMING REMARKS

Ronald A. May

We're talking about Technology Assessment. I assume that most of you wouldn't be here if you didn't have some notion of what we're talking about. I would like to define it, however.

The definition is one used by the firm of Peat, Marwick, Mitchell and Co. in a survey of Technology Assessment it made in 1972 for the National Science Foundation:[1]

> Technology Assessment is "the process of identifying actual or potential secondary effects of a technological development (or of a set of interrelated technological developments) on social, political, economic, and/or environmental values or institutions."

There are a couple of things I'd like to call attention to. Technology Assessment is not concerned with technology itself, or technology in the broad sense. I hope we can have some consensus on this. We are talking about assessing the effects of specific technological developments or, alternatively, specific interrelated technological developments.

It is important that we do this. There has been a fairly large literature on Technology itself—its history, its methods, its institutions. But we are not concerned here with such sociological problems.

We might attempt to distinguish between Technology Assessment and Technology Forecasting. There have been some suggestions that what I'm talking about really isn't Technology Assessment at all, but Technology Forecasting. I don't particularly care what words we use, so long as we keep in mind that we are talking about this process of prediction. So keep that in mind as we go on.

What does Technology Assessment mean for lawyers? Obviously, changes in our society which would involve predicting second order of effects of technology would have social and legal repercussions.

The N.S.F. study referred to was based on a questionnaire sent to industries, universities, government, and other institutions to determine what exactly they were doing in the field of Technology Assessment at that time—beginning in 1970. One of the things that struck me was that lawyers were, even then, involved in Technology Assessment. It was quite surprising that lawyers were the third most numerous of the disciplines which were involved at that time in Technology Assessment.

Another thing was that ten times as many TA's that were studied in this survey were "problem initiated" as opposed to "technology initiated." In other words, only one out of ten TA's had been done because somebody developed a new technology and decided they wanted to assess its impact. Stated conversely, in nine out of ten TA's there was a problem, and the technology was studied on that account. Lawyers are problem solvers, so this is significant.

A third thing this survey came up with was that they asked why these TA's were made—what were their purposes. Interestingly enough, most of them were done to influence executive decisions—internal executive decisions—in the companies or institutions that were making them.

Another significant reason for Technology Assessment (many had more than one reason) was to influence legislative and agency decision makers.

Most significant of all, very little TA was done to influence judicial decision-making. I don't understand this. Maybe Judge Levanthal can explain it to us. I think it might possibly have something to do with lead time on Technology Assessment.

Michael Baram is primarily responsible for this program. In an article he wrote for *Science* (reprinted in *Jurimetrics Journal*)[2] he created a model for citizen participation in decision making. He stated that his purpose in writing this article was to develop "a coherent framework for the social control of technology."

Now his effort was characteristically modest, but the challenge in those words is monumental: A coherent framework for the social control of technology. I assume that everyone here thinks that this is desirable, and possibly even necessary. I assume also that most of us would agree the job is not being done well today by the amateurish, self-appointed, self-serving groups which claim to be working toward the social control of technology.

Recently, I spent some time with a professional economist. In the course of our conversation I asked him his opinion about the Senate Bill for an Act which has been entitled, "The Balanced Growth and Economic Planning Act of 1975," introduced by Senators Humphrey and Javits. That Act would set up an economic planning mechanism on the federal level.

This economist friend of mine is a professor of economics and a liberal. Given that, I fully expected that he would think that this Bill was wonderful. We all favor economic planning, especially liberal economists.

I was really amazed when he threw cold water on it. He said our

society was such that we would have a very difficult time creating institutions which would be effective economic planning institutions.

He thought it would be too hard to determine and articulate citizens' wishes in connection with economic planning and decision making. This occurred to me: Here's a 150-or 200-year-old discipline primarily concerned with mechanisms for determining and articulating citizens' wishes involving the marketplace.

If economists can't do it after 150 years, how can a discipline like Technology Assessment which is only five years old hope to "develop a coherent framework for the social control of technology"? I'm not going to try to answer that part, but perhaps others in this Symposium can.

REFERENCES

[1]Peat, Marwick, Mitchell and Co., *A Survey of Technology Today* (National Technical Information Service, June, 1972).

[2]Baram, Technology Assessment and Social Control, 180 *Science* 465 (May 4, 1973), reprinted in 14 *Jurimetrics Journal* 79 (Winter, 1973).

INTRODUCTORY REMARKS

Dr. Michael S. Baram

Technology Assessment is a term used to describe a variety of analytical methods which can be employed to evaluate new technological developments and persistent problems with existing technologies—for purposes of improving social management or control.

The social controls are obviously those necessary to regulate the technological applications in order to limit certain externalities or adverse effects, but also, and not so obviously, to promote and guide certain needed developments by government and industry to application as well.

So technology assessment does not mean technology arrestment, but essentially means that a more systematic approach is available for use to guide Congress, the regulatory agencies and industry in developing policies and programs, and to provide better bases or frameworks for judicial review of agency decision making on technological matters such as the issuance of permits and the setting of standards.

The Technology Assessment Committee of the new Section of Science, Technology, and Law is now planning its activities to address technology assessment and a number of other issues in the "field" of law and technology. The committee is large and diverse; it includes a good balance of attorneys in private practice, in federal agencies, in corporations, and academia.

I have recently solicited from the members expressions of technological subjects or legal issues of interest, with which the committee should begin to grapple. Responses are now coming in and cover a broad range of subjects; for example:

a. Energy Sources—fossil, nuclear, solar, etc.
b. Outer Continental Shelf Developments—extraction of hard and soft minerals, construction, etc.
c. Computerization—implications for competition, privacy, etc.
d. Corporate Responsibility
e. Drug Regulation
f. Occupational Health Standards
g. Telecommunications
h. Electronic Money
i. Burden of Proof in Long Term Health Hazards Cases
j. Administrative Law Aspects of Technology Assessment, including standardsetting, etc.

This smorgasbord of issues can lead to indigestion; therefore, the Committee will choose only a few of the foregoing to focus its efforts. The Committee will meet twice this fall—in September at M.I.T. in Cambridge and in October in Washington—to reach decisions on this and other matters and to initiate research. Because our tasks will lie at the technology-law-policy interface, I hope that a number of experts in various technical and analytical fields, such as Professor Rose (nuclear energy) and Dr. Coates (assessment methods) will continue to work with us.

And now it is my pleasure to turn to our distinguished panelists, who will discuss several of the legal, policy, and methodological aspects of Technology Assessment.

SOME METHODS AND TECHNIQUES FOR COMPREHENSIVE IMPACT ASSESSMENT

Dr. Joseph Coates

In the next few minutes I will discuss some of the elements involved in conducting a technology assessment.

Having the temerity to tell you how to do this sort of thing—or at least how it is done—I ought to present some personal background that may lend credibility to my remarks.

I was responsible to the National Science Foundation program in technology assessment for some three years. I have been involved more or less in some thirty of them—in a variety of different roles. I now am assistant to the director at the Office of Technology Assessment, U.S. Congress, and am aware of the activities throughout that office. Over the last five years I have briefed and informed numerous agencies in and out of government about technology assessment. The concept has been adequately described by previous speakers. Rather than repeat a definition, let me emphasize that technology assessment is timely, urgent, and inevitable.

Technology assessment must basically go past knowledge. The world is well populated with experts who can recite the facts, the circum-

stances, the situation. Experts often can make reliable forecasts and estimates. The key deficiency facing both public and private enterprise in the United States is not the lack of knowledge, but the lack of public wisdom.

When you have all the facts, all the information, all the conjectures, all the certainties, all the uncertainties, what do you make of them? How do you make a wise decision?

Technology assessment is the name for the particular practice of policy studies which attempts to organize certainties and uncertainties about the future—about technological consequences, and present them in a format, style, and approach which will inform the public policy process. That will presumably lead to better decisions.

My focus today is largely on public policy, but parallel elements almost exactly parallel apply to large corporations and large institutions —any kind of private group—and individual citizens who are concerned with technology. But just for convenience, let me speak in terms of public policy.

It is important to recognize right off that there is not any method or technique for conducting a technology assessment. Aside from the fundamental epistemological grounds for this situation, let me suggest three very practical considerations that make it almost certain there will be no general formula by which a technology assessment should be performed.

First of all, there is the technology itself that one is examining. The techniques that relate to exploring something like hybrid rice are different from those that relate to a program of sex selection or artificial insemination. And those, in turn, differ from a program of drug rehabilitation or from a proposal to build a bridge across the Straits of Messina or from a proposal to reroute the northward running of the rivers in Siberia to water the central Asian plain.

The technology itself in part determines the methods and the techniques appropriate to studying a socio-technological issue.

Secondly is the question of the sponsor. Since the assessments we are talking about are quite substantial, involving anywhere from one to thirty man-years of work, somebody has to foot the bill. And the person footing the bill usually has a stake in the outcome. It should be advice and guidance to him or his institution. But his stake is not likely to be universal. Consider, for example, an anti-senility drug. It is rather clear that the interests of Merck Sharpe and Dohme, however broad they may be, are circumscribed. They are primarily interested in the future business environment. They are interested in the questions of what will be the institutional, organizational and social environment in which they will be doing business. The Food and Drug Administration obviously has a wider charter—the White House has an even wider charter—the Association of Retired People has a charter which is somewhat different from those three. And then finally, the Congress perhaps has the widest charter of any formal organization.

Consequently, the responsibility of the agency or group for which an assessment is done should influence to some extent how the problem

is scoped out and approached. If not, there could be a great waste of resources for little practical return. That is not to say that results should be biased in favor of the interests or prejudice of the sponsor, only that they should be useful to him.

Third and finally, the budget is a primary determinant in what can be done. It is absolutely essential to keep in mind that the same problem can be assessed in one man-year of work—$50,000—or for 30 man-years of work—at one and a half million dollars. In each case they will do different things, using different tools, different methods, different approaches. You cannot build an in-put out-put model of Nebraska for $50,000—but that does not mean that you cannot do economic analysis. You cannot do a 1200 person public survey in order to collect information if your budget is for one man-year of work.

So, the budget level constrains the techniques which you can use.

Now let me turn to the problem of conducting a technology assessment—since there is no method or technique that can be applied, one might conclude that the situation is dark, desperate and in disarray. That is not at all the case.

Let me now discuss the ten elements or modules—or components—which if all adequately and fully addressed will comprise a technology assessment. And in talking about these elements, I want to highlight for you some of the problems associated with doing them and not necessarily review the details of each element. See Figure I at page 167.

The first of these key elements is an address to the problem itself. If the Secretary of Agriculture comes forward with a question on the implications of a new technology of animal husbandry, or if the Secretary of Health, Education and Welfare comes through with a concern about implementation of a drug prevention program, one knows with apodictic certainty that public official is troubled. He does not understand the situation. Otherwise, he would not be prepared to put forward a hundred or five hundred thousand dollars or two million dollars in public funds for study assistance.

The very fact that an official is prepared to put money behind seeking the resolution of some difficulty he faces makes it almost certain that he does not understand the difficulty in its full complexity.

Consequently, the analytic study group must repeatedly and throughout the study reexamine the question. One has to constantly search to be sure that the proper question is addressed, *i.e.*, a question or issue that will illuminate and not obscure the public policy issues.

Doing this seemingly simple thing runs into major practical problems. All public and private agencies of any size are bureaucracies. In order for a bureaucracy to spend money, it must create the illusion of knowing what it is doing. It must frame a problem, write a contract—it must ask a question—or specify methods and procedures—it must give delivery dates. In a technology assessment most of that is in some sense an intellectual charade. A sensible analyst has to go past that and be sure that the group is really addressing the right question in the proper scope, time frame, etc.

One major study, for example, on the continental shelf development

spent six months out of a $300,000 award going down the wrong conceptual path before they established that it was not the physical technology that was dominating the system, but rather it was the policies of the Bureau of Land Management.

And in another study of electronic funds transfer, the study group recognized very quickly that there will not be any cashless—checkless society, but rather a less cash, and fewer checks society. That shift radically changes the nature of the issues studied.

The second element in technology assessment has to do with the system itself. One has to be sure that one adequately lays out what the systems are that one is studying. For example, there is no such thing as the electronic funds transfer, in any sense of a single system. Rather there are collections of technological capabilities which may be put together in different technical institutional formats of quite different scope, size capabilities and functions. And one has to map a number of these alternatives in order to be sure that one is adequately exploring cost and consequences of the technology. This ambiguity is characteristic of almost every new technology.

The third element that should be addressed is the examination or the disclosure—or the discovery—or the probing—of what the impacts could be. If we do so-and-so, what might happen? This is an extremely interesting question. The general issue is impossible, the specific cases very challenging. Search for impacts is almost guaranteed to paralyze most professional workers. Most professional workers have not been trained—in fact, they have been trained away from being able—to address a hypothetical question without obvious boundaries. What might happen if we did so-and-so is such a question.

They usually wish to force the answer into some category that they are familiar with. The economist wants to tell you the economic consequences—the psychologist wants to tell you the psychological ones—the organizational sociologist stresses the organizational ones.

This element of an assessment is one in which priests, nuns, housewives, boyscouts, truck drivers and clerks are on a par with economists, lawyers, and nuclear physicists. Bringing diversity into the situation in order to probe what-if questions is a key element which must be accommodated in spite of the professional's reluctance to do so. Even at that most people are not good at systematic conjecture.

The fourth element flows from the third. Having disclosed a range of possible consequences (for example, in one study of geothermal energy, the group identified some 1500 non-trivial and plausible impacts of that technology), the next question one faces is how to organize them—how do you make sense out of them?

And the primary tool for a first cut I would argue on the basis of experience is economic analysis. Clearly if a technology option is grossly beyond economic feasibility, then most of the rest of the analysis is a waste of time, and beside the point.

However, the tendency on the part of most analysts, particularly using economic tools, is to want to stop too soon, both in terms of the economic analysis itself and almost always in terms of the analysis that

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A group that spent 15 months—or 10 man-years—on probing a subject is likely to know more about it than anyone else. Their informed judgment in the form of an essay or speculation is more valuable to a public official than some vagrant remark by those less informed.

But the professional worker is often reluctant to speculate, even in a structured format. It runs counter to his experience and training.

The next element is the identification of decision apparatus—who is in charge with regard to a technology? I doubt that there is a technology of any significance in the United States that does not involve the interests of a minimum of 50 to 60 public agencies, not to mention scores of private sector organizations. There are also non-governmental institutions, foreign and international agencies which may have a direct decisionmaking authority or advisory role with regard to a technology.

The failure to identify all of those with responsibility and authority and to explore their responsibilities is a common defect in public policy analysis.

Yet failing to systematically explore present responsibilities may subvert the definition of plausible, reasonable and acceptable means of managing the technology. The task is fairly straightforward. Almost craft work, it is just not often done.

The next and sixth element is extremely difficult because it reflects the crisis of imagination that pervades the United States' public, private, academic, professional and public interest sectors.

Having identified the authority structure, what can they do? What are the reasonable set of options open for dealing with the technology? Once again, one is in a situation in which most professional workers have become so hidebound by 5, 10, 20, 40 years of professional experience that they cannot think in imaginative and innovative terms. Yet you must have some fresh ideas to challenge and develop by deep-seated analysis. One must create before one analyzes.

So this problem of what could the decision apparatus do is a central intellectual problem in any technology assessment.

The seventh element that one must consider is conclusions and recommendations from the study. A key difficulty I have observed with policy analysis and analysts dealing with conclusions and recommendations is that they tend to fall into two pathological syndromes.

The first is to repeat the study problem—you are doing a study on pesticides research, and the primary conclusions will be you need more pesticide research. You are doing a problem on ethical values of artificial insemination, and the principal conclusion is we need more study on the ethical values of artificial insemination.

The second pathology in dealing with conclusions and recommendations—more characteristic of the academic than the more experienced analysts—is to drive the decisionmaker into a corner and instead of analyzing to become an advocate. This pathology boils down to "Mr.

Public Official, Mr. Congressman, or Mr. Secretary, I've analyzed the problem, and there is only one alternative that can save you, Man or the Universe." Yet every experienced public official knows that there is never only one thing he can do.

One is not finished however. This is not the end of the study. There are three other key elements that must be looked at.

The eighth element identifies the parties at interest. Who are the stakeholders? Who are the people who will be the winners and losers, the people truly impacted by the technology?

Generally, stakeholders are not looked at systematically and as a formal part of the analysis, to the detriment of the analysis. But the parties of interest are of commanding importance for several reasons.

First, they will help you disclose the impacts—both corporate and personal—since it is they who will be impacted by the technology.

Second, the search will help you identify those parties of interest who are latent, who are not yet organized, or who do not know of their stake in the technology. It will permit the analyst to get at them in an early and timely way, and perhaps reduce the rather sterile litigation that often accompanies new technological ventures.

Third, the parties of interest are the primary groups who will determine the ranges of acceptable public policy options. As you all know, in the United States, we are made up of a checkerboard of interest groups. And it is these interest groups that determine what is acceptable and unacceptable in terms of legislation.

The ninth element which needs attention, and which tends to be overlooked, is the matter that I call macrosystems alternatives. We have talked about how to get the job done—element two, *i.e.*, the range and ways within the system that we are particularly concerned with. But suppose they were precluded. What are the other major ways of approaching the goal objective of the technology under study? Suppose we could not use any of the 15 ways of getting oil off the North Slope? What other ways are there of dealing with our needs for energy?

Now these macrosystems alternatives are of great importance for two reasons. First, the public official or legislator is ultimately going to ask the analyst about them. The latter will be embarrassed if he says "Gee, I never thought of that."

The other value of course is that the macrosystems alternatives gives you an external standard for evaluating a technology.

Finally, perhaps the most important and difficult element in a technology assessment is making explicit and examining the state of society assumptions entering into your analysis. And let me just give you one example that will show the significance of this.

I had occasion to read several years ago six of eight major energy forecasts done between 1967 and 1971. And by major I mean investments in the public and private sector that probably represent an aggregate of two or three million dollars in study money.

In none of these studies was the word "Arab" or "embargo" mentioned. In other words, the analysts had as an unexamined assumption

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the notion that the Arabs would in perpetuity behave the way that they had in the past. They had not made it clear that that was a key assumption in their thinking and, hence, deprived themselves of the opportunity to analyze what the consequence of that key assumption no longer holding might be.

Having accomplished these ten elements with regard to any technology, one will have a technology assessment. These ten elements are not part of a linear process. You do not start with the first and go to the last—but rather they represent an iterative process. If you are doing a technology assessment, you should sit with your colleagues and go through all of this as best you can in a day or two days or a week, however long it takes. Having done that—having mapped the problem—having gotten a sense of the whole rather than the individual elements—one then devotes one's major effort to the main exercise and then finally, at the end, as the study draws to a close, one cycles around two, three, four or more times to evolve and deal with the criticism and the elements missing and to burnish the study.

FIGURE I
Elements of a Comprehensive Technology Assessment

1. Examine Problem Statements
2. Specify Systems Alternatives
3. Identify Possible Impacts
4. Evaluate Impacts
5. Identify the Decision Apparatus
6. Identify Action Options for Decision Apparatus
7. Consider Conclusions and Recommendations
8. Identify Parties at Interest
9. Identify Macro System Alternatives (Other Routes to Goal)
10. Identify Exogenous Variables or Events Possibly Having Effect on 1–9

TECHNOLOGY ASSESSMENT IN THE CANADIAN ENVIRONMENT

John J. Shephard

I am most gratified to have been invited to attend this meeting of the Association. Lest you are eagerly awaiting the sage advice of an expert, please allow me to protest my innocence. I am a Canadian businessman recently turned public servant. I have not yet lost the narrow focus of the former nor yet acquired the protective jargon of the latter.

I had previously developed two major reservations about technology assessment, both of which emerged from a tenuous data base. The first had to do with a strong skepticism as to the substance of the new disci-

pline and as to its practical value in the decision-making process. The second arose from the fact that I could not understand much of its language.

Above all, I feared that we in Canada were once again about to reveal our character as a Lesser Developed Country by importing a novel methodological concept from an advanced society to add to our armoury of status symbols.

Although these several fears were compounded by a dawning realization of the strong legal component of technology assessment, I am by now considerably reassured and even enthusiastic about the concept, principally, perhaps, because, under other guises, technology assessment has been with us for some time. In Canada, for instance, the LeDain Commission on the Non-medical Use of Drugs could be so described.

For the last two years, my colleagues at the Science Council of Canada have been engaged in a wide-ranging study of decision-making processes in Northern Development. In so doing, six technology studies have been commissioned, each one dealing with a major energy project. From among these, I have selected the MacKenzie Valley Gas Pipeline project to discuss with you over the next 15 minutes. In the course of my comments on it, I hope to analyze the Canadian characteristics of a Technology Assessment system and also to compare this particular project with what I currently conceive to be the generally accepted essential of Technology Assessment.

To an immigrant such as myself, Canada is a geographic and political matrix, crossed vertically by impossible political boundaries and horizontally by a series of pipelines. Within this context, one of the largest technology assessments yet attempted was launched in March 1974 when the Governor General-in-Council appointed the Honorable Justice Berger to report upon the social, environmental and economic impact, regionally, of the construction, operation and abandonment of a proposed gas pipeline in the Yukon and Northwest Territories down the MacKenzie Corridor. He was also instructed to provide proposals on how pertinent and specific environmental and social concerns might be satisfied in the event that the application for the pipeline was granted. This discrete technology assessment is itself an element of a much more massive appraisal system involving a host of Federal and Industrial institutions, with the apex of the decision being the Cabinet itself.

The pipeline applicant is Canadian Arctic Gas and the project involved calls for some 2600 miles of 48-inch pipe to be deployed over Northern terrain which not only offers formidable physical constraints but the ownership of large tracts of which is in dispute. The inquiry includes both the pipeline itself, the associated infrastructure of several dozen pumping stations and ten airports, and also any other pipeline which might subsequently be routed through the same MacKenzie Corridor. Some $7 billion are involved.

In all, Justice Berger was correct in observing that such an inquiry is "unique in Canadian experience." As of this date, the preliminary hearings have been completed, the first overview of the project has been

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presented, and the formal hearings are in process. Completion is scheduled for early 1976 with a report to be issued in the summer of that year.

Rather than bore you with details of the pipeline project, I will concentrate on five aspects of the Berger inquiry which will reflect Canadian vagaries in relation to technology assessment;

1. the jurisdictional issue;
2. the nature of the technology assessment system;
3. its operational mode;
4. the influence of the inquiry on the national appraisal of the project; and
5. the impact of the technology assessor in the person of Justice Berger.

I. Jurisdictional Issue

With regard to the jurisdictional issue, you will all doubtless be aware that, in Canada, our political adversary system is Federal/Provincial rather than Executive/Legislative. As a consequence, the solution of an Office of Technology Assessment (OTA) created and managed by a legislative assembly is not available to us, nor in fact would it be desirable even if it were available. An additional problem in this particular MacKenzie Valley project is that the Federal Government, through its Department of Indian and Northern Affairs, is administratively dominant north of the 60th parallel and could not therefore directly execute a technology assessment with any hope of credibility as to impartiality.

The solution adopted, perhaps the only one available under the circumstances, was to create a special Commission of Inquiry, entrusted to a member of the provincial judiciary, appointed by the Governor General-in-Council and operating in the public domain and inviting full public participation. In my own view, this mechanism serves the double advantage of removing the assessment from elitist isolation whilst at the same time protecting it from potential political influence. It would appear to me that in both respects the mechanism may be superior to that of the OTA, and I commend it to your attention.

The scope of the inquiry is wide but is defined with reasonable clarity. Powers of subpoena are accorded but resort to them has not been made. On this latter point, I have reason to suspect that although the matter has not been put to test the decision may have been regretted, particularly with regard to the matter of confidential Government information.

II. The Nature of the Technology Assessment System

Under this heading, I am accepting the definition of a Technology Assessment System, advanced by Drs. Gibbons and Voyer of the Science Council and as comprising:

"those social groups which are (or should be) concerned with developing a given technological program. The elements which make up this system may, or may not be bound together by formal arrangements; coupling is affected by their mutual interest in the development and diffusion of a given technological capability."

Within this context, the range of core actors and secondary and peripheral actors in the MacKenzie pipeline project is extraordinarily wide, ranging from two pipeline applicants, two national governments, the usual environmentalist groups, and three races speaking four or more distinct languages, stretching, in small communities, across an immense territory. The number of peripheral actors is increasing rapidly and daily, the most recent being four glass manufacturing companies who have united to protest the potential shortage of natural gas vital to their production operations. The total system is therefore not only considerable in scale but unusual if not staggering in complexity.

III. Operational Mode

In recognition of the complexity of the assessment system, the Berger Inquiry has developed an operational methodology which provides for several innovative features:

a. There are, for instance, two types of public hearings, to be carried out interactively. The one is formal, employing legal proceedings, and carried out in territorial capitals. The other consists of informal discussions conducted in a variety of small communities throughout the North and characterized by absolute informality of exchange. At each such community gathering, the proceedings of the formal hearings are discussed and views recorded for the next formal session. This procedure has had an enormous and positive impact in terms of popular participation.

b. Secondly, arrangements have been made for continuous radio reporting and translation of proceedings throughout the North and for video-tape dissemination by the CBC Northern Communication Service; this technique again has vastly improved non-elite inputs into the assessment.

c. Thirdly, there has been a deliberate interpretation of the terms of reference, already wide, in the widest possible sense, balancing the consequent alarm against the need to "conduct a fair and thorough inquiry," and to involve the widest range of actors and actor input.

d. Fourthly, provision has been made for the funding of participating or intervenor groups which could not otherwise afford to be represented. In this connection, some $400,000 of federal funds has been granted to Inuit and Indian groups, and $200,000 to environmental groups, to assist in adequate prepraration and presentation of views. Smaller amounts have been granted to northern municipal and business associations. This, I feel, is a novel method of balancing the Technology Assessment System.

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IV. Influence of the Inquiry on the National Appraisal

The position of the Berger Inquiry within the total MacKenzie Valley Pipeline assessment system is extremely interesting. Although the scope of the Inquiry as to the impact of the application is wide by specific direction, the Inquiry is forbidden to comment on whether or not the application should be approved. There is also no guarantee or certainty that the Federal Government will await the outcome of the Inquiry before deciding whether or not to approve the application.

Nevertheless, the extremely effective way in which the mode of the Berger Inquiry has been defined and implemented, particularly with regard to its openness and to its obvious impartiality, has served to elevate the Inquiry to the status of a dominant actor in the total national assessment of the project. It has become by far the most publicly influential of the several assessments of the project which are being carried out. Even more importantly, the very methodology of the Inquiry, with its continuous process of communication and interaction with all Northern elements, is serving, quite noticeably, to create a distinct sense of Northern community which will have very considerable political and social ramifications for the entire nation.

V. The Role of the Technology Assessor

The assessor himself, Justice Berger, has had an exceedingly marked impact on the Inquiry to the extent that I am fully convinced that Technology Assessment is indeed an interplay of values, personalities and processes rather than a rigid and mechanistic discipline. The extensive personal travel to acquaint himself with and let himself be seen by the Northern residents, his rigorous impartiality, and the effectiveness of personal communications so essential to evoking community response, have been key factors in the assessment. It is quite easy to conceive of radically different results developing from the same Inquiry under an assessor endowed with a belief in narrow or legalistic interpretations of terms of reference and in mechanistic and highly institutionalized proceedings.

In reviewing the Berger Inquiry as a Technology Assessment, permit me finally to enumerate elements which I deem to be vital to technology assessment as a discipline and those which are missing.

In the first category, I would suggest that the following technology assessment characteristics are present:

1. the "openness" of proceedings;
2. full public involvement, *i.e.*, the widest possible range of actors;
3. the Inquiry takes place within the innovative process;
4. the assessment is conducted by parties other than the executive arm;
5. the scope and guidelines are reasonably well delineated;
6. the overriding national goals are quite clear; and

7. there is a strong predictive element in the assessment, in that the "installation, maintenance and abandonment" of the pipeline involves a period of at least twenty years.

I think that where the Berger Inquiry is deficient as a technology assessment lies in two factors:

1. The Commission, although asked to investigate other pipelines and even one other pipeline application, was instructed not to investigate other technological solutions to energy transportation.

2. The assessment was initiated as a reaction to an actual application. This, I think, imposes constraints upon the technology review which could limit its value.

In conclusion, as one of the members of the Advisory Council of the OTA has observed, "the mandate of the Inquiry clearly makes it a technology assessment" and its mode "is clearly a method of incorporating greater sensitivity to dynamic value shifts now occurring in all industrialized societies." In our view, the Inquiry will exercise an enormous influence upon the future conduct of Technology Assessment in Canada. It will play a vital role in the exposure of executive decision-making machinery and processes to the public. It will focalize and encourage community response. It may even add a new role and dimension to our judicial system. Above all, it may serve to impose broader value systems on an as yet consumer and growth oriented society. I therefore frankly admit to the enthusiasm of the convert in regard to technology assessment as practiced in Canada.

TECHNOLOGY ASSESSMENT—LEGAL AND POLICY IMPLICATIONS FROM A CORPORATE PERSPECTIVE

William F. Kennedy

There have been two versions of the title of our panel. The one I first saw was called Technology Assessment: Legal and Policy Implications. There is a second one which appears in your program—and which some of us would regard as question-begging—called Technology Assessment: Legal Implications of the Limits of Growth. Not surprisingly, I prefer the first version. We all have to respect the constraints imposed by environmental and resource limitations. But there are those of us who believe that these constraints should lead not to a cap on technical development nor to an end to it, but to a redirection. This is not to deprecate the constraints. Over a generation, the required redirection of the economy is likely to be very substantial.

In any event, you can characterize our panel topic in various ways, but I don't believe anyone would call either version well-defined. One approach to so expansive a subject is to try it in small bites, and that is what I will attempt here.

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Let me begin with some contrasts between the concept of technology assessment and the environmental impact statement process called for by the National Environmental Policy Act of 1969.[1] The congressional interest in technology assessment developed of course in the late sixties, intersecting the growing public and congressional concern about environmental deterioration. One of the more fascinating pieces of legislative history in that period is the way in which the enactment of NEPA preempted the efforts led by Congressman Daddario, supported by the National Academy of Sciences,[2] to develop mechanisms for orderly appraisal of the consequences of technical innovation—economic, social and cultural, as well as environmental.

If you believe that technical innovation still has a contribution to make to the national well-being, the downgrading of non-environmental values implicit in this legislative outcome was mildly unfortunate. I say mildly because, in perspective, the dramatic new emphasis on environmental issues reflected in NEPA and in the air and water quality legislation[3] was both an inevitable response to growing public concern and an indispensable corrective to previous years of neglect.

Still, recent developments seem to me to make it clear that the philosophical premise of technology assessment—as developed by Congressman Daddario and the original study panel of the National Academy of Sciences—is sounder than the concept embodied in some extreme readings of NEPA. We have learned the hard way from the Arabs that factors like inflation, economic growth, employment, adequacy of energy supplies and national security must be weighed along with environmental values.

The problem with technology assessment to date is not its intellectual content but that no one has found a way to make it all that effective in practical terms. Congress has established in the legislative branch an Office of Technology Assessment,[4] and this is a step to be welcomed. But there is a very important difference so far between the work of that office and the NEPA section 102 process.

NEPA has teeth. It has teeth because in the words of the Supreme Court in the most recent *SCRAP* decision,[5] it creates "a right of action in adversely affected parties to enforce" the obligations imposed by section 102. It has teeth because the courts have undertaken to enjoin major projects until the impact statement process has been carried out to their satisfaction.

By contrast, the Office of Technology Assessment, although it has potential, is the servant—I would say the prisoner—of the Congressional Committee system with its jurisdictional rivalries and conflicts. Presently these rivalries are precluding, as Senators Mansfield and Scott have pointed out, any orderly approach to energy problems.

If I may turn to a particular interest of mine, it seems to me that if ever there was a set of problems which, in the abstract sense, were made to order for technology assessment, it is those posed in the debate over what the national policy should be on nuclear energy. We have reputable scientists on both sides of the issue. We will have one[6] and perhaps several state-wide referenda as to whether to call a halt to new nuclear

projects and even to shut down existing plants. We have pending congressional controversies about the breeder and about renewal of the Price-Anderson legislation. We have congressional concern about the adequacy of safeguards, national and international, against diversion of nuclear material.[7] We have bills in the Congress providing for a nuclear moratorium coupled with a specific call for an appraisal by the Office of Technology Assessment.

One can ask: If technology assessment is a sovereign remedy, why hasn't Congress prescribed it for this problem?

I would suggest that one reason is that the underlying issues are only partly technical, that what we have fundamentally is a conflict of perceptions and values which cannot be settled by a panel of scientific wise men on Olympus, but only in the heat and dust of political contest and debate.

If Congress can get itself together with a Committee structure to address the nuclear problems in an orderly way, then the Office of Technology Assessment can play a useful role—not of course as judges but as advisers identifying the pros and cons of different policy options. Until that time we will have to struggle along issue by issue trusting in the end—as I for one do—in the good sense of the voters and their elected representatives.

Another way to state this point is that sound decisions are more likely to come from the on-going process of public debate—sloppy and imprecise as that process may be—rather than from an attempt to rely on the superior wisdom, foresight and detachment of specialists and technicians. One is reminded of John Kennedy's reported line after the Bay of Pigs bemoaning his trust in his diplomatic, military and intelligence advisers—that all his life until then he had known better than to rely on experts.

I share then with the environmental bar a belief in the adversary process—only I think that in late years we have posed too many issues to the judiciary rather than fighting them out in the political arena. For some issues, the coupling of the technology assessment process to the Congress seems to me sounder than NEPA's reliance on the courts.

The NEPA decisions give the courts an enormous power—a power illustrated again by the decision this June of the United States Court of Appeals for the District of Columbia in *Sierra Club v. Morton*,[8] which effectively halts for a substantial period the development of coal reserves in the Northern Great Plains. I'm not quarreling with the particular result so much as expressing uneasiness about the extraordinary power of courts in NEPA litigation.

I say this without any particular criticism of the courts. In cases like *Sierra Club v. Morton*, they are filling a policy vacuum—a vacuum created sometimes by congressional default, sometimes by an impasse between the Executive Branch and Congress.

But even if Congress should resolve more issues than it does, it can't decide them all, and we have to look to agencies and courts—and this leads to several current issues about the agency and judicial decision process.

The first of these issues relates to the kind of proceeding which

should be held before an agency when complex technical issues are involved. In *American Airlines v. CAB*,[9] in *Holm v. Hardin*,[10] and in *International Harvester v. Ruckelshaus*,[11] Judge Levanthal has written seminal decisions, holding in effect that even in rule-making proceedings, the literal Administrative Procedure Act requirements which call only for notice of the proposed action and an opportunity for written comment may not afford the parties an adequate hearing or permit the development of a proper record for judicial review. In some rule-making cases, an oral hearing may be required and perhaps even a limited opportunity for cross-examination.[12]

These decisions challenge the classical categories of the Administrative Procedure Act which call only for what I would regard as a perfunctory process in rule-making and for what I believe is excessive reliance on trial-type formalities in adjudication. Judge Friendly—another great administrative law authority on the Federal bench—has just published an article in the *Pennsylvania Law Review*[13] which is a characteristically thorough and lucid analysis of the kinds of hearings which might and should be held before administrative agencies. He differs with Judge Leventhal's reasoning in some of these cases but, if I read him rightly, would arrive at the same result through a somewhat different route.

It has been unfortunate that there has been so little congressional interest in a systematic approach to this critical issue of administrative law—even though the question comes up again and again in the consumer regulatory legislation enacted in recent years where there have been running fights about what kind of proceeding should be held before the agency and about the appropriate standards for judicial review.[14] It is good to have Judge Friendly suggest that a congressional examination of this subject might be appropriate.

I would hope that any such resolution would lead to more emphasis on oral hearings in rule-making and less emphasis on procedural mechanics and formalities in adjudication. This leads me to the related question —the costs and delays which result from prolonged environmental litigation. Judge Friendly cites one study showing that the cost of a $600 million 1200 megawatt nuclear generating plant, assuming a 12 percent cost of money and an 8 percent inflation factor, would be $1,336,000,000 if the plant took ten years to complete as against $981 million if the plant could be finished in six. For all electric generating plants planned for the single year 1980, a 20 percent reduction in the period of construction would save over $3.1 billion on the same assumptions.[15]

It's numbers like these which raise the question of whether we shouldn't require impact statements as to the costs of delays imposed by environmental litigation. Currently in the aftermath of the Supreme Court decision in the *Alyeska* case,[16] there are bills in the Congress to provide for payment of fees of public interest law firms. It seems to me that any committee hearings on such bills should consider the other side of the coin. Assuming as we must that some lawsuits will be without merit, what disincentives should be established for litigation where the plaintiff does not prevail but causes expensive delays? If we give "public interest" law firms a free shot—recovery of fees if they win, no penalties

if they lose—we may sooner or later be reminded of the line of the Frenchman, that self interest wears many masks, including the mask of disinterestedness.

Before coming here I had planned to say a few words on the debate about burden of proof in environmental lawsuits which developed during the *Reserve Mining*[17] litigation and which led to proposals for new legislation by Senator Nelson and others. Going over the very careful opinion of the Eighth Circuit in that case, I have simply been confirmed in an initial premise; namely, that in many such lawsuits, the facts are likely to be too complex, the concerns and interests to be balanced too important, and the possibilities of judicial relief too varied to try to settle matters in advance by some simple sweeping formula.

I suppose there are those on both sides of the environment/economy debate who see the *Reserve Mining* case as a relatively easy one—although each side would perhaps have its own view of why it was easy. To me the case seems very difficult, and I suppose in the coming years we will have more like it. It is in cases like *Reserve Mining* involving a balancing of conflicting interests on complex and obscure facts that I think courts can play a very valuable role—as I like to think the Eighth Circuit did in the *Reserve Mining* situation.

A year or so ago in some discussions with the Committee on Science and Law of the New York City Bar Association it appeared that the Office of Technology Assessment, under the guidance of Tim Atkeson, its then General Counsel, might undertake a review of liability and compensation problems associated with hazards growing out of complex or advanced technology. I don't know what has become of this, but it still seems to me like a useful idea.

Liability and compensation for the consequences of extraordinary accidents growing out of nuclear activities or commercial air transportation or other potentially hazardous programs, such as transportation of oil by large tankers or offshore drilling, seem to me to present questions which outrun the capabilities of the classical system of tort litigation.

There is always the initial judgment as to whether the activity is socially justified in view of the risk. But once that judgment is made in the affirmative, it would seem that we ought to have a system of assured and expeditious recovery by injured persons on a no-fault basis, with assurance of adequate funds to provide such recoveries and with the costs of accidents internalized so that they are borne by the activity which gives rise to the accident.

NOTES

[1]Pub. L. 91–190; 83 Stat. 852; 42 U.S.C. § 4321 et seq.

[2]*Technology: Processes of Assessment and Choice.* Report of the National Academy of Sciences for the Committee on Science and Astronautics, U.S. House of Representatives, July 1969.

[3]Clean Air Act Amendments of 1970; Pub. L. 91–604; 84 Stat. 1676; 42 U.S.C. § 1857 et seq.; Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92–500; 86 Stat. 816; 33 U.S.C. § 1251 et seq.

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[4]Technology Assessment Act of 1972; Pub. L. 92–484; 86 Stat. 797; 2 U.S.C. § 471 et seq. This Act is set forth as Appendix I.

[5]Aberdeen & Rockfish Railroad Co. v. SCRAP, 422 U.S. 289 (1975) at 319.

[6]California Nuclear Safeguards Initiative. The Initiative is to be on the June 1976 California ballot.

[7]Export Administration Amendments of 1974; Pub. L. 93–500, § 14; *Peaceful Nuclear Exports and Weapons Proliferation, A Compendium*, Committee on Government Operations, U.S. Senate, April 1975; *Laws and Regulations Governing Nuclear Exports and Domestic and International Nuclear Safeguards*, Message from the President, May 6, 1975.

[8]514 F.2d 856 (D.C. Cir. 1975).

[9]359 F.2d 624 (D.C. Cir. 1966), *cert. denied*, 385 U.S. 843 (1966).

[10]449 F.2d 1009 (D.C. Cir. 1971).

[11]478 F.2d 615 (D.C. Cir. 1973).

[12]*Cf.* United States v. Florida East Coast Railway Co., 410 U.S. 224 (1973).

[13]Friendly, "Some Kind of Hearing", 123 *U. Pa. L. Rev.* 1267 (June 1975); *also* Stewart, "The Reformation of American Administrative Law," 88 *Harv. L. Rev.* 1667 (June 1975); Nathanson, "Probing the Administrator's Mind," 75 *Col. L. Rev.* 721 (May 1975).

[14]Boyer, "Alternatives to Administrative Trial-Type Hearings," 71 *Mich. L. Rev.* 111 (1972).

[15]Friendly, "Some Kind of Hearing", 123 *U. Pa. L. Rev.* 1267, 1312, note 228.

[16]Alyeska Pipeline Service Co. v. Wilderness Society, 421 U.S. 240 (1975).

[17]Reserve Mining Co. v. Environmental Protection Agency, 514 F.2d 492 (8th Cir. 1975).

Appendix to Notes

THE TECHNOLOGY ASSESSMENT ACT OF 1972

Public Law 92–484
92nd Congress, H. R. 10243
October 13, 1972

An Act

To establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application; to amend the National Science Foundation Act of 1950; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Technology Assessment Act of 1972". Technology Assessment Act of 1972.

Findings and Declaration of Purpose

Sec. 2. The Congress hereby finds and declares that:

(a) As technology continues to change and expand rapidly, its applications are—

(1) large and growing in scale; and

(2) increasingly extensive, pervasive, and critical in their impact, beneficial and adverse, on the natural and social environment.

(b) Therefore, it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems.

(c) The Congress further finds that:

(1) the Federal agencies presently responsible directly to the Congress are not designed to provide the legislative branch with adequate and timely information, independently developed, relating to the potential impact of technological applications, and

(2) the present mechanisms of the Congress do not and are not designed to provide the legislative branch with such information.

(d) Accordingly, it is necessary for the Congress to—

(1) equip itself with new and effective means for securing competent, unbiased information concerning the physical, biological, economic, social, and political effects of such applications; and

(2) utilize this information, whenever appropriate, as one factor in the legislative assessment of matters pending before the Congress, particularly in those instances where the Federal Government may be called upon to consider support for, or management or regulation of, technological applications.

Establishment of the Office of Technology Assessment

Sec. 3. (a) In accordance with the findings and declaration of purpose in section 2, there is hereby created the Office of Technology Assessment (hereinafter referred to as the "Office") which shall be within and responsible to the legislative branch of the Government.

(b) The Office shall consist of a Technology Assessment Board (hereinafter referred to as the "Board") which shall formulate and promulgate the policies of the Office, and a Director who shall carry out such policies and administer the operations of the Office.

Technology Assessment Board.

(c) The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information

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which may assist the Congress. In carrying out such function, the Office shall:

(1) identify existing or probable impacts of technology or technological programs;

(2) where possible, ascertain cause-and-effect relationships;

(3) identify alternative technological methods of implementing specific programs;

(4) identify alternative programs for achieving requisite goals;

(5) make estimates and comparisons of the impacts of alternative methods and programs;

(6) present findings of completed analyses to the appropriate legislative authorities;

(7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraph (1) through (5) of this subsection; and

(8) undertake such additional associated activities as the appropriate authorities specified under subsection (d) may direct.

(d) Assessment activities undertaken by the Office may be initiated upon the request of:

(1) the chairman of any standing, special, or select committee of either House of the Congress, or of any joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members;

(2) the Board; or

(3) the Director; in consultation with the Board.

Information, availability.

(e) Assessments made by the Office, including information, surveys, studies, reports, and findings related thereto, shall be made available to the initiating committee or other appropriate committees of the Congress. In addition, any such information, surveys, studies, reports, and findings produced by the Office may be made available to the public except where—

(1) to do so would violate security statutes; or

(2) the Board considers it necessary or advisable to withhold such information in accordance with one or more of the numbered paragraphs in section 552(b) of title 5, United States Code.

81 Stat. 54.

Technology Assessment Board.

Duties.

Technology Assessment Board

Sec. 4. (a) The Board shall consist of thirteen members as follows:

(1) six Members of the Senate, appointed by the President pro tempore of the Senate, three from the majority party and three from the minority party;

(2) six Members of the House of Representatives appointed by the Speaker of the House of Representatives, three from the majority party and three from the minority party; and

(3) the Director, who shall not be a voting member.

Membership.

(b) Vacancies in the membership of the Board shall not affect the power of the remaining members to execute the functions of the Board and shall be filled in the same manner as in the case of the original appointment.

Vacancies.

(c) The Board shall select a chairman and a vice chairman from among its members at the beginning of each Congress. The vice chairman shall act in the place and stead of the chairman in the absence of the chairman. The chairmanship and the vice chairmanship shall alternate between the Senate and the House of Representatives with each Congress. The chairman during each even-numbered Congress shall be selected by the Members of the House of Representatives on the Board from among their number. The vice chairman during each Congress shall be chosen in the same manner from that House of Congress other than the House of Congress of which the chairman is a Member.

Chairman and vice chairman.

(d) The Board is authorized to sit and act at such places and times during the sessions, recesses, and adjourned periods of Congress, and upon a vote of a majority of its members, to require by subpoena or otherwise the attendance of such witnesses and the production of such books, papers, and documents, to administer such oaths and affirmations, to take such testimony, to procure such printing and binding, and to make such expenditures, as its deems advisable. The Board may make such rules respecting its organization and procedures as it deems necessary, except that no recommendation shall be reported from the Board unless a majority of the Board assent. Subpoenas may be issued over the signature of the chairman of the Board or of any voting member designated by him or by the Board, and may be served by such person or persons as may be designated by such chairman or member. The chairman of the Board or any voting member thereof may administer oaths or affirmations to witnesses.

Meetings.

Subpoena.

Director and Deputy Director

Sec. 5. (a) The Director of the Office of Technology Assessment shall be appointed by the Board and

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Chairman and vice chairman.

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Appointment.

shall serve for a term of six years unless sooner removed by the Board. He shall receive basic pay at a rate provided for level III of the Executive Schedule under section 5314 of title 5, United States Code.

Compensation.

83 Stat. 863.

(b) In addition to the powers and duties vested in him by this Act, the Director shall exercise such powers and duties as may be delegated to him by the Board.

(c) The Director may appoint with the approval of the Board, a Deputy Director who shall perform such functions as the Director may prescribe and who shall be Acting Director during the absence or incapacity of the Director or in the event of a vacancy in the office of Director. The Deputy Director shall receive basic pay at the rate provided for level IV of the Executive Schedule under section 5315 of title 5, United States Code.

(d) Neither the Director nor the Deputy Director shall engage in any other business, vocation, or employment than that of serving as such Director or Deputy Director, as the case may be; nor shall the Director or Deputy Director, except with the approval of the Board, hold any office in, or act in any capacity for, any organization, agency, or institution with which the Office makes any contract or other arrangement under this Act.

Employment restriction.

Authority of the Office

Sec. 6. (a) The Office shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including, but without being limited to, the authority to—

(1) make full use of competent personnel and organizations outside the Office, public or private, and form special ad hoc task forces or make other arrangements when appropriate;

(2) enter into contracts or other arrangements as may be necessary for the conduct of the work of the Office with any agency or instrumentality of the United States, with any State, territory, or possession or any political subdivision thereof, or with any person, firm, association, corporation, or educational institution, with or without reimbursement, without performance or other bonds, and without regard to section 3709 of the Revised Statutes (41 U.S.C. 5);

Contracts.

(3) make advance, progress, and other payments which relate to technology assessment without regard to the provisions of section 3648 of the Revised Statutes (31 U.S.C. 529);

(4) accept and utilize the services of voluntary and uncompensated personnel necessary for the conduct of the work of the Office and provide transportation and subsistence as authorized by section 5703 of title 5, United States Code, for persons serving without compensation; 80 Stat. 499; 83 Stat. 190.

(5) acquire by purchase, lease, loan, or gift, and hold and dispose of by sale, lease, or loan, real and personal property of all kinds necessary for or resulting from the exercise of authority granted by this Act; and

(6) prescribe such rules and regulations as it deems necessary governing the operation and organization of the Office.

(b) Contractors and other parties entering into contracts and other arrangements under this section which involve costs to the Government shall maintain such books and related records as will facilitate an effective audit in such detail and in such manner as shall be prescribed by the Office, and such books and records (and related documents and papers) shall be available to the Office and the Comptroller General of the United States, or any of their duly authorized representatives, for the purpose of audit and examination. Recordkeeping.

(c) The Office, in carrying out the provisions of this Act, shall not, itself, operate any laboratories, pilot plants, or test facilities.

(d) The Office is authorized to secure directly from any executive department or agency information, suggestions, estimates, statistics, and technical assistance for the purpose of carrying out its functions under this Act. Each such executive department or agency shall furnish the information, suggestions, estimates, statistics, and technical assistance directly to the Office upon its request. Agency cooperation.

(e) On request of the Office, the head of any executive department or agency may detail, with or without reimbursement, any of its personnel to assist the Office in carrying out its functions under this Act. Personnel detail.

(f) The Director shall, in accordance with such policies as the Board shall prescribe, appoint and fix the compensation of such personnel as may be necessary to carry out the provisions of this Act.

Establishment of the Technology Assessment Advisory Council

Sec. 7. (a) The Office shall establish a Technology Assessment Advisory Council (hereinafter referred to as the "Council"). The Council shall be composed of the following twelve members: Membership.

(1) ten members from the public, to be appointed by the Board, who shall be persons emi-

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nent in one or more fields of the physical, biological, or social sciences or engineering or experienced in the administration of technological activities, or who may be judged qualified on the basis of contributions made to educational or public activities;

(2) the Comptroller General; and

(3) the Director of the Congressional Research Service of the Library of Congress.

Duties.

(b) The Council, upon request by the Board, shall—

(1) review and make recommendations to the Board on activities undertaken by the Office or on the initiation thereof in accordance with section 3(d);

(2) review and make recommendations to the Board on the findings of any assessment made by or for the Office; and

(3) undertake such additional related tasks as the Board may direct.

Chairman and Vice Chairman.

(c) The Council, by majority vote, shall elect from its members appointed under subsection (a) (1) of this section a Chairman and a Vice Chairman, who shall serve for such time and under such conditions as the Council may prescribe. In the absence of the Chairman, or in the event of his incapacity, the Vice Chairman shall act as Chairman.

Term of office.

(d) The term of office of each member of the Council appointed under subsection (a) (1) shall be four years except that any such member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. No person shall be appointed a member of the Council under subsection (a) (1) more than twice. Terms of the members appointed under subsection (a) (1) shall be staggered so as to establish a rotating membership according to such method as the Board may devise.

(e) (1) The members of the Council other than those appointed under subsection (a) (1) shall receive no pay for their services as members of the Council, but shall be allowed necessary travel expenses (or, in the alternative, mileage for use of privately owned vehicles and a per diem in lieu of subsistence at not to exceed the rate prescribed in sections 5702 and 5704 of title 5, United States Code), and other necessary expenses incurred by them in the performance of duties vested in the Council, without regard to the provisions of subchapter 1 of chapter 57 and section 5731 of title 5. United States Code, and regulations promulgated thereunder.

Travel expenses.

80 Stat. 498; 83 Stat. 190. 5 USC 5701.

(2) The members of the Council appointed under subsection (a) (1) shall receive compensation for each day engaged in the actual performance of duties

Compensation.

vested in the Council at rates of pay not in excess of the daily equivalent of the highest rate of basic pay set forth in the General Schedule of section 5332(a) of title 5, United States Code, and in addition shall be reimbursed for travel, subsistence, and other necessary expenses in the manner provided for other members of the Council under paragraph (1) of this subsection.

Utilization of the Library of Congress

Sec. 8. (a) To carry out the objectives of this Act, the Librarian of Congress is authorized to make available to the Office such services and assistance of the Congressional Research Service as may be appropriate and feasible.

(b) Such services and assistance made available to the Office shall include, but not be limited to, all of the services and assistance which the Congressional Research Service is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the Congressional Research Service under law performs for or on behalf of the Congress. The Librarian is, however, authorized to establish within the Congressional Research Service such additional divisions, groups, or other organizational entities as may be necessary to carry out the purpose of this Act.

(d) Services and assistance made available to the Office by the Congressional Research Service in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Librarian of Congress.

Utilization of the General Accounting Office

Sec. 9. (a) Financial and administrative services (including those related to budgeting, accounting, financial reporting, personnel, and procurement) and such other services as may be appropriate shall be provided the Office by the General Accounting Office.

(b) Such services and assistance to the Office shall include, but not be limited to, all of the services and assistance which the General Accounting Office is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the General Accounting Office under law performs for or on behalf of the Congress.

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Office by the General Accounting Office in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Comptroller General.

Coordination with the National Science Foundation

Sec. 10. (a) The Office shall maintain a continuing liaison with the National Science Foundation with respect to—

(1) grants and contracts formulated or activated by the Foundation which are for purposes of technology assessment; and

(2) the promotion of coordination in areas of technology assessment, and the avoidance of unnecessary duplication or overlapping of research activities in the development of technology assessment techniques and programs.

Scientific programs, financing. 82 Stat. 360.

(b) Section 3(b) of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1862(b)), is amended to read as follows:

"(b) The Foundation is authorized to initiate and support specific scientific activities in connection with matters relating to international cooperation, national security, and the effects of scientific applications upon society by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such activities. When initiated or supported pursuant to requests made by any other Federal department or agency, including the Office of Technology Assessment, such activities shall be financed whenever feasible from funds transferred to the Foundation by the requesting official as provided in section 14(g), and any such activities shall be unclassified and shall be identified by the Foundation as being undertaken at the request of the appropriate official."

64 Stat. 156; 82 Stat. 365. 42 USC 1873.

Annual Report

Sec. 11. The Office shall submit to the Congress an annual report which shall include, but not be limited to, an evaluation of technology assessment techniques and identification, insofar as may be feasible, of technological areas and programs requiring future analysis. Such report shall be submitted not later than March 15 of each year.

Appropriations

Sec. 12. (a) To enable the Office to carry out its powers and duties, there is hereby authorized to be

appropriated to the Office, out of any money in the Treasury not otherwise appropriated, not to exceed $5,000,000 in the aggregate for the two fiscal years ending June 30, 1973, and June 30, 1974, and thereafter such sums as may be necessary.

(b) Appropriations made pursuant to the authority provided in subsection (a) shall remain available for obligation, for expenditure, or for obligation and expenditure for such period or periods as may be specified in the Act making such appropriations.

Approved October 13, 1972.

Legislative History:

HOUSE REPORTS: No. 92–469 (Comm. on Science and Astronautics) and No. 92–1436 (Comm. of Conference).

SENATE REPORT: No. 92–1123 (Comm. on Rules and Administration).

Congressional Record, Vol. 118 (1972): Feb. 8, considered and passed House; Sept. 14, considered and passed Senate, *amended;* Sept. 22, Senate agreed to conference report; Oct. 4, House agreed to conference report.

TECHNOLOGY ASSESSMENT AND THE ROLE OF THE COURTS

Judge Harold Leventhal

Thank you, Mr. Chairman. Ladies and Gentlemen, I had planned when I accepted the invitation to speak here today to talk on a decision of our court. But at this moment, it is still pending in our court, so I can't talk about it. The issue is whether the regulation of the Environmental Protection Agency, which provides for the reduction of lead in automotive gasoline on a phase-out basis, should be sustained. The initial panel of our court held that it was too uncertain what the consequences of that lead to public health could be to permit a statutory finding of hazard—or sufficient hazard—and this first panel struck down the regulation. It has been reheard and argued, but the decision has not been issued.

But the problems raised by it are somewhat like those in the *Reserve Mining* case—to which Bill Kennedy referred—and I'll speak about that in a minute.

I must say that without knowing exactly what is meant by technology assessment—although I've surely tried to reach some definitions—I agreed to come today because I am sensitive to the fact that technical and scientific matters and their resolution increasingly identify what we're doing in the federal courts, especially in appellate courts like my own, in our reviewing decisions of federal agencies. We are joining the legislative and executive branches in exploring issues on the frontiers of knowledge and, in rare instances, initiating rules of law determining the legal underpinnings of social control.

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I think I would summarize my three main observations and conclusions from my own judicial experiences—and perceptions—with these comments.

First, the courts are not only confronted with technical questions, but they are increasingly involved in the specific methodology that is used in analyzing the technical questions. They are no longer disposing of questions on conclusory statements by experts, but they require an exposure of the underlying methodologies or, possibly more accurately, an opportunity at some point that there should be an exposure of the details of the methodologies.

Second, I think courts have changed their ideas that arose in ordinary tort litigation and criminal litigation, in which we require matters to be established by a preponderance of the evidence, or beyond a reasonable doubt. We do that when someone's liberty may be taken away—giving what I might call a "certitude feeling" about the way in which rules of law are applied. However, the *Reserve Mining Company* case, involving discharge of the taconite tailings into Lake Superior, and a number of other cases are more accepting of the idea that it is alright for the government to do something even though it doesn't know exactly what's going on but is having to make a reasonable guess.

Third, I think that the ground rules of the courts are going to have to adjust, and will be adjusting, to the idea that even after you come to a result it is not frozen. There is increasing awareness that technology is not frozen: new problems emerge and new risks are seen so that decisions once made are not final and can be reappraised—and there are rights to reappraisement.

In the paper that I originally prepared, I covered some of the basic doctrines of law which the courts are used to in their ordinary litigation. Without getting into the details, we seem to have come up with words for different standards. I've mentioned preponderance of evidence for ordinary cases in the civil tort field. And I mentioned beyond a reasonable doubt for the criminal and detention cases. And in between we have a class of cases called matters that require clear and convincing evidence.

These standards have not been quantified. In my very first opinion on the bench, I suggested that as an increasingly computerized society we ought to quantify them and say to the jury, you bring in a verdict for the government, if you're willing to bet 20 to 1 that the government is right.

A quantitative approach might project at something like a 51% probability for ordinary cases, and maybe a 95% probability of accuracy for criminal cases with, say, a range of 70% to 75% for intermediate-type cases that are considered to have special values, such as deportation cases and cases of fraud, which are the classic cases.

In all these cases I think that the courts are aware and always have been aware that the central question is the balancing of benefits and burdens, or benefits and risks. The common law of nuisance has always sought to determine what is the net public good from maintaining a copper smelter or an industrial project, or whatever it is that is discharging into the river, for example.

Until recently the strong benefits of economic expansion or the maintenance of an economic activity was dominant in the courts. Now of course, that's being revised by virtue of administrative regulations pursuant to the new statutes.

In that setting, with that kind of approach to risks and benefits, a very primitive one, the courts were confronted with NEPA, starting in 1970. Bill Kennedy has said that NEPA elevated environmental considerations above other aspects of technology, and that is very likely so, but in any event the courts had the responsibility for construing NEPA, for administering the idea that an impact statement had to be filed showing the environmental consequences of any major federal action significantly affecting the quality of the human environment.

I think that the court approach has been heartening. Without deep scientific training, the courts have been able to get the central idea that there has to be a broad and coordinated analytical approach by an agency, which I assume is part of the technology assessment concept, and that there has to be rigorous enforcement of this interdisciplinary analysis and balancing process for decision making to the extent of being willing to say this project or activity has to stop because such an approach was not employed.

You don't act this way because you think the project is unsound. I remember the first opinion that I wrote stopping a project: it involved the leasing of off-shore oil and gas in the Gulf of Mexico. Now I was actually convinced in my own mind that this was a very important program for the government to carry out, notwithstanding the kinds of impact on coastal estuaries and marine and plant life.

But what was said by the Secretary of the Interior in that case is that all he had to consider were the environmental impacts of his particular task of determining whether or not to lease such properties; that he didn't have to consider, for example, what might be the alternatives of import control. It seemed to the court that it was important to establish the idea that you don't splinter up projects just because one particular agency happens to act first or happens to have a limited charter and that there must be an integrated approach to agency decision making. Other opinions also stress the idea of calling for consideration early, while the problems are still of manageable proportions.

Bill Kennedy referred to the opinion in the coal lands case. I didn't happen to sit on that panel, but I don't think that the court was motivated by the idea that the particular project was a bad one. Rather, it was deemed important to insist on processes and procedures that have worked to bring the public into the agency processes.

I listened with great interest to our Canadian friend and his description of the work undertaken by his Justice Berger, because it seems to me that what he said confirms a thought that I've had. That is this, that there are so many issues in which there is an important difference of approach and difference of opinion that can't be resolved purely by reference to scientific and technical data or methods.

There is a felt need for a review machinery that has an element of objectivity in it, and that is why I think Congress has called on the courts.

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It isn't really that courts know better; they don't know as well. But they do have a feel for procedure, a feel for participation. They have an ability, I hope, to monitor the process of an agency so that a wide impact, a wide understanding or a wide presentation of possibilities will be considered. I may also add we have established a rule of reason, so that we don't require agencies to engage in crystal ball guesswork.

Someone wrote an article a couple of years ago saying, I don't know what difference all of this has made that no one has ever really stopped a project on the basis of an attack under NEPA; that is, because environmental policy was not considered.

Well, I believe that throughout the government there are projects that are marginal, with a close balance for one reason or another as to whether they're worthwhile and how the tradeoffs should work. Previously, such projects were considered without reference to environmental impact. Now, when the environmental impacts get factored in, such projects are stillborn or modified. There is a system for public participation in the United States. It isn't as loose-knit or as free form and agile as the Canadian system that we've heard described. It consists of filing written comments for the most part. But it still is a way of getting interested groups, with their intense interests, to be able to have their say and to make sure that they're not just overlooked.

Some of the courts have gone so far under NEPA as to engage in extended analysis of the so-called cost-benefit analysis involved. I believe there's a lengthy opinion that a district judge in Texas wrote, in which he concluded: If we're going to talk about environmental aspects of this project of the Corps of Engineers, and we're using cost-benefit analysis, it's just wrong to have this cost-benefit process employed by the Corps of Engineers in which they did quantify the environmental benefits of the dam project in question, but simply did not adequately take into account the environmental harms.

This is not merely a decision on procedure. It is not merely a decision on formalities. It's a decision on content. That is, that there wasn't a sufficient disclosure of the contents, in this case of the environmental impacts, for the purpose of decision making.

Its significance is not minimized by the fact that we all know there are many things that really can't be quantified. That's one of the problems in cost-benefit analysis. There are so many qualitative judgments. At least the exercise of making a checklist and of identifying the problems and their magnitude serves a useful and disciplinary function and makes certain that important concerns—social, economic, environmental—are not overlooked.

I used the word economic, but it's not a slip of the tongue. The first speaker identified the importance of the economic cut. The more I think about it, the more I believe that relationships between the economists and the ecologists have to be emphasized. The economists have some techniques for how to measure those things that don't really show in the market, but they don't have data about the scientific aspects. One of the important objectives that we have to provide whether through Technology Assessment or any other systems analysis approach to problems is

the increasing interreaction between the economist and the ecologist and the other disciplines.

Bill Kennedy has referred to a couple of opinions that I've written, which have been attacked by various groups and praised by others. I understand Judge Friendly has applauded the results but not the reasoning. These are decisions that basically review what environmental agencies have done. They say in effect: You can't run this thing through on a routine submission. There are some questions that are so important that maybe you have to have some oral exposition. The importance of oral exposition was emphasized by John Shephard earlier.

And sometimes, perhaps in a limited amount, the oral exposition should include cross-examination. There are some problems with those opinions that I won't get into now, but I think they get across the idea of flexibility, of the combination of informal and formal approaches, with the idea of trying to superintend the process so that things are not swept under the rug and do get exposed and ventilated.

Sometimes when we engage in this kind of judicial action we are at the extreme limits of understanding the underlying scientific problems, so that we can talk intelligently on the procedural problem. I have written that I think that there might be some provision for scientific assistance to the courts. That's another subject, one that's being much debated.

But overall, the courts seem to have worked out a dual approach. When they've been called upon to review the non-environmental mission agencies, they want to make sure that such agencies have taken into account the environmental problems associated with their intended actions. When they've been called upon to review what the environmental agencies have done under the Clean Air and the Clean Water Acts, for example, they want to make sure that such agencies have taken into account the economic and the technological matters. Both approaches tend toward a full picture of the interrelated considerations.

It isn't that the judges have the primary role. They can't, at least in a form of government where the judicial branch is separated from the executive and the legislative. I personally think there is much merit to the idea of having judges chair commissions of inquiry, as is the case in England and possibly in Canada. But that isn't our system, save for notable exceptions like the Warren Commission. But our system for review by judges does enable the judges to participate in the total agency process toward the ojbective of balance, of full presentation of different factors and points of view, with some measure of objectivity.

I was going to talk about the *Reserve* case, but I don't think I will now, as it's too complicated, except to say this. The scientists in that case were in great doubt as to whether Reserve Mining's discharge of what looked like asbestos fibers into Lake Superior really did have any impact on human health. We know that air-borne asbestos fibers are a carcinogen. But do we know about water-borne asbestos fibers as small as these were, in as low concentration as these were? Studies showed that the tissues of people who died in Duluth over the past fifteen years didn't have more asbestos fibers than those who died in St. Paul. So there were all sorts of doubts about the matter.

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Normally, courts won't listen to scientists unless the scientist says I am testifying that such-and-such is the case, with reasonable scientific certainty or reasonable medical certainty. That's our standard. Those are the magic words.

In this *Reserve* case the experts said: I cannot say anything with reasonable medical or scientific certainty, because we just don't know; our technology is not that far advanced. All we can say is we think it's a problem and think it would be prudent to take care of the problem. The courts were willing to take action on that basis. Something like that question has been before us in the *Ethyl* case which involved leaded gasoline.

Part of the trouble seems to be that scientists frequently make their submissions in a very tentative way. When you read their articles, they are not as definite as they are in the courtroom, where they have been guided by a lawyer, to focus on the magic words. They'll write an article which says for example: Some observations can be made. It's all gently and tentatively put. Scientists have a basic approach which involves adding a little bit to each others work, cooperatively, rather than in an adversary stance on an issue voicing their observations in a very tentative way.

Up to now the courts have insisted that if things are to be put at all, they must be put in a relatively assured way. I think we're now receding from that. At least on these big issues that I have been talking about. The courts are now more willing to act on matters that are tentatively put, but the judges have to be attentive to the tentativeness.

I've written some opinions saying that the courts should be only a partner of the agencies involved. Judge Friendly jibed at me in his article by saying: Yes, Judge Leventhal says the courts should be a partner, but what he means is that they should be the senior partner.

I won't plead to that charge. I'm not called upon to answer it. But I think that we do have now, in the courts, a mechanism which may fit into the overall approach of Technology Assessment, which assures fairness and which assures responsible presentation of the different elements of regulation. These are important functions, and I hope that they will continue to be conducted in the courts, or in any substitute for the courts, such as an ongoing institution for technology assessment, which systematically addresses the implications of scientific and technological developments.

THE IMPORTANCE OF TECHNOLOGY ASSESSMENT IN GOVERNMENT DECISIONS

Dr. David J. Rose

Technology Assessment, being an attempt to organize the process of decision-making under conditions of uncertainty, has been practiced for

a long time, but not under that name. A cardinal principle of it is the exploration of indirect and sometimes deleterious consequences of new technologies, an activity whose importance was emphasized by Karl Marx.

Technology Assessment as an aid to government policy has historic precedents; I will recount one familiar to you all but perhaps not in these terms. It is the series of events leading up to the attempt by Spain in 1588 to defeat England via the Armada. Present conventional wisdom has it that navies were easy to purchase in those days and that little technological preparation or thought of consequences were involved. So it was for the Armada—assembled in about one year; but look at the consequences, and what had been underway years before in England.

Until that time, ocean battles had been fought in the style of land wars: the ships were large, carried many troops, and were designed to be effective only at short range, particularly when coupled together; whereupon the troops fought much as on land. Sea-borne artillery was unreliable and inaccurate, except at close range. The English, under Sir John Hawkins in the Admiralty, and Sir Francis Drake at sea, developed a radically new view, explored the consequences, and gambled the future of England on it. Their new concept was that shipboard artillery could be made accurate at relatively large distances, thus permitting the destruction of large troop-carrying ships from afar. The new naval vessels need not carry a large complement of troops and therefore could be built with less superstructure, sail closer to the wind, and in general outmaneuver the enemy. In this way England could hope to defeat its stronger enemy and spent years before 1588 preparing for the occasion.

The outcome is well known; in defeating the Spanish Armada, the English lost scarcely 100 men. The assessment was not a narrow one just involving internal naval affairs; even long before 1588, it affected English defense, economic and materials policy, and of course changed irrevocably the balance of power in Europe and throughout the world.

Technology assessment is presented as a discipline, which it is in part; but it is also an art, and can be done well or badly, just as all other arts and sciences too. Rubrics, guidelines and examples help to illuminate the issues, but nothing can replace the development of feeling for what is essential; otherwise, in the name of disciplinary development, we are lost in an infinity of detail.

I turn now to a more specific case—the development of technology assessment capability for the U.S. Government, especially as an aid to congressional decision-making. Since the 1960s, a House Subcommittee under Representative Emilio A. Daddario had pressed strongly for a Congressional Office of Technology Assessment. At that time, and until the early 1970s, The Congress could call upon few resources of its own. The Congressional Research Service sufficed for quick opinions, but not for studies in depth. In 1973, only two congressional staff members had doctorates in the physical sciences. Thus Committees of the Congress were strongly dependent for their information upon other groups in the Executive Branch of Government, in industry, in Universities, etc.; all

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these may be quite honest, but they are naturally partisan to their own views and ambitions, and color their advice accordingly.

The present Congressional Office of Technology Assessment, headed by former Representative Daddario, now starts to fill the need for a stronger source of advice. It has a budget of about $5,000,000 per year, a Congressional Board of Directors (called the Technology Assessment Board) consisting of six senators and six representatives, plus an outside advisory committee.

Critical to OTA's successful operation will be a proper selection of issues. In principle it filters and accepts requests from Congressional Committees and can initiate studies itself. In practice, OTA combines these requests and its own preliminary assessments to construct its program of activities. It must choose a mix of issues, some short term, some long term, some easy and perhaps not very profound, some difficult and very profound. In this way, it makes for itself a sustaining program of activities and presents to the Congress a more-or-less continual flow of useful information. Here it must be borne in mind that the assessments must be timely, in the sense the Congress may decide an issue, such as some facet of energy policy, using whatever basis for decision is then available. In that case, it is better to have prepared a simple overview assessment than either none at all or only a few items explored in depth.

It has been sometimes thought that OTA can function principally by contracting its assessment tasks to specialized outside groups. This may work for issues in which the outside group has the capability to surround the entire issue and its consequences, but for the larger problems facing OTA and the Congress, no such outside groups exist. Putting the matter most bluntly, any group capable of responding at length to a request for proposal from OTA has already developed specialized capabilities and has either a past to defend, a present to support, or a future to prepare for. Another reason exists for a strong internal staff in OTA: suppose an assessment is done outside; no matter what its quality, it will not please everyone (unless the issue was trivial), and the assessment will be bound to raise further questions both within the Congress and between the Congress and other groups. To resolve these questions, a continuing competent staff must exist in OTA. The best arrangement seems to be the construction of special assessment panels, made up broadly from outside groups, plus the competent OTA core.

This method of working has been applied by OTA in a number of cases, of which I am most familiar with energy. After several months of preliminary analysis of method, the OTA undertook an assessment of the Fiscal Year 1976 Budget for the U.S. Energy Research and Development Administration. Organization for the work followed the general lines I have described: temporary task forces and an overview group assembled from a multiplicity of sources, both from inside the traditional world of energy technology and from other areas affected by it: the social sciences and law, for example. The exercise, carried out in a hectic three-week period during February 1975, yielded about seventy sub-assessments of major and minor issues and in particular emphasized the degree of bal-

ance and imbalance between major parts of the energy sector. Some examples were:

Emphasis on nuclear technologies versus increased need in non-nuclear sectors;

Emphasis on electric power provision, to the neglect of other activities;

Emphasis on provision with respect to more efficient utilization (*i.e.*, conservation);

Emphasis in the physical and technological aspects, often to the neglect of societal consequences;

Emphasis on long vis-à-vis short-term prospects, where the attention was gratifyingly satisfactory toward long-term technologies; and

Lack of attention to manpower provision or public communication.

Extensive congressional hearings took place during the Spring of 1975, for which the OTA assessment provided a strong background of relevant material.

A similar but enlarged assessment now proceeds at OTA, with respect to the Energy Research and Development Administration's National Plan, revealed to us on June 30. ERDA itself has incorporated in its new plan a number of ideas generated by the earlier OTA activity and the congressional debate. Many of the same issues as before will be covered again, this time with more sophistication, as OTA, the Congress, and the Executive Branch learn the value of such constructive debate.

This brief summary is meant as an example only. The OTA presently has strong programs in materials, ocean-related topics, and many other areas, and these brief remarks are meant to give an indication of the usefulness of technology assessment organized in the right way and in the right places.

As the parts of society become more and more integrated, as common resources dwindle, and as an ever-increasing world population demands an ever-increasing quality of life, better organization of energy, resources, housing, transportation, health care—any major thing you care to name—must be provided. Each area of activity impinges upon many others, as we have seen in current examples; politics affects energy availability, and vice versa; energy and the environment often seem to clash. Technology assessment, an attempt to organize the holistic nature of these coupled activities, becomes increasingly important with time, and hopefully our sophistication grows with time to perform the work.

SOME REGULATORY IMPLICATIONS OF TECHNOLOGY ASSESSMENT

Dr. Michael S. Baram

To conclude this wide-ranging panel discussion, I want to briefly address two aspects of regulation which have been troublesome, and for which Technology Assessment may be particularly useful.

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The first aspect, which relates to radiation and other hazardous substances in general, is the increasingly important regulatory function of forcing the development and application of appropriate control technologies on industry—normally, the development and application of devices and techniques to protect public and worker health and safety. The question becomes: Is the regulatory program appropriately forcing and guiding necessary advances in control techniques and their timely use?

We are familiar with the controversy which now surrounds a number of provisions of the Air and Water Pollution Control programs, the Atomic Energy and Offshore Development programs, OSHA, etc.—controversy about the nature and magnitude of adverse effects and the availability, reliability and feasibility of control measures to use.

Should the control requirements to be imposed by agencies on industry, normally in the form of design and performance requirements, be based on the economic feasibility of the techniques, on the basis of health effects and environmental effects, or by some balancing of both considerations? Congress has provided conflicting messages to the agencies in its legislation, and the agencies are left with the difficult value judgments as to what approach is authorized by Congress to be in the societal interest —to allow a firm or industry to continue to discharge hazardous materials until economically feasible controls are developed; to shut down a polluter because of emissions determined by the agency to be possibly dangerous to human health, irrespective of the economic considerations; to use cost-benefit analysis in determining the requirements to be imposed; or what?

Technology Assessment of such problems and their alternative solutions could provide Congress with a better understanding of the nature of the problem, and objective information on industrial ability to respond with new control measures, within certain time frames. Congress could thereupon provide the agencies with more realistic control requirements and schedules and less discretion on the tradeoffs to be made in regulation. Maybe it is unrealistic to assume that technology assessment could bring about the shifting of some of this judgmental burden onto the Congress where it belongs, but it deserves some consideration.

Another way of looking at this or, more accurately, a second facet of regulation for which technology assessment may be useful, concerns what analytical methods should be employed in agency rule-making or standard-setting. Should an agency striving to set various standards for ionizing radiation, for example, standards for radiation discharge, environmental levels, and human exposure, use cost-benefit analysis? The Nuclear Regulatory Commission presently uses this balancing technique —in other words, radiation standards are being set at the balance point between the control costs and the health and other benefits. True cost-benefit requires numbers. It is very difficult to establish numerical values for health benefits such as a reduction of deaths and illnesses. It is also very difficult to get reliable information from industry on what the true costs of imposing new controls to further reduce radiation would be. Should cost-benefit be used in matters involving health and safety at all?

In the highway safety and motor vehicle safety fields, Congress and the agencies have rejected use of cost-benefit in matters involving human life—particularly for sensitive areas such as schoolbus design. Or is cost-benefit the only realistic or rational or democratic way to proceed? Could cost-effectiveness analysis or some systems model provide a more appropriate basis for making decisions on standards with human health implications?

Here is a major task for technology assessment and our lawyers and technical analysts, to assess the analytical techniques that are available for regulation and standard-setting—which can range from Jeremy Bentham's felicific calculus to cost-benefit analysis, systems analysis, and other modern techniques—in order to determine their analytical, ethical, and other limitations and to prescribe their use in regulatory processes accordingly and in full knowledge of these limitations.

We are learning that our problems lie not with stereotypes of agencies and industries, nor with "bad" technologies, but with our analytical and management capabilities for running regulatory programs, capabilities which somehow must be further developed to integrate rationality and humanism in decision-making.

QUESTION AND ANSWER SESSION

JUDGE LEVANTHAL (in response to a question on scientific experts in court): . . . Experts are expected to testify in court differently from what they might say in a conversation where they are just "mind-blowing" or running up the flag of possibilities for reflection. They're not supposed to testify in court unless their method of approach has wide acceptance, but there are differences between experts, and in applying even an accepted method to a particular case, there are borderline issues and questions of judgment. Therefore, there are differences in the results that they reach. But in each case they should have a generally accepted methodology for analyzing the situation. Otherwise, it shouldn't be the subject of testimony. That rule has been evolved for cases where you have a jury. The jury is likely to be very impressed by the scientist—unless the scientist contradicts the jury's own common sense of a situation, in which case they will not be impressed by the expert.

However, in an adversary situation, the lawyers and the scientists are tangling with each other, and we do not have a constructive or corroborative instrumentality for arriving at a disposition. Juries get to be confused, and the courts try to present some picture to the jury without confusing them utterly. The best that the courts have been able to work out is to require of experts accepted methodology or accepted scientific doctrines with some latitude for differences of opinion. If a scientist is willing to say that he has a reasonable scientific certainty about a matter, and if he's willing to testify to that effect, he is permitted to testify—and give his reasons. . . . This is an imperfect situation and tends to slant keeping scientific testimony out unless it has a certain amount of establishment. . . .

For example, about 50 years ago the court said in a rule that is

generally followed: we won't take lie detector evidence. The legal principal was that there wasn't sufficient acceptance of a scientific principle or of the technique of interpretation of the blood pressure variations to permit this to be called a generally accepted scientific phenomenon.

In the ordinary parlance, people may say, "why don't you take a lie detector test?" One politician may say this to another. The question was raised with respect to Alger Hiss, who refused to take a lie detector test, and immediately 80 percent of the people concluded he was guilty. The uncertainties had no influence on the ordinary supposition.

A year ago the question of whether we should allow voice prints in addition to finger prints came up. There are scientists who measure the variations in voices and develop distinctive voice prints. We said it wasn't established enough for courtroom use, although I remember vividly that at the time of the 1967 war in the Middle East some inferences were drawn by responsible government officials on the basis of radio communications and their voice prints.

There are many times in the ordinary affairs of life where you just have to make a judgment on skimpy information, because that's all you've got. These are not elevated to be sufficiently useful or sufficiently established to put into the jury room.

The jury is not supposed to take into account things that are speculative. The point that I was trying to make was that we have to shift our gears to the extent that the courts are assigned any role in these large questions of technology assessment or environmental assessment and public policy. Courts have to shift their gears to accept matters that can't be stated in those relatively certain terms.

But even when methods are accepted—admitted in reasonably certain terms—there's room for dispute, uncertainty and probability calculation, as much litigation would attest. Certainly it's a familiar occurrence that scientists are on both sides of many highly charged and highly controversial questions of application of methodology.

Yet they all testify under the standard rules of evidence and law, in terms of reasonable scientific certainty—meaning application of usually reasonably accepted methods.

QUESTION: One of the really exciting areas for both scientific and technological development in the last decade is the theory of human judgment. And there are two main approaches to that.

One involves what are called policy rules, the rules by which individuals make decisions. It's now quite feasible to expose them and understand them and determine the weights that are given to the various factors.

The other is a more objective procedure called decision theory, and there are many, many opportunities to apply this to the kinds of issues that are at stake here.

But imagine something like the *Reserve Mining* case—or any other major environmental question—where you are prepared to put substantial investment into a sound decision.

Let's assume instead of having an expert one had a court empanel certifiable experts—two, three, twelve, fifteen or other number. It's now

technologically feasible to not only determine their judgments but to weigh them and evaluate them, employing electronic technology. Let me describe how one could do this in a courtroom, as it is doable technically today.

An electronic device on the wall could present the weighted judgments of the panel of experts, in response to questions posed to them. For example, the judge could pose to the panel of experts: What is your judgment on the probability of risk to the citizens of drinking this water or using this water routinely?

The experts can then make a presentation which will give their aggregate probabilities or the distribution of their probability—they can now make the decision judgment personally and not in the face of interlocutory elements, and it can be displayed as to its subjectivity.

They can be asked questions as to the probabilities of specific risks to the public or any kind of question in which a judgment or probability or weighing of any sort can be evoked and therefore can be presented objectively and in terms of weighted averages.

It seems to me that that kind of technology is almost ideal for approaching the major issues for which one can find experts and empanel them. I believe one could even present this and explain what's happening to a jury so that they could understand the questioning in real time.

The problem would be, and this is where I presume the judge would come in, to avoid the tendency to throw curves, to tangle the jury up. If one is interested in getting the judgments, the weights and their opinions, the judge can presumably do this with a degree of dispatch and accuracy that will permit the weights and evaluations to be made useful.

JUDGE LEVANTHAL: I am not going to testify as an expert. We were presented in our court with the problem courts have generally of trying to figure out how many judges they need for their volume of work. We were presented with a series of studies in which the number of cases that come into our docket were broken up into twenty-five categories.

The administrative offices know, year by year, how many cases go into each category, more or less. What they don't know is the time requirements of the average case in each category. The judges all sat around with the electric panels to which reference has been made, and a method was presented to us for reaching a qualified judgment of a qualitative decision, what should have been a relatively simple thing: What are the average cases in this category going to require in terms of the amount of time, in your experience? We were all given a direct criminal appeal, which is a pretty standard item, as having the value of one. And we had to give the relative weights for the other categories.

It was really quite interesting. Here we were, nine judges each with a little box, and when a question was posed, we each punched our box. Up on the electronic board were the answers that were given by the judges.

The tendency of the people who ran the project was to accept our judgments when they were clustered together, when there was no great

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What interested me was that when our weights were widely scattered, we would talk to each other about who voted for this weight or that; or why; or what was meant. We had conversations about the matter and why we differed so much.

Even when our judgments were clustered closer together, such conversation as we were able to have, which the system doesn't really call for since it calls for us to be impersonal, showed that we were often taking the same questions in a field in which we were experts in quite different senses and making quite different judgments and sometimes coming closely together for diametric reasons. What happens when you have that kind of a mechanical approach to a qualitative question and you don't have some instrument for asking why and how and what did you mean?

There are all sorts of ambiguities inherent in the results. I don't think that this technique or others like it can be administered unless there is some opportunity to pin somebody and ask him questions and make sure that you're all talking more or less about the same thing. The rules of reference must be clear.

QUESTION: Judge Leventhal, you mentioned in your comments the need for scientific assistance to the courts. I would be very interested in hearing your comments on what form you think that assistance will take.

JUDGE LEVENTHAL: I sometimes listen to a case on the bench and try to ascertain which points are just points that get talked about. You have to have some sort of censor in your mind to tell you which are the telling points and which are the turning points. A great deal of understanding of the lingo and of the technical question is necessary before you can address yourself to the general question or the policy question or the procedural question or the question of fairness.

Judges who were chosen because of the certain amount of their practical experience and exposure to the social sciences are not likely to have wide-ranging information in physical science fields.

What we've been doing is sort of studying as best we can and reading over the records that have been made. The trial judges have the benefit of having experts who are live and talking to them and who can respond to questions, who can educate them. In my practice as a lawyer, the first thing I did when I got into a technical case was to get a very solid scientific education from my witnesses. And I would first examine my witnesses before I went into the hearing. And I was able to put myself in command of a certain amount of basic knowledge before I got into the non-technical question so that I could understand and present the non-technical question.

Judges just don't have the same technical access in the system as it is now. And it seems to me we ought to have access to, say, the National Academy of Sciences or some other broad-based group of experts. There would be no point in naming someone to be called "scientific advisor to the court" as one person couldn't possibly know enough of the various

fields of science that might be covered. What we would have in my approach is somebody that we could talk to, so we could say: Will you please help me understand what is being said here and what is written here, not because I'm going to decide technical questions but so that I can get the background.

I advanced this thought in an article in the *Pennsylvania Law Review.* I have met with nothing but rejection on this proposition because all lawyers are suspicious if you have somebody who you're talking with when they're not present. The lawyer wants to know what such conversation is about so that he can have somebody respond.

I have to have someone who will help me understand what I'm listening to or what I'm reading. Although some lawyers are good at getting ready and getting up in the sciences, many are not. This is a complete impasse, as far as I can see. The suspicion index is about nine times as great as the value index at this time. But I think like other things ideas will change and perceptions will change, and this is a development that may come in time.

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