"TECHNOLOGY ASSESSMENT" IN INDUSTRY: A COUNTERPRODUCTIVE MYTH?

A REPORT TO THE OFFICE OF TECHNOLOGY ASSESSMENT, U. S. CONGRESS

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1. INTRODUCTION: THE NEED FOR NEW TERMINOLOGY

The term "technology assessment," we will argue, should be reserved to describe a form of policy analysis that is designed to support public-sector decisionmaking and the judicious allocation of public resources through the analysis of potential impacts and consequences to society. The use of the term technology assessment for comparable analyses designed to assist private-sector decision-making is, we believe, undesirable and counterproductive. To force-fit the term technology assessment to these activities is to create a Procrustian bed that obscures rather than illuminates, and it tends to cast into a negative perspective some very useful and progressive developments in corporate planning and the exercise of corporate responsibility.

By implying unrealistic and quite possibly undesirable expectations, insistence on the term technology assessment tends to evoke, in industry management, resentment and resistance, both of which become barriers to the development of these desirable management support activities. This resentment and resistance, in turn, may prevent industry from appreciating and making use of the findings of public-sector technology assessments, and from politically supporting this public-sector activity. At the very least, an insistence on using the term technology assessment to query industry about its planning and decisionmaking techniques tends to confuse those who are trying to respond to these inquiries and to produce data that are nearly worthless or completely misleading.

Public-sector technology assessment was conceived and has evolved over a decade and a half to fit the needs of public decisionmaking and public policy formulation. Public policy formulation rests on the broad responsibility of government to protect and advance the public interest. It requires the sensitive trading off of potential impacts on multiple, competing national objectives, and the balancing of special and group interests and conflicting definitions of the public interest. The function of industry, on the other hand, is to generate the stream of goods and services that responds to society's demands--demands created by public policy objectives and demands that are created by the exercise of individual freedom and choice.

So long as industry respects and complies with the constraints imposed by constitutionally sound governmental authority on behalf of the public, it is at least debatable whether industry has a responsibility, or even a right, to attempt to make subtle determinations as to what constitutes the long-range public interest. It is true that some potential detrimental impacts of technology may be unequivocably unacceptable, or may obviously fall outside of bounds set either formally (in general terms, by public policy) or informally (by simple human morality). We can suppose that imposition of a grave, hidden risk to the life and health of consumers, whether or not that risk is covered by existing legal prohibitions and regulations, is unequivocably wrong and that the avoidance of such risk is unequivocably the responsibility of industry. We may also suppose that the unannounced introduction of a serious new pollutant, not yet recognized by laws and regulations, also violates the social responsibility of industry. (However, the acceptance, by both public policy and the general public, of the high mortality associated with the automobile illustrates the fact that even these social imperatives are not clear cut and universal.)

By comparison, the judgment that potential indirect, second order, downstream impacts of technology are either "detrimental" or "desirable" is incomparably more complex, subtle, and difficult. All the informal adaptations and adjustments that society will make to technological change must be included in this judgment, and it is doubtful that any industry or corporation, from its limited institutional perspective, would be able to identify, much less evaluate, these potential impacts. Corporations who must account to directors and stockholders have difficulty justifying the extensive use of resources to study indirect impacts that the corporation has no clear responsibility to manage and no "levers" to control.

Problems of public and even internal credibility arise because of the difficulty of avoiding organizational bias. Should the firm's technology assessments be made public, either the judgment and authority of corporate management would be constrained or the public image of the corporation would be vulnerable to damage. Indeed, aside from these practical considerations, there is the serious question of whether it is more desirable for broad technological initiatives to be stimulated by the corporation's own assessment of potential, indirect social impacts and consequences or by societal values, as they are reflected in economic forces which already are shaped or at least bounded by public actions. The former

at least raises the possibility that subtle choices and decisions that should be made in public forums would be pre-empted in corporation board rooms.

Thus, the assumption that industry should do technology assessment, in the form evolved to support public decisionmaking, is at the least questionable. However, this assumption is implicit in surveys of "the use of technology assessment in industry," including the mini-survey reported in this paper. We suggest that the failure of investigators to recognize and deal with this dubious assumption means that much of the information introduced into the public record as a result of such studies has been unreliable and misleading. One of the present authors has strongly suspected this, as she was associated, as an advisor, with several such studies. This suspicion was confirmed as we listened to respondents in this survey struggle to give us realistic and honest answers to questions phrased in terminology with which they were familiar, but which did not fit their own terms of reference. In larger and more impersonal surveys, this problem would no doubt be compounded by the strong temptation to answer affirmatively questions that implicitly invite the corporation to present itself as "wearing a white hat." This could and does lead survey respondents to label as technology assessment everything from legally required safety checks to purely profit-motivated market research.

Many corporations do, indeed, conduct analyses that are analogous to public-sector technology assessment, yet inherently different in purpose and in scope because they are intended to support corporate decisionmaking. While they may be both future oriented and focused on assessment of potential consequences of technological initiatives, their objective is to enhance the long-range viability and strength of the industry rather than to maximize the overall benefits to society.

These studies include, for example, analyses that are intended to help corporate managers ensure that the company:

- Respects and complies with the regulatory restraints established by public policy to safeguard the public interest;
- Anticipates restraints or liabilities that might be imposed in the future to achieve the evolving objectives of public policy; and
- Identifies evolving or changing societal needs and demands so as to identify both future opportunities and possible future constraints on corporation activities.

These studies are focused more on the impacts of social change on the company than on the impacts of the industry on society.

In some companies, a form of social benefits accounting, usually known as the "social audit," has also developed. Usually an extension of the annual financial report to stockholders, social audits attempt to display the societal benefits such as employment, participation of employees in community service activities, additional tax revenues, and contributions to charitable and educational programs, etc., created by a company and by its location in a particular community or region. Social audits usually do not discuss the indirect impacts of the corporation's products or services.

Recently, the Securities Exchange Commission (SEC) promulgated a requirement that "public companies" carry out an environmental audit of their activities in order to protect stockholders from environmental liability. SEC has said that it will require 50 of the largest companies to perform such audits within the next year or two. So far, at least three very large companies--U.S. Steel, Allied Chemical, and Occidental Chemicals--have carried out, or initiated, these environmental audits. As yet we have no information about the scope and content of these audits.

2. A Mini-Survey of "Industry Technology Assessment"

To get an overview of whether and to what extent technology assessment and related activities were being conducted in industry, we surveyed 27 corporate executives and researchers who had attended technology assessment workshops or short courses. We believe these people were the most familiar with the concept of technology assessment and the most likely individuals to be involved in any ongoing activities within their firms and/or to know of such activities in other firms.

These individuals were sent a two-page questionnaire (see Appendix 1); those who did not respond in writing were contacted with follow-up calls.* We received 23 responses to the original 27 inquiries. Seven of these responses were written replies to the questionnaire; sixteen were interviews conducted by phone during the follow-up. Three persons could not be located, and two additional responses came from persons recommended by one of the original interviewees.

*Many of these people have requested confidentiality and were assured that neither their name or their company's name would be used without their prior knowledge. They will be identified with their permission, in an appendix, after reviewing a draft of this paper.

We also conducted a literature search for topics related to industrial technology assessment. This is not a statistical analysis of the frequency of technology assessment activities within corporations, since the cost of surveying even the Fortune 500 corporations would have been well beyond the resources available for this study, and would have been further complicated by the lack of any clear and unambiguous definition of technology assessment used by the industries themselves.

Two conclusions emerged from this study. First, technology assessment is not a common or very familiar concept, even in these corporations. Second, in those firms that did claim to be doing technology assessment, the term was applied to a wide variety of activities and concepts. There were obvious instances of "old wine in new bottles," as marketing studies and technical feasibility studies were hastily relabeled technology assessments.

It would appear that technology assessments, or more precisely, parallel activities that should be differentiated from public-sector technology asessments, do have a potential role to play in industrial decisionmaking. However, this role will be both different and more limited than the role of technology assessment in governmental decisionmaking. This role will also differ among industries. Certain industries can be expected to use such studies more frequently and to develop more sophisticated techniques than others.

3. INDUSTRY FAMILIARITY WITH TECHNOLOGY ASSESSMENT

The interviewees were already familiar with technology assessment by virtue of having attended at least one short course or conference. However, we were regularly told by an interviewee that he/she was the only one in the company who had an interest in technology assessment. Many of these people had attended a technology assessment course or workshop at their own initiative; they were supported to the extent of corporate reimbursement for their participation but not encouraged to take further action on establishing the concept within the company.

One corporate official, who had previously spent 10 years as a consultant to Fortune 500 companies, said that he has never encountered technology assessment in any of the companies he has worked with. He put technology assessment today in the position of strategic planning 20 years ago, guessing that maybe one in a hundred corporate officers would have even heard the term.

Several factors seem to contribute to this lack of knowledge about the concept of technology assessment. First, the idea, going back barely over a decade, originated in the field of public policy, and for many of these companies, it is an idea that has never touched any of their activities directly. Second, technology assessment has been very sparsely considered, if at all, in the industry "trade press." Magazines such as Fortune and Forbes, as well as the more specialized business newsletters, have by and large ignored it. These are the prime sources of general information for the business community. Technology assessment has been written up primarily in articles directed to the scientific and engineering communities or to the public policy community. Those companies whose officers are the most aware of technology assessment are companies that are primarily involved with high technology, innovative activities that carry a high degree of public and governmental visibility.

Respondees showed an interesting split on the complexity of technology assessment itself. There were those who tended to view technology assessment as a common sense technique that was widely used by a variety of companies--but under different names. As one person comments, "I believe any major company, of necessity, plans with tools like technology assessment without ever giving them special names." Another felt that it was a fairly straightforward, commonsensical approach to dealing with emerging technologies, and that people in a number of contexts were doing it in bits and pieces without calling it technology assessment.

On the other hand, there were those who considered technology assessment to be too elaborate and rigid a technique to be used by most corporations. At the extreme was one executive from a large company whose viewpoint was that technology assessment was an elaborate process designed to make a great deal of money for consultants. He explained his company's lack of any technology assessment activities by saying, "We voted with our feet; we feel that as a concept, technology assessment is not relevant. . . ."

The companies showing the most familiarity and interest in technology assessment concepts, whether or not they had actually attempted to do studies, appeared to have several characteristics in common. They were engaged in high technology, innovative activities, with a relatively large proportion of their work force trained in some field of engineering or the sciences. These companies tended to see their activities as having a direct effect on the environment or some other aspect of society. Perhaps more importantly, however, they also tended to see

themselves as being vulnerable to impacts from outside of the company, particularly from segments of the public or from government regulations. Many of these companies view technology assessment solely in terms of trying to anticipate the effects of the outside world on their own activities, rather than anticipating the effects of their activities on factors outside of themselves. One chemical company executive stated this succinctly in explaining the technology assessment activities of the corporate research division: "Research managers spend a great deal of time looking at future trends and trying to identify future opportunities for a high technology chemical company."

Those companies having the least overall familiarity with technology assessment, and the least interest in it, appeared to be companies involved in the manufacture and distribution of basic goods and services, such as food products and household goods. The respondents from these corporations had largely given up any idea of instituting some form of corporate technology assessment, even if they personally considered it a good idea. A marketing executive from one large food company admitted that he did not see any future possibilities for corporate technology assessment activities as being either "terribly realistic or likely" with his corporation; that company was tied to a system of quarterly goals for production and sales that limited planning to a quarterly schedule. Another executive from a multiproduct corporation felt that the company might use something like technology assessment if they ever decided to introduce a product that was radically different or controversial.

A fair number of firms fall into a "maybe" category. In these companies, there were at least a few people in the firm who had some familiarity with technology assessment but while the management of the company was not opposed to technology assessment, it was not particularly interested in the concept either. A research engineer with a high technology manufacturing firm, one that produced no consumer products, expressed the idea simply: "They feel they'll get around to looking into it sooner or later." Another person currently involved in technology forecasting indicated that one of the things that could spur interest in technology assessment was a government requirement that it be done.

Overall, corporate awareness of technology assessment appears to be limited to one individual or a small group of people within each corporation, even in those corporations that claim to be doing technology assessment. In some cases, one person has been able to implement some technology assessment activities within

the company; in others, their interest remains purely individual. In no case, however, were we able to find a corporation having any sort of a technology assessment process that appeared to be crucial to the decisionmaking of the firm.

4. WHAT IS "INDUSTRY TECHNOLOGY ASSESSMENT"?

Some firms are beginning to call a broad range of activities technology assessment. Firms have different, and often conflicting, definitions of the term, and within a single firm, different individuals can be working on the basis of conflicting definitions. In one case, contact was made with two persons--one involved in technology forecasting and the other a corporate planner--within the same branch of the same firm. The technology forecaster maintained the firm was not doing any technology assessment and saw no realistic possibility of its doing any in the near future. He felt that management did not consider such studies cost effective. His colleague, on the other hand, stated that the corporation was doing technology assessment because management considered it important. The studies he referred to as technology assessments appeared to be forecasts of future technologies and their potential for the corporation; they were probably done by the forecaster who did not consider these efforts technology assessments.

Another respondee listed the following activities as technology assessment: (1) technology forecasts; (2) market analyses; (3) engineering evaluations; (4) site analyses; (5) environmental scans; (6) competitive analyses; (7) economic and business analyses; and (8) other. These studies were done to "help manage the business safely, profitably and avoid surprises," and the major recipients of these studies were the project managers, with department heads and other relevant management also being the targets for such reports. The studies were done regularly and routinely, but as an "integral part of our planning and not something separable or distinct." While some of these activities do contain elements of technology assessment, it is apparent that what was done in this case was to take the company's regular planning process and incidental planning tools and relabel the whole thing technology assessment. The activities thus became technology assessments "after the fact."

A number of respondents have identified market assessments and analyses as technology assessments, or the closest thing to technology assessments done by their firms. In most cases, the person was fully aware that such studies did not fit the definition of technology assessment very well. One company executive, for

example, said that "the closest thing to technology assessment is. . .trying to predict areas of business opportunity for the future." At the same time, he admitted that the company did "very little in the way of analyzing the effects of their business activities on either society or the environment."

Environmental assessments and environmental impact statements mandated by Federal law were identified by several respondents. An individual from one large industrial laboratory identified a number of studies that he did not consider technology assessments, but that were what he called related activities. These included product safety studies involving the laboratory's own employees, the employees of other firms, and the general public; environmental impact statements; and toxicity studies involving the products.

Several large, technology-dependent corporations have offices or divisions that regularly engage in activities that could be called "inverted technology assessments." These divisions are involved in extensive efforts to anticipate future societal developments for the purpose of analyzing the potential effects of these developments on the firm. One major corporation has a two-pronged approach to this form of industrial technology assessment: (1) a small, centralized futurist group reporting to the executive management; and (2) a more short-term project and technology planning office within each of the corporation's several technology areas.

The smaller futurist group had been started by a small group of people within the firm about 5 years ago. It started out by looking at a number of techniques that could be useful in planning for the long-range future of the firm, including futurism, technology assessment, and technology forecasting. The group's interest was oriented primarily toward government, future technologies, and economic factors; the body later was established as a permanent fixture in the company, reporting directly to the top levels of management. Group members presently conduct their own studies, attend seminars and workshops of interest, and produce reports for management. They also conduct brainstorming sessions within the company on such topics as corporate options for coping with the lack of availability of traditional energy sources. They maintain their orientation toward future technological changes, government activities, and economic changes; but they do not cover the social implications of corporate activities (though they do cover the reverse--the effects of social and political change on the company).

This company's second route for industrial technology assessment is the planning function within the technology centers. These centers deal with the various product areas of the corporation and with areas of broad concern, such as energy and the environment. Concerned with both short-term project planning and long-term impacts of their areas of interest, the centers started out being primarily interested in business and economic issues, but have gradually evolved to consideration of the longer term (10-20 years) in areas such as environmental issues. Again, their primary orientation is inward--that is, consideration of impacts on the firm--though they have looked at such issues as the safe disposal of industrial wastes.

Another corporation identified a similar structure within its corporate research division, in which future trends are tracked and then related to future opportunities and hazards for the corporations. Each of the component research divisions attempts trend assessment in its own area for the purpose of planning future corporate activities.

One of our sources said that her corporation had an extensive system to track future social, political, economic, and other developments, and to forecast their effects on her company. However, she was unwilling to provide details beyond the fact that these anticipatory efforts included such issues as energy, environment, taxation, occupational health and safety, and government regulation.

A number of respondents either identified specific instances of technology assessment related studies or indicated that their companies would, under certain circumstances, be open to the idea of conducting a one-time, ad-hoc technology assessment--most probably with the assistance of outside consultants.

A researcher in one Canadian electrical company gave an interesting account of an unsuccessful attempt at contracting out a technology assessment that has apparently left management leery of conducting any further technology assessments (this was the company's first encounter with the process of technology assessment).

Several years ago the company had hired a contracting firm in the United States to conduct a technology assessment on the effects of rate structures on electricity consumption. The study was intended to examine the ramifications of changing rate structures on the use of electricity, including the social and regulatory impacts. In retrospect, the company was of the opinion that the study

fell far short of expectations and that they had been promised much more than was delivered. They did not find the study useful in the decisionmaking process, and it was consequently forgotten except as a negative incentive to future technology assessments, either in-house or by contract.

When the respondent tried at a later time to propose a much more limited, in-house technology assessment in his own area of expertise (including analysis of such areas as social impact), he met with resistance. The general reaction seemed to be, "This looks interesting, but we don't want to put the time and effort into it." Management seemed to consider technology assessment an unproven quantity, both in terms of the technique itself and in terms of the company's ability to produce a successful outcome and arrive at information useful in the corporate decision-making process.

A defense-related group of one major national research and development corporation is currently conducting one technology assessment related study--an environmental impact statement for the MX missile program. This is a relatively large project being performed by both in-house staff and outside consultants, with emphasis on consultants. Funded by the U.S. Air Force, the project is estimated to be a 10-to-20-person effort that will last 2 to 4 years.

In another instance, one respondent wrote:

> Because of the nature of our business, we normally have no requirements to perform assessments of our technology developments. That is, being predominantly in the space, communications, and software businesses for the government, we do not become involved with justifying what we do. (Considering TA in the context of satisfying regulatory requirements, etc.) However, from the technology futures point of view, studies of where our business might go and what problems might be encountered, I feel that TA studies would definitely be helpful. But, until management is incentivized for the long term, support for such work is unlikely unless funded by the government."

This illustrates several fairly common responses. First, technology assessment, even in its inverted form (i.e., consideration restricted to impacts of outside factors on the firm's activities) seems to be a hard concept to "sell" to management, which sees no reason and has no incentive to do it. Second, technology assessment of impacts of the firm's activities on outside factors is often viewed in terms of "justification," or will be done only to the extent necessary to satisfy regulatory requirements.

Some companies did identify sporadic attempts to examine corporate activities in terms of their impacts on broader social issues. These attempts generally parallel a show of government interest. One chemical company executive stated that wherever there is a government policy, the company will generally try to formulate its own policy and/or analyze its activities in terms of that policy. A common example is a company's environmental policy.

Another respondent gave an example of an extensive examination of the projected availability of oil and gas in the near future, and the impacts of that availability on corporate activities. The study was contracted out to an independent engineering firm and resulted in the decision to build a wood-burning cogenerator plant. The wood-burning generator emerged as the most viable option to provide future additional power capacity because it would provide electricity at about half the cost of a traditional generating plant, would serve the community better, and in annual, full-time operation would only use 0.1 percent of the available wood within a hundred-mile radius. Of this amount, a considerable percentage could be purchased from farmers in the form of scrap wood that had no other market value. Obviously, this study did include awareness of impacts on the surrounding community and an effort to include community benefit (as well as corporate benefits) in the analysis. The project, which will cost approximately $30 million and will be brought on line in 1982, was finally approved two years ago.

Another interviewee said that a technology assessment resulted in the decision not to develop solar cells, but did not give details.

One respondent in a multiproduct manufacturing company felt that his corporation would at least consider using technology assessment in the future if the company were planning to enter a new or radically different area of activity. In his opinion, this was the only way the corporation would do any sort of technology assessment, there being little justification for a continuing process of technology assessment within the company.

Aside from specific studies, several respondents have identified a process that might be called informal technology assessment. In some cases this is much closer to the concept of technology assessment as a tool for identifying the second-order impacts of a project or area of new technology than are many of the more formal studies cited.

This informal technology assessment usually involves an individual or a small group of people in an office or division who have taken on the responsibility of staying aware of potential technological changes and their possible impacts on other elements of society. The information is used in their reports and advice to top management without being called technology assessment, and many of these informal assessors have come to the conclusion that their corporations will not put the resources into a formal program of technology assessment. Comments such as the following give some idea of the nature of this informal process of technology assessment: "We do try to bring in social effects, but this isn't a primary thing. It is done on an informal basis. As issues are raised, we try to get the information to the highest level. I've tried to familiarize myself with the issues and to inject this knowledge of social and political factors into the company's decisionmaking." Another comment: "We try to keep our eyes open and sense emerging trends, but there is no formal group doing technology assessment."

In some ways, this informal type of technology assessment appears to have advantages from the perspective of the corporate management. It is a less threatening technique--for instance, a primarily negative assessment presented informally would not seem as dangerous as an officially sanctioned, written report.

Overall, those companies that consider themselves to have engaged in technology assessment have identified a significant number of activities as either assessments or related activities. Some of these are obvious relabelings of conventional corporate practices, such as marketing studies, technical feasibility studies, site planning, etc. Other activities appear to be partial attempts at technology assessment--or more commonly, inverted technology assessment.

5. THE POTENTIAL OF "INDUSTRIAL TECHNOLOGY ASSESSMENT"

Industrial technology assessment is evolving into a different process from those activities called technology assessment in the public sector. This is not necessarily undesirable, but the two processes should not be confused. Industrial technology assessment, even at its most sophisticated, is fundamentally an analysis of the effects of technological, social, economic, and political change on the industry doing the assessment. Only secondarily, if at all, are industries looking at how their activities affect the external environment.

The largest volume of analysis of the effects of an industry's activities on the outside world is probably environmental analysis. This is the area in which

corporations have been mandated, in some situations by the government and now specifically by SEC, to analyze certain of their major activities.

There is little incentive in the corporate sphere to conduct further analyses of the effects of corporate activities on the outside world. This would involve putting resources into obtaining information that most firms feel they do not need. As one of the respondents stated, "Corporate officers tend to get information that helps them make specific decisions or deal with specific problems. These decisions are first financial, and second, technological. Secondary and tertiary impacts are generally discounted by the corporate world."

Many corporations have trouble perceiving the value of doing even "inverted technology assessment" (impacts of society on the corporation); they see even less benefit in studying the effects, particularly the negative effects, of their planned areas of activity. Many corporate planners do understand that these negative effects can come back to haunt a corporation in the form of public anger and government regulation. But unfortunately, even this sometimes appears to become an argument for using technology assessment activities to identify ways of manipulating public opinion and sidestepping government regulation.

Perhaps what is necessary is an explicit recognition of the intrinsic differences between technology assessment in the public and the private sectors. To the extent that corporate officers can be convinced of the value of "objective" technology assessment in guiding corporate decisionmaking into the most socially desirable options, corporate decisionmaking can become more informed and responsible. However, internal assessments on the part of corporations should not be considered substitutes for technology assessment in the public sector. Indeed, most assessments would be kept from the public if only because they contain proprietary information. We cannot assume that private-sector assessments of future technological options will necessarily be either "objective" or reach conclusions based primarily on the net good for society external to the corporation. That kind of assessment rightly belongs in the public sector.

To the extent that public spirited corporations are willing to take on the task of doing some assessments internally, the collective task will be made easier. In many cases, the corporations themselves will benefit in the long run by avoiding costly mistakes or by identifying truly profitable and socially advantageous courses of action.

However, we do not believe that this sort of analysis will be widely done within the corporate sector in the near future. We argue that to use the term "technology assessment"--a term that whatever its own shortcomings is now firmly attached to public policy impact assessment--to describe parallel but fundamentally different corporate planning activities is a mistake. It both obscures the current status of these activities and creates barriers to their future development and improvement.