

SOCIETAL PROCESSES OF TECHNOLOGY ASSESSMENT

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1. Introduction

There has been a tradition of viewing TA as doing (or being commissioned to do) studies on the impacts of some technology or technological project, and devising some way of assessing the impacts. In addition, such studies should, in the words of the report of the National Academy of Engineering, "... be produced in an environment free from political influence or predetermined bias" (1). Such studies are obviously important, and developments in methodology, quality improvement and quality control, must be welcomed. An exclusive focus on the studies and their methodology, however, implies attention to the means of TA only, and a neglect of aims and uses to which the studies are put, whether they are free from bias or not.

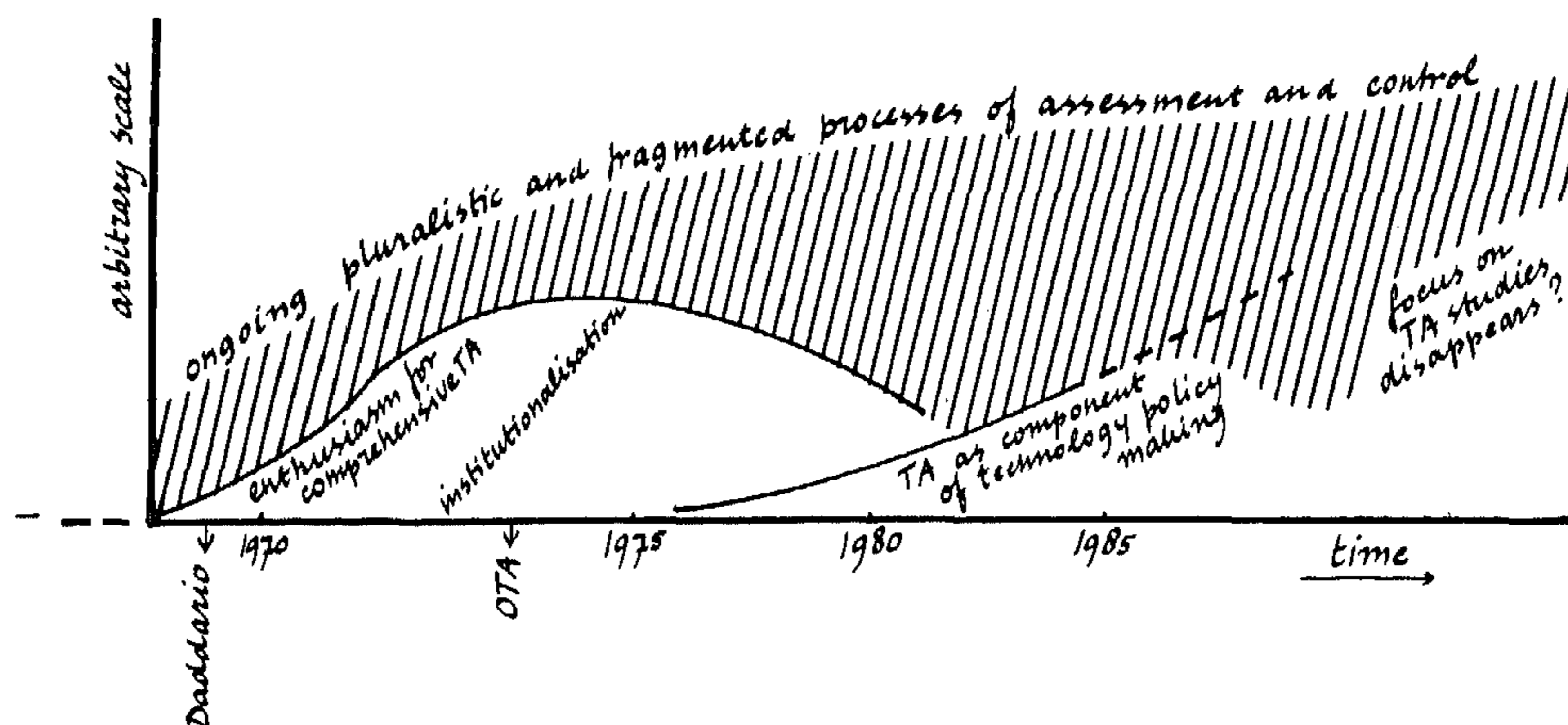
Such criticisms have been voiced before. I want to take a further step, and argue that TA studies should be seen as a part of a societal process of technology assessment, often conflictual, shot through with strategical action, and not simply to be resolved by "objectivity", if that would be attainable. This is not meant to be a message of despair, however. In and through conflicts and strategical action, the issues may be articulated further, recognition of potential impacts may spread. In short, societal learning may occur, and TA studies may contribute to the learning process.

Such an argument is not only an academic critique of a certain tradition in TA. It comes at a time of re-appraisal of TA, during which the dissatisfaction of the late 1970's gives way to new interest, provided TA exercises are linked more closely with policy making. The outcome of this re-appraisal is visible in recent attempts to institutionalize the TA function in European countries and Australia (2). Such closer links with policy making will make it impossible to search for objectivity through isolation from political and societal

affairs. TA researchers will now be confronted with what Brian Wynne has called "home truths about social reality" (3): conflicting models of thought, interest politics and on top of that, symbolic politics like consensus engineering. So it might be useful to start with the societal processes, and evaluate the role of TA studies from that perspective.

The broadening of perspective can also be illustrated with the help of a potted history of TA (primarily in the US), as summarized in the scheme below.

Figure 1



In the traditional view, TA is a form of policy analysis, designed to support public-sector decision-making and the judicious allocation of public resources, through the analysis of potential impacts of technology and its consequences to society (4). This view has been criticized as too managerial, as claiming TA to be a "technological superfix" (5). And policy makers have grown disappointed, after the high hopes at the beginning of the TA movement. Yet, TA will not disappear:

Although the future of technology assessment as a discrete activity within the national-governmental process appears uncertain, its underlying philosophical perspective may well have a more-enduring and profound influence on politics in the United States (6).

What is the TA "philosophy"? Its essence can be captured by saying that the aim is to reduce the (human) costs of learning by trial-and-error, by means of anticipation of

future developments and impacts, and by accomodating such insights in decision making and its implementation. Such a philosophy is already clear in the original impetus for TA, e.g. when Congressman Daddario speaks of an "early warning" function of TA (7). In the US developments, the philosophy has been narrowed down to specific goals of institutionalization, including the Congressional wish to bolster its expertise vis-a-vis the Executive (8). But it has not disappeared, if not in the Office of Technology Assessment, then in activities of scientists and special issue groups, who warn against potential negative impacts. The philosophy is also clear in the recent, renewed attention for TA, e.g. in the Dutch policy memorandum on TA, and more generally, the integration of science and technology in society (9).

2. Controversies as informal technology assessment

From the broader perspective of a TA philosophy, commissioned TA studies are only one way of anticipation and feed-back into decision making. There are all sorts of occasions during which potential impacts of technology are suggested, criticized, debated and assessed. And decisions are taken, partly derived from the balance of cognitive and social forces in such processes.

Clear examples are "early warning" controversies. The potential impact of chlorofluorocarbons, used in spray cans, on the ozone layer has been a very visible controversy, which has not been fully resolved, although it is not in the public eye anymore (10). The debate on risks of recombinant DNA research is another example. The public debate has died down, after its peak during 1975 - 1977, and the benefits of the new technology are now at the centre of the stage. The balance of forces has changed, partly because of the eagerness to reap the fruits of the new techniques (and to participate in the innovation race), partly also because the debate stimulated studies of risk of recombinant DNA, which turned out to be less than was thought originally, at the time of the early warning. The relative safety of the research is now widely accepted, and the effectiveness of the bureaucratic containment of risk (classification of experiments and requirements of good laboratory practice, physical and biological containment) is taken for granted. Indeed, those who would now query the safety of recombinant DNA research would be labeled deviants.

The dynamics of such controversies can be understood from

their beginning as an "early warning" (or, more rarely, an "early promise"). Such claims go against accepted routines, against a "nothing unusual" definition of the situation (11). Therefore, the response will also be an attempt to restore order, even if it is phrased as a statement about the behaviour of micro-organisms and estimates of risks. Such a socio-cognitive dynamic continues when the response to the original "warning" or "promise" is perceived as a "specious reduction", and the critic feels forced to -speciously - inflate his claims in order to get a hearing (12). The message of "catastrophe around the corner" can then be ridiculed by the other party. The controversy escalates, and frustrations rise because each party can - rightly - point at exaggerations, misrepresentations and lacunae in the stand of the other party or parties.

Obviously, positions, alignments and interests of the several actors in the controversy will influence their views and reactions. But it would be wrong to focus on them exclusively. Even in the case of NIMBY controversies, where a chemical plant or a nuclear waste dump are opposed to avoid getting it "in my backyard", knowledge claims about positive and negative impacts quickly come to the foreground. In our scientific age, interests have to be defended by reference to scientific facts and insights, which then will become a focus of the controversy.

The point can be made in a different way, by comparing a controversy about potential impacts with a more traditional conflict, in which also a "warning" occurs. Take the infant formula controversy, about the way some companies promote (or have promoted) their powdered milk for infant feeding in developing countries. Some critics have denounced these companies, bringing to light what they consider to be reprehensible practices, and arguing against them in terms of the relative value of breast feeding and formula feeding of infants, by pointing at the lack of clean water in developing countries, and by referring to attitudes and cultures of the people concerned. The dynamics are similar, but the main focus is on the morality of the practice and the credibility of the companies. In the recombinant DNA research controversy and other TA-type controversies, the "denouncement" is of something that may be the case. The moral rightness or wrongness of continuing as before will now be bound up inextricably with the question whether the claims about potential harm are well founded, and what the balance is with present and future benefits. Knowledge claims are the main focus, and the dynamic is irreducibly socio-cognitive.

Socio-cognitive dynamics can be described in terms of conflicting, but interacting problem definitions. "There may be danger to public health from recombinant DNA research" is a common component in the problem definitions, but whether one should envisage ever more speculative happenings or be satisfied with a set of reasonable safety rules that will - hopefully - be followed by researchers and other people involved, is a matter of contention. The problem definitions and their interaction shape research agendas. For example, the escape of genetically manipulated micro-organisms from the laboratory was brought up as an important concern, so studies were made of containment measures and (later) of the fate of escaped organisms. Thus, when "crippled" strains were produced, these could resolve a major part of the controversy: they were an answer to what then was the focus of the debate. Other questions, like interference with biological evolution, that were raised originally but had been in the shadow of the main focus, now tended to be forgotten, or if brought up, put off by general arguments that nature herself breaks the barrier between species.

The effects of a problem definition can be discovered by asking what is not put on the agenda of the debate, for example the possible impact on the balance of the struggle for survival, the so-called mechanism of biological evolution. (Actually, this question now returns with a vengeance: too little is now known about ecological effects of releasing genetically manipulated organisms into the environment, while experiments, e.g. on frost-damage reducing bacteria, are underway.) More important for our present analysis is that knowledge claims and findings relevant to what is on the agenda of the debate have to be accommodated somehow by the contending problem definitions, on pain of losing terrain. As long as such interaction occurs, knowledge claims will get articulated in and through the socio-cognitive dynamic of the controversy, and recognition of potential impacts for what they are worth will improve.

Because some (societal) learning occurs about potential impacts, controversies can be seen as an informal TA process. When the parties battle over the nature and assessment of impacts, claims are pitted against another, scientific, as well as institutional and political resources are mobilized. Strategies of specious reduction and inflation have already been noted, problems are redefined or shifted in scope, opponents are maligned, etc. (13). It is easy to be cynical about these processes and see them as degradation of "real" argument. But cognitive resources are mobilized and further articulated, become available to the parties in the arena of

the controversy. Learning occurs, even if one may have doubts about the quality of learning in particular cases.

Societal learning is not always recognized because it is equated with consensual views and resolutions of the controversy. Since it is exceptional for controversies to get resolved fully - they normally linger on and fade away when the political interest and/or the balance of power shift -, one should not concentrate upon consensus. The outcome of a controversy can be robust, e.g. "risks of recombinant DNA reserach are negligible when the present regulations are followed", even when critics continue to raise doubts. This view is consolidated, and available without special effort, e.g. to third parties (14). In contrast, critics run up against a network of scientific findings, arguments, alignments, interests, which would take an immense effort to deconstruct. A striking example, where the critics have given up in spite of their being unconvinced, is provided by the smoking-cancer controversy. The American Tobacco Institute, supported by the tobacco industry "to promote public understanding of the smoking and health controversy and ... knowledge of the historic role of tobacco and its place in the national economy" has a history of vigorous campaigns against the smoking-cancer links. During the last few years, they have changed their strategy, because their information material was arousing more and more hostility in their audiences (i.e. it took them more and more effort to deconstruct the smoking-cancer link). Their campaigns now emphasize the individual's right to smoke, and while spokesmen insist there is still no proof, the effect of the new strategy is further consolidation: "when even the tobacco companies do not fight the smoking-cancer link anymore, it must be a fact ..." (15).

Although the robustness of an outcome of a controversy resides in its being consolidated, it is not just a matter of power or of fashion. The difficulty of its deconstruction is caused by the linkages in the network containing at least partially articulated knowledge claims, as produced by the socio-cognitive dynamic of the controversy. Thus, there is a difference between the status of the smoking-health link in 1985 and in 1900. Around the turn of the century, cigarette smoking was criticized as a sign of moral degradation, which would therefore also damage health (as a punishment for the sin). This view was powerful at the time, and a number of US States prohibited cigarette smoking. But the smoking-health link remained an empty claim, which could be deconstructed at will, as long as one agreed to the immorality of smoking. There was no important network link between the two (16).

The final point to be made in this section is that the societal learning, i.e. articulation and recognition of potential impacts as an informal TA occurs in and through the interaction of the strategical actions of the several parties. Because of the interests involved, and the socio-cognitive balance of power implied by a robust outcome, such an informal TA is, in a sense, implemented automatically. The parties concerned have to take the assessment of impacts into account, or become vulnerable to attacks that are difficult to counter. The nuclear industry is a case in point, where spokesmen complain that safety measures are unnecessarily strict, while the industry continues to take great care to follow them.

3. TA studies and their strategic use

Since TA studies, and comparable TA activities like expert workshops, are often organized when there is some controversy about potential impacts, the analysis of the preceding section may provide a fresh perspective on the utilization of TA reports: they will be part of the socio-cognitive dynamic, both in terms of reference, the way their problem is defined, and in the use and abuse that is made of their findings. Such insights will also be useful in non-controversial cases, because strategic action remains a fact of life.

Of the few studies of utilization of TA reports, I shall use Whiteman's work on Congressional use of reports by the Office of Technology Assessment (OTA) to draw out some important points (17). In his detailed analysis of citations to and use of two OTA reports, on coal-slurry pipelines and on residential energy conservation, Whiteman avoids the usual, but misleading distinction between instrumental and conceptual/symbolic use of social science. As Knorr has emphasized before, even when the legitimatory function of (social) science dominates, the prevailing view of science as being instrumentally useful entails that legitimation can only be produced through concrete, instrumental use of scientific findings (18). A more adequate distinction is the one between substantive use (concrete or conceptual use before policy positions have been established) and strategic use (specific conclusions and findings are used in promoting action or justifying decisions already taken). Whiteman uses also a third, intermediate category: elaborative use, where specific findings are used to further specify an overall position already established. The definition of strategic use is in line with the notion of strategical action used in the

preceding section, and similar to the way economists talk of strategical action when actors hide their preferences in order to preserve their bargaining power.

The table below shows what the more cynical thought already: Congressional use of OTA reports is often strategic (N is the number of committees that used the report)(19). The difference in the extent of strategic use is related to the degree of conflict surrounding the issue and the resultant political visibility: high for coal-slurry pipelines and low for residential energy conservation. Conflictual issues give rise to strategical action, as was to be expected from my analysis of controversies.

Table 1 U.S. Congress Committee Use of two OTA reports

type of use	coal slurry pipe- lines	residential energy conservation
substantive	0	2
elaborative	1	4
strategic	3	5
	4	9
	2	7
		4
	N=4	N=10

In addition, some learning occurs. Whiteman notes for coal slurry pipeline project:

"There were some arguments that people were making that they just dropped because they didn't make sense anymore in light of the OTA report" (20).

It need not have been the light of reason that changed their behaviour. People would be afraid to be an easy prey for harassment by their opponents if they were to continue with their original argument. Whatever the motivations and causes, the learning is visible in the emergence of a forceful repertoire of established arguments and accepted insights. The

force of the repertoire resides in the costs that actors incur when they go against it (21).

If utilization of TA reports is to be measured by the "learning" that occurs, it is clear that in some cases it is the strategic use of the report, rather than the report itself, that determines utilization. The further implication is that attempts to stop the strategizing may actually reduce the amount of learning that occurs on the basis of a TA report or a TA activity. In the analysis of controversies it is clear that mutual articulation only occurs when a battle is actually engaged; contrasting medical evaluations of estrogen replacement therapy in the US and UK co-existed as long as there were no incentives to interact (22). In the same way, TA reports and TA activities are utilized by becoming a political resource in a debate. Since their original findings may well be deconstructed in the course of the debate, this would not count as utilization in the traditional sense. But their contribution still is to set in motion a process of societal learning. A refusal to participate in socio-cognitive dynamics condemns TA reports to being ineffectual.

An intriguing example of the importance of strategizing is provided by two conferences on the hazards of the chemical 2,4,5-T, a herbicide used in the US and as a strategical weapon in Vietnam. Concern about health effects (possibly because of the presence of dioxin) led to EPA hearings, industry intervention, litigation, and by 1973 the final trial was in sight. Proponents of the herbicide (producers, US Department of Agriculture, user groups like the American Farm Bureau Federation) decided to hold a pre-trial conference, where they would not go for tactical ploys - as they would in a session before EPA - but have a critical look at their position, as it were marshal their troops. State-of-the-art findings should be consolidated, so that their witnesses would be more confident and no unexpected surprises could be sprung upon them by the other side (23).

The fact of the conference being held was made known to the other parties (EPA and Environmental Defense Fund), who then requested to be allowed to participate. The conference was successful in its own terms, but the extended participation had a side-effect: the review of evidence led EPA three months later to terminate their procedure to limit the use of the herbicide.

The controversy was not fully resolved, however, and when further data accumulated, EPA started proceedings anew. The proponents of the herbicide remembered the earlier conference and set out to organize a dispute-resolving conference in

1979. Great efforts were made to involve all relevant scientists and all relevant parties. Most of the opponents refused, however, because they did not want to be implicated in an outcome over which they might not have sufficient control. The conference was held, but had little impact. Professional magazines criticized the lack of balance in the participants, and printed comments from opponents.

Clearly, because of the interplay of strategical action, as well as the perception of strategical action of one actor by another, objectivity and consensus development that is actively sought cannot be achieved. While a marshalling of evidence can have an impact as long as it is part of the socio-cognitive dynamic, as in the first conference. The National Academy of Engineering may continue to require TA studies to be produced in a sanitized environment (24). But if such purism makes the resulting objectivity ineffectual, it is better to take the strategic use of expertise, of TA reports, of workshops, into account. If my analysis of the occurrence of societal learning is correct, one should not bemoan strategizing as an evil that cannot be avoided, but actually try to profit from it.

4. Improving societal learning

My argument can be summarized as: "You cannot stop ongoing strategizing. But this does not imply that you are only playing poker games". If this is correct, it is important to draw out implications as to how societal learning can be improved.

A negative implication has already been mentioned. Attempts to overcome the strategizing by creating a sheltered niche, e.g. a science court, or "objective" TA studies, are doomed to fail. If a niche is found, one removes oneself from the arena, and is condemned to be ineffectual. The overall failure of Dutch societal debate on nuclear energy to influence political decision making can be explained in this way.

A government, or a society, that wants to have safe and acceptable technology in actual fact, not just as a blueprint of how to go about it, has to work with and through the strategizing. TA studies as an independent input into the policy process need not be given up, but must be seen as part of the pluralistic and fragmented societal process of assessment and control of technology. Abandoning the ideal of comprehensive TA, and focussing on issues that are crucial in a

particular decision-making situation are the first steps, that are now being taken in most countries. A further step is the recognition of government being an actor among others, albeit with particular aims and responsibilities. Having better technologies then implies assessing the strategies of important actors like industrial corporations, and playing on them, for instance by reinforcing the impact of public credibility, e.g. with respect to safety and environmental measures. This happens all the time; compare for example the carefully orchestrated study of smoking-health relations and the public presentation of the findings in 1964, by the US Surgeon General (25). My point is that TA studies should be recognized as one of the instruments of such an orchestration. (It should be noted that governments, by explicitly becoming one of the actors, risk losing their legitimation of standing above the parties. This risk weighs more heavily in Europe than in the US.)

The other main point of my analysis has been that societal learning may occur, which implies that it is important to identify conditions conducive to societal learning, and to design ways of improving such conditions. Both the analysis of controversies and the consideration of utilization of TA reports show that learning must be conceptualized as the achievement of the availability of a forcefully articulated repertoire. Views, arguments, insights, embedded in such a repertoire are robust, i.e. cannot be changed without a lot of effort. Robustness does not signify some absolute measure of progress towards truth or correctness: an outcome may be robust and at the same time wrong. But in the business of TA there is no way of knowing if one is correct about potential impacts. So robustness is the best we can ask for (26).

Since robustness is achieved through the interaction of problem definitions of actors in public arenas, improvements must be found in handling such interactions. For example, "interaction professionals" may be more important in some situations than TA experts; one might think of the skills of social scientists to understand and sensitively present the perspectives of different social groups (27). Another implication refers to the involvement of new groups, with their particular problem definitions. Participation of new actors may dissolve robustness that has been painstakingly constructed. This can be welcomed as breaking through the "nothing unusual" definition of the situation that prevails. But participation should then not be construed as a right, e.g. of citizen groups, but as something to be fought for on the basis of a claim about the limitations of prevailing

convictions. Only in this way will a process of societal learning be set in motion, and will an answer be possible to Mazur's question, how much opposition is still a good thing (28).

TA studies may support the societal learning process, but it is clearly not sufficient to limit oneself to commissioning studies and improving their utilization. There must be complementary TA activities, or better, TA studies must be part of a larger set of such TA activities. For example, the tactical use of an exemplary case of a "good firm", e.g. in handling environmental issues, can be more productive in actually creating and maintaining a clean environment than hundreds of impact studies. But the choice of the example and the tactics of its use have to be informed by a diagnosis of the dynamics at work in the sector, a diagnosis that will profit from the insights of practitioners, but will also require TA studies (of societal processes rather than technological impacts).

Critics of TA have described it as legitimatory rhetoric, and compared it with the interest in corporate social responsibility: both add a new type of legitimation to the arsenal of corporations and government agencies, and in doing so help to maintain their position of power (29). This may well be true at a particular moment in time. Such means of strategical action can also set a process in motion, however, in which points of leverage are provided and opportunities for change occur (30). It is possible to profit from such processes, but only if one broadens one's perspective of TA to societal processes. There are clear signs that this is happening in industrialized countries. It will not guarantee that the goal of reducing the human costs of having to learn by trial and error will be reached. But such a broad view of TA is surely a necessary condition.

Notes and Literature

- (1) National Academy of Engineering, 1969, Report of the Committee on Public Engineering Policy, "A Study of Technology Assessment", to the Committee on Science and Astronautics, US House of Representatives, Washington D.C., July, as quoted by B. Wynne, "The Rhetoric of Consensus Politics: A critical review of technology assessment, Research Policy, 4 (1975) 108-158, at p. 124.
- (2) Assessing the impacts of technology on society, Paris: OECD, 1983.
- (3) B. Wynne, op. cit. (note 1), p. 155.
- (4) The particular phrasing is quoted after Vary T. Coates and Thecla Fabian, 1982, "Technology assessment in industry. A counter-productive myth", Technological Forecasting and Social Change, 22, 330-342.
- (5) B. Wynne, op. cit. (note 1), p. 119.
- (6) Vary T. Coates, 1982, "Technology Assessment in the National Government", in: David M. O'Brien and Donald A. Marchand (eds.), The politics of technology assessment. Institutions, processes, and policy disputes (Lexington MA: Lexington Books, D.C. Heath & Co.), 33-50, concluding sentence at p. 48.
- (7) According to O'Brien and Marchand (op. cit. (note 6), p. 6), Emilio Q. Daddario proposed an office to monitor technological developments and provide an early warning of their potential hazards and detrimental effects, according to his paper "Technology Assessment Legislation", Harvard Journal on Legislation, 7, (1970) 507. The Technology Assessment Act of 1972 (section 472) describes the basic function of the Office of Technology Assessment as "to provide early indication of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress" (quoted after O'Brien and Marchand, p. 44 and p. 264).
- (8) Compare the quote from the Technology Assessment Act (note 7) and the analysis of Fred B. Wood, "The Status of Technology Assessment. A view from the Congressional

Office of Technology Assessment", in O'Brien and Marchand (op. cit. note 6)., pp. 211-222. Other observers have suggested that OTA was an attempt of scientists to continue their grip on policy after the influence of the President's Science Advisory Council had waned; see Barry M. Casper, 1978, "The rhetoric and reality of Congressional Technology Assessment", Bulletin of the Atomic Scientists, february, pp. 20-31.

- (9) The Office of Science Policy of the Government Ministry of Education and Science in the Netherlands has issued a policy memorandum Integratie van Wetenschap en Technologie in de Samenleving (Integration of Science and Technology in Society)(June 1984), which includes some innovative proposals to improve and canalize "early warning" processes. Public policy activities of scientific and professional bodies are to be stimulated, as well as educational activities. A "societal address" function should be set up, comparable to an ombudsman for science and technology concerns, but now with a direct link to government offices commissioning TA studies, and to a yearly report on TA questions, to be discussed in Parliament.
- (10) See Lydia Dotto and Harold Schiff, 1978, The Ozone War, Garden City, N.Y: Doubleday. An analysis of the socio-cognitive dynamic of this controversy and the effect of conflicting problem definitions on the research agenda and the articulation of knowledge claims is given in Arie Rip, Comparative study of science-related controversies: Avoiding blind spots, paper presented to the Annual Meeting of the Society for Social Studies of Science, Blacksburg, VA, 4-6 November, 1983.
- (11) The terminology is adapted from symbolic-interactionist analyses, e.g. Joan P. Emerson, "Nothing Unusual is Happening", in Tamotsu Shibutani (ed.), Human nature and collective behavior. Papers in honor of Herbert Blumer, Englewood Cliffs, N.J.: Prentice Hall, 1970, pp. 208-222. The phenomenon is important in all "warning" or "denouncement" situations where public interest is involved, e.g. in whistle-blowing and in uncovering fraud in science.
- (12) The terminology is adapted from Robert E. McGinn, "In defense of intangibles: the responsibility - feasibility dilemma in modern technological innovation", Science,

Technology and Human Values 5 (no. 29) (Fall 1979) pp. 4-10. Again, the phenomenon can be found in many situations.

- (13) Strategical shifts of scope are discussed by James C. Petersen and Gerald E. Markle, "Expansion of conflict in cancer controversies", in Louis Kriesberg (ed.), Research in Social Movements, Conflicts and Change, vol. 4, Greenwich, Conn.: JAI Press, 1981, pp. 151-169. The maligning of opponents in the form of "stigma contests" is discussed by Edwin Schur, The Politics of Deviance, Englewood Cliffs, N.J.: Prentice Hall, 1980.
- (14) Analysts of the controversy, for instance, can mention in passing: "The NIH's risk-assessment program provided information in the long-term consequences of rDNA, and largely as a result of the NIH's assessments, the risk of rDNA research appears to be considerably less than initially believed". (Bonita A. Wlodkowski, "Biomedical Technology, the rDNA controversy", in O'Brien and Marchand, op. cit. (note 6), pp. 119-137, at p. 134). The argument of the critics has always been that there has not been a full risk-assessment program, and NIH has, in fact, not provided information about long-term consequences of rDNA research. But such a statement is clearly available to justify in retrospect, the belief in the low risks of the research.
- (15) Ronald J., Troyer and Gerald E. Markle, 1983, Cigarettes. The battle over smoking, New Brunswick, N.J.: Rutgers University Press. The aim of the Tobacco Institute is quoted after p. 97.
- (16) Troyer and Markle, op. cit. (note 15).
- (17) Utilization of TA reports is discussed by Steven C. Ballard and Thomas E. James, 1983, "Participatory research and utilization in the Technology Assessment Process. Issues and recommendations", Knowledge, 4 (3), march. pp. 409-427, and by Suzanne Kohout and Bernd Wingert, Considering the utilization of TA - the case of information technology studies, paper presented to the Conference Methods and Experiences in Technology Assessment, Utrecht, 27-28 June 1985. For congressional use of OTA reports, I draw on David Whiteman, "Congressional use of Technology Assessment", in O'Brien and Marchand, op. cit. (note 6), pp. 51-64, and David

Whiteman, "Reaffirming the importance of strategic use. A two-dimensional perspective on policy analysis in Congress", Knowledge, 6,(3) (March 1985), 203-224.

- (18) Karin D. Knorr, 1976, Policy-makers use of social science knowledge: symbolic or instrumental?, Vienna, Institute for Advanced Studies, Research Memorandum no. 103, July, as presented to the Meeting of the Society for Social Studies of Science, Ithaca, N.Y., 4-6 November 1976. see also Whiteman, Knowledge, (op. cit., note 17), p. 205.
- (19) The table is derived from Table 1 in Whiteman, Knowledge, op. cit., note 17, p. 211. The two numbers in each element of the Table refer to "concrete" (= instrumental) and "conceptual" use, respectively. Congressional visibility is measured by the number of citations of OTA reports in congressional documents (committee hearings, committee prints, committee mark-up sessions, committee reports, floor speeches), 761 citations for the coal slurry pipeline report, 33 for the residential energy conservation report (Ibidem, p. 219).
- (20) Whiteman, Knowledge (op. cit., note 17), p. 221.
- (21) Whiteman, Knowledge (op. cit., note 17), p. 219, notes that "Visibility through strategic use ... is not often sought by policy analysts. Part of the reason is the perception that strategic use is "improper" use. In addition, strategic use carries with it certain risks that substantive use does not. The maintenance of a nonpartisan image (...) is crucial to the survival of many policy research organizations". He then points out that substantive use itself always occurs within a complex web of influences, and returns to the strategic use to make essentially the same point as in my argument: "A search for impact (or policy analysis, A.R.) that is guided solely by the "rational model", however, ignores the effects of strategic use. In fact, the denigration of strategic use as "meaningless" or "symbolic" is a reflection of the assumption that such use has no effect on the substance of public policy. Some strategic use may indeed have no effect, but this needs to be much more thoroughly examined. Research is needed on the extent to which strategic use of analytic information increases the sophistication and alters the focus of congressional debate" (ibidem, p. 221). Whiteman then gives the quote I

have used already in the main text. The emergence of a forceful repertoire is implied by Whiteman's analysis. Ballard and James's recommendations for participatory TA can be interpreted as strategies to build a robust repertoire (in their case, with particular emphasis on the role and responsibilities of the policy analyst). See op. cit. (note 17).

- (22) Frances McCrea and Gerald E. Markle, "The Estrogen Replacement Controversy in the U.S.A. and the U.K.: Different answers to the same question?", Social Studies of Science 14, 1984, pp. 1-26. British medical experts are aware of the American discussion on possible cancer links and attend conferences, but the definition of estrogen replacement (women's right instead of the American definition of a therapy against illness) is so different that can consider the American debate irrelevant. Another example is the debate on caffeine, where little articulation of knowledge claims seem to occur except when the federal Food and Drug Administration initiates a study and issues a warning to pregnant women. See Ronald J. Troyer and Gerald E. Markle, "Coffee drinking: an emergent social problem", Social Problems, 31 (4)(April, 1984), pp. 403-416.
- (23) The story of the two conferences is drawn from Milton R. Wessel, Science and CONscience, New York, N.Y., Columbia University Press, 1980, pp. 151-165. Wessel, however, concentrates on better procedures to reach consensus - a futile undertaking, if my analysis is correct.
- (24) See their quote in the opening paragraph of this paper.
- (25) Troyer and Markle, op. cit. (note 15).
- (26) Actually, a comparable argument can be given for the business of science. Elsewhere, I have analyzed the construction of scientific facts in the production of robustness; see for example Arie Rip, Controversies and Informal Technology Assessment, A paper presented to the conference on New Trends in the Sociology of Science and Knowledge, Varna, Bulgaria, 3-5 September 1984.
- (27) See for this point John Wilkes, "Case studies: a promising way to assess Technological Impacts?", 4S Review 1 (2), Summer 1983, pp. 8-21, who reviews a study

of the Love Canal affair by sociologist Adeline Levine and proposes that participants might usefully adopt some of her participant observer's skills. Thus, the point is not about the value of mediation.

- (28) Allan Mazur, The dynamics of technical controversy, Washington D.C.: Communications Press, 1981, p. 6-7, sets out the issue admirably: "A critic is not brighter or wiser than a proponent, but he usually operates by stacking up as many objections as are feasible. Invariably some of these are groundless, but they force both sides to examine carefully those assumptions which might otherwise be taken for granted (if there is sufficient social power behind the critic's position, A.R.), and in the process valid problems are sometimes brought to light. (...) How much opposition is a good thing? The problem is to balance the proponents of a technology against its opponents so that each probes the other's position, exposing weak spots that might otherwise escape attention, but not so that neither side wholly overwhelms the other. Perhaps it is naive to believe that a delicate balance is realizable, but it seems foolish to reject the notion outright, considering that we barely understand the nature of technical controversy - of the social processes and mechanisms that make up a dispute". Mazur and I share the fallibilistic perspective on controversies: they may be functional for our society because they can, in principle, weed out the weaker assumptions and insights in our views. But his recipe for improving societal learning is to separate facts and values, to create a niche for less power-dominated debate, thus undermining his own analysis of the dynamics of controversies. It should be noted that the question of participation, or access by third parties, has further dimensions. Creating channels for the introduction of external, or third party, considerations is important by itself, because further network links become possible this way. But much depends on what flows through such channels: will increased accomodation to, say, Moral Majority sentiments improve societal learning and control over technology and its impacts?

- (29) Wynne, op. cit. (note 1), p. 136.

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- (30) This is not naive optimism. It is true that the present analysis does not consider the power bases of the different actors, and may therefore stand helpless in the face of brute resistance. But the dynamics at the macro-level, as they may be analyzed by political economists, are not independent of changes at the meso-level, e.g. through credibility dynamics, as discussed in the present paper. That it is difficult to specify these links, indeed may be impossible to do in a definite way, is no argument to refrain from activities at the meso level. A comparable discussion can be given of the problem of "autonomous" development of technology. See Arie Rip, "Opening the black box of technological development", in Ronald Campiche, (ed.), Actes Congrès International de la Sociologie de la Religion, Lausanne/Louvain, C.S.I.R., 1985, pp. 107-119. Both issues, or better, these two aspects of one problem, have to be confronted in order to overcome what has been called the "control dilemma": potential impacts of technological development can be assessed with some confidence only when the developments have proceeded so far that control has become very difficult. See David Collingridge, The social control of technology, London, Frances Pinter, 1980.