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Technology controversies: Technology assessment as a public discourse

1. Participation, discourse, and technology assessment

In the context of social debates about technology, methods of understanding and consensus-building have recently been increasingly used as a way of rationally resolving conflicts and controversies about modern technologies. Parallel, so to speak, to the approaches of recent technological sociology, which understands the genesis of technical systems and artefacts as the result of complex, non-formalized social negotiation processes and conflicts (e.g., Rip 1986; Bijker et al. 1987), formalized procedures of understanding or negotiating large-scale technological projects are thus being tested from a more practical political perspective. Such attempts are made, for example, in the form of the participation of those affected in the context of administrative planning, or in the use of the mediation procedure developed in the U.S. to resolve technical conflicts (Zilleßen et al. 1993; Hoffmann-Riem/Schmidt-Aßmann 1990; Carpenter/Kennedy 1988).

In the context of technology assessment (TA) projects, which focus less on current project-related conflicts on the ground (such as municipal planning projects) and more on general social controversies about the meaning, purpose, opportunities and risks of new technologies, the term "discourse" is being used more and more frequently, at least in the German debate. Reference can be made here, for example, to the TA project of the Social Science Research Center Berlin (WZB) on herbicide-resistant crops (van den Daele 1993b; Bora/Döbert 1993), the project "Biological Safety in the Use of Genetic Engineering" of the Office of Technology Assessment at the German Bundestag (Gloede et al. 1993), or the TA Academy of the state of Baden-Württemberg, which has set up its own "Discourse and the Public" department. The concept of "constructive TA" developed in the Netherlands, which endeavors to shape processes for the development and implementation of new technologies in a participatory manner, does not refer to the concept of discourse, but pursues comparable intentions with discursive concepts (Rip/van den Belt 1986). Such concepts are associated with the idea that an assessment of the consequences of technology or an evaluation of new technologies is hardly possible without taking into account a wide variety of

social, more or less organized, demands and problem views. In this respect, the boom that the term "discourse" is currently experiencing in TA projects is an update to the element of participation, which has accompanied the concept of TA from the very beginning as an essential, albeit rarely realized, postulate (cf. Hennen 1993).

The idea of TA arose in the context of the growing crisis of state control over the supposedly uninfluenceable dynamics of innovation, with increasing technologization on the one hand, and on the other, the crisis of state legitimacy in view of the thematization of the negative consequences of "technological progress" by new social movements. This resulted in a twofold task for TA: Providing scientific policy advice with the aim of resolving the political control crisis (decision-related), and integrating the diverging evaluative and normative demands on technology policy in order to overcome the legitimacy crisis (public-related). This dual task has always played a prominent role in conceptual debates on TA. In a review of TA congresses in the 1970s and 1980s, Smits (1990) notes that the discussion at the first major international TA congress in The Hague in 1973 was characterized by two camps into which the "TA community" was divided: The representatives of a "reductionist approach," who saw TA as a scientific procedure for improving political decisions that should be kept free of politically judgmental arguments, and the representatives of a "holistic approach," who saw TA more as a participatory procedure of continuous communication between those affected about values, norms, and interests that enter into the evaluation of a technology. Participatory concepts of technology assessment are thus directed against a more "instrumental" understanding of TA as scientific policy advice (cf. Bechmann 1990, p. 144ff.). This opposition is characteristic of the development of scientific policy advice and policy analysis as a whole. An overview of the history of policy analysis in the U.S. shows the development from a rather positivist self-image to a self-image of policy analysis that takes greater account of the political-social context of science. The tension between technocratic tendencies and participatory potential, which is typical of policy analysis, always became particularly clear when policy analysis was concerned with the social and ecological implications of technical innovations (Torgersen 1986, p. 43).

The instrumental understanding of TA, which essentially sees TA as a communication process between scientists and decision-makers, revealed its weaknesses with the dwindling of a socially shared value basis for assessing scientific and technological development, and with the growing realization of the fundamental uncertainty of predictions about the consequences of technology. The necessity of

linking up with public technology controversies thus became clear as an indispensable prerequisite for TA. On the one hand, TA requires the input of the knowledge of those affected in order to promote a "well-informed" political decision that takes all aspects of a problem into account. On the other hand, the interests and values of those "affected" must be taken into account if the political decision to be made is to have any hope of being "accepted" by society.

By taking up the term "discourse," the insight into the necessity of a participatory approach in the context of TA is updated. However, the recourse to the concept of discourse also more or less clearly formulates a claim that was previously made rather implicitly in connection with participatory procedures of technology assessment: The social debate about technology should be "rationalized," and controversies about technology should be "objectified," or stripped of their vested interests. Ideally, "discursive" TA is expected to achieve consensus on previously controversial issues by obliging those involved to engage in "argumentative," "objective" debate. In connection with such expectations of the performance of discourses, the question arises as to the rationality that is brought to bear in discourses, as well as the question of the rationalization potential that discourses can mobilize, i.e., their possible contribution to the preparation of better – in the sense of more socially reasonable – decisions. In the following, an attempt is made to substantiate the thesis that discursive procedures of technology assessment are to be understood as a reaction to public technology controversies and that their efficiency and rationality are based on this.[1] Just as technology controversies are to be understood as "informal technology assessment" (Rip 1986), TA is conversely to be understood as the formalization of public technology controversies.

Insofar as technology controversies are to be understood as public discourses on phenomena of a crisis of industrial modernity, TA processes – as an attempt to organize these discourses – cannot do without a mobilization of the rationality of the processes of understanding which are set in motion in public discourses on pending problems, reasonable solutions, and legitimate decisions. To develop this thesis, I first outline the central social development processes that form the background for current technology controversies (2). This is followed by a discussion of the concept of discourse, in which discursive rationality is identified

1 These considerations are based in part on a discussion on the subject of "TA and discourse" which took place in September 1992 at the Office of Technology Assessment at the German Bundestag, in which Gotthard Bechmann, Fritz Gloede, Leonhard Hennen, Christoph Lau, Joachim J. Schmitt, and Rene von Schomberg took part. I would like to thank Thomas Petermann for his critical review of the manuscript.

as an adequate response to the crisis of scientific-technical rationalization that emerges in technology controversies (3) and discursive procedures of technology assessment as procedures of formalizing public technology discourses (4). Finally, two central problems that TA discourses face are discussed, namely the question of the relation of TA procedures to scientific discourses and political decisions (5, 6). Finally, the question of the problem-solving capacity of discursive TA procedures is discussed (7).

This outline is intended as a contribution to the discussion of the concept and program of technology assessment. But, I would also like to attempt to link the more practically oriented TA discussion to more recent sociological theorizing and to situate the socio-political phenomenon of "TA" in terms of social theory.

2. Everyday life, science, politics: On the crisis of scientific-technological rationalization

The increase in performance and the multiplication of options for action that characterizes scientific and technological rationalization and is the basis for its success brings with it an increase in the consequences associated with actions. The shaping of the future is increasingly dependent on decisions that have to be made in the present without being able to fully foresee their consequences. Such diverse sociological diagnoses of the present as those by Beck (1986, 1993) and Luhmann (1986, 1992) can be reduced to this common denominator. The fundamental uncertainty or "ambivalence" (Bauman 1992) under which individual and social action is subject as a result of scientific and technological rationalization can be identified in problems of *everyday life,* the *scientific system*, and problems of *political decision-making*, which overall lead to a loss of confidence in the "technical feasibility of society" (Bonß 1993, p. 21). TA can be understood as a reaction to this crisis in the process of scientific and technological rationalization. It is part of society's attempts to overcome this crisis. What this consists of in detail is outlined below, with cursory reference to more recent approaches to social theory, in which technology controversies and the concept of risk play a central role.[2] The aim is not to provide a systematic theoretical development of the causes of the crisis of scientific and technological rationality, but merely to

2 Cf. Bechmann (1993) on the socio-theoretical career of the concept of risk.

point out key aspects of the new problem by taking up the central motifs of various recent social theory approaches.

From the perspective of the *everyday world*, processes of technical and scientific rationalization initially appear as an enormous expansion of the possibilities for action, and also the certainty of action, for the individual. The expansion of the scope for action consists in the detachment of individuals from traditional social ties and the dissolution of traditional world views. In addition, processes of scientific and technological rationalization are constantly creating new options for action in the form of success-guaranteed, i.e., safe and efficient technical artefacts and infrastructure systems. The process of mechanization thus introduces new socio-technical guarantors for ensuring certainty of action into modern everyday life – as a substitute, so to speak, for the traditional ties and patterns of interpretation that guarantee certainty of action (cf. Hennen 1992). However, the mechanization experienced by individuals as a relief for their actions comes at the price of an increasing dependence of the individual action situation on social conditions, i.e., conditions that cannot be controlled by the individual. This can be characterized as the typically modern, technically mediated form of "anonymous socialization" (cf. Hennen 1992, p. 212ff.). Anthony Giddens (1990, p. 22ff.) has characterized the effect of this form of socialization with the term "disembedding" as a temporal and spatial dissolution of the boundaries of action situations. In addition to the monetization of social relationships, i.e., the process of economic rationalization, Giddens describes "*expert systems*" as an essential "disembedding mechanism." "Expert systems" can be understood as technical-scientific artifacts and infrastructure systems, as well as the expert knowledge required for their operation or the socially trained role of the expert. The "disembedding mechanism" consists of individual or local action situations becoming increasingly dependent on and structured by spatially and temporally distant processes through the connection to "expert systems." To the extent that more and more conditions of action are socially produced and secured, the production of certainty of action is no longer within the competence of the individual – it must be guaranteed by society (including by science/technology) and therefore becomes a political issue. With increasing dependence on expert systems (or, in a broader sense, technology produced by expert knowledge) in everyday practice, *trust* in expert systems becomes a central resource for social integration.[3]

3 Cf. also Zygmunt Bauman (1992, p. 239ff.), who sees the function of the psychological expert or therapist in the creation of "identity" through the mediation of "objective knowledge" – i.e., social demands – with subjective preferences, whereby trust – here in the person of the expert – becomes the central factor in the success of this mediation.

However, the trust in anonymous "expert systems" that is necessary in the modern age to guarantee certainty of action is necessarily precarious. It must be maintained in the face of ultimate ignorance of how the systems work and without the mediation of (known) persons.[4] The existence of this trust is ultimately dependent on the (usually confirmed) everyday experience that "expert systems" provide action-stabilizing services for the lifeworld (Hennen 1992, p. 190ff.). However, when the scientific-technical system is faced with problems that it raises itself, but which it has no means of dealing with – and this is the case with the issues of safety and social compatibility that are the subject of modern technology controversies – the basis for trust necessarily dissolves. Laypeople are forced to extend their action-oriented "relevance system" (cf. Schütz 1972) – the framework of what is considered significant for their own actions – beyond the "world within reach" – their private everyday life – because "relevance" is imposed on them by the intended and unintended effects of the "expert systems." In this way, however, they cancel the delegation of the guarantee of certainty of action to "expert systems." The "expert systems" necessarily become the object of everyday pragmatic reflection, whereby the social relationship central to (technical) modernity – the complementary roles of expert and layperson – becomes problematic. The achievements of the scientific-technical system can no longer be taken for granted, without reflection, as a secure background for everyday actions (cf. Hennen 1992, p. 198ff.).

The new uncertainties of everyday life are the result of problems produced in the *scientific-technical system.* In terms of systems theory, the scientific system appears to be an extremely efficient system for increasing options for action by reducing environmental complexity through the coding of all questions along the lines of the "true/false" dichotomy. At the same time, however, it is blind to, or unable to "resonate" with, the consequences of its operations in the environment that cannot be processed along the lines of the internal code (Luhmann 1986). Since science and technology operate self-referentially, nothing can be determined a priori about the environmental adequacy of the constantly produced new options for action. It is only ever possible to recognize in retrospect what the environment tolerates. Thus, although science permanently expands the space of available options, "science [...] does not increase certainty, but rather uncertainty" (Luhmann 1990, p. 371). Science is then increasingly concerned with analyzing

4 Cf. also Luhmann's concept of system trust and the thesis of a lack of "internal guarantors" (the individual's own competence), which characterizes securities guaranteed by systems (Evers/Nowotny 1987).

the consequences, risks, and dangers of its own products. However, the more that science attempts to "clarify" risks, the more it emphasizes the provisional nature of scientific knowledge and becomes "self-reflexive" (Beck 1986, p. 254ff.). Scientific doubt is thus applied to science itself, and advances in science reveal the limitations of past truths. In this way, science loses part of its function of securing action in everyday life (see above), as well as its legitimizing and pragmatic function for political action (see below).

With the increasing penetration of science into social processes, the freedom that science has fought for in relation to other social subsystems is also becoming problematic. Large-scale technical systems become an experiment with society because large technical systems or so-called "risk technologies" cannot be tested in all their complexity under laboratory conditions. The implementation of the technology is at the same time a test of its functionality. This means that a "risk transformation" takes place: The risk of research hypotheses being untrue is transferred to society. However, this makes the research privilege – the independence from external control that science has fought for vis-à-vis the political system, problematic (Krohn/Weyer 1990). When research (including and especially basic research, cf., e.g., genetic engineering) is "directly" involved in social development, when "research hypotheses of science become future hypotheses of society" (ibid., p. 118), then the relationship between science and society is open to discussion, because then the social rationality of scientific knowledge also becomes questionable. Advances in knowledge in modern science are essentially based on experimental arrangements of knowledge production, in which science creates its own objects. However, through "decontextualization" – the isolation of research objects from their natural environment – modern science systematically ignores the reality components that arise from the interaction of the laboratory objects with environmental components. Science, its findings, as well as its (technical) products, must be "recontextualized," i.e., they must be evaluated with regard to the possible consequences of their reintroduction into complex environments (cf. Bonß et al. 1992). To this end, they may not only have to be confronted with other scientific disciplines – in the sense of an interdisciplinary "recontextualization" (cf. Hohlfeld 1993). The social rationality of scientific and technological achievements, their compatibility with lifeworld concepts of appropriateness, tolerability, and reasonableness are also up for discussion.

This means that "epistemic discourses" (cf. von Schomberg 1992), in which the sciences ascertain their own possibilities of knowledge and agree on "appropriate" theoretical paradigms and heuristics, become directly relevant to society beyond the boundaries of science. An epistemic discourse could be, for example,

the question which is discussed in the debate on the risks of genetic engineering as to whether genetic manipulation can lead to the unintended development of pathogenic organisms from components that are considered harmless, and which could have dangerous long-term consequences for the environment or humans. Depending on the theoretical concept of the way in which individual genes interact with each other (in the context of the entire genome), the probability of such a risk must be assessed differently. However, the hypothetically plausible risk of the unintended emergence of pathogenic organisms can neither be ultimately proven nor ruled out. Ultimately, such scientific ambiguities can only be clarified scientifically. However, they have implications beyond science, because it is now up to politicians to decide which genetic engineering experiment or procedure can be approved as "safe enough."

The dynamics of the scientific-technical system, its tendency toward an unchecked increase in options, as well as the practical everyday uncertainties triggered by this, are also putting the *political system* under pressure. The new uncertainties of everyday life and the dwindling trust in "expert systems," which previously served as a functional equivalent for traditionally guaranteed certainties, reach the state in the form of new demands on the task of providing services of general interest, and in the form of difficulties in generating consensual decisions. With the assumption of the task of promoting science and technology, the state also becomes the addressee for the grievance of unintended consequences of scientific and technological development. However, the political system lacks, on the one hand, opportunities for control and, on the other, social consensus as a basis for legitimizing technology policy decisions.

The problems of the scientific system affect the state in its possibilities of social control, because the "reflexive scientification" also becomes a political problem with the increasing scientification of politics. The problematic relationship between science and politics becomes most apparent in the case of epistemic discourses, in which the sciences become involved when assessing risk and security issues (see above). Science does not reduce complexity and thus increase decision-making capacity, but rather increases complexity and imposes decisions on politics despite unresolved scientific controversies (von Schomberg 1992, p. 272). The "functional authority of science" is shaken. What science is supposed to do for politics – the guarantee of certainty of action under strong pressure to act by recourse to an established authority that guarantees the right decision (ibid., p. 260) – science does not do in this case. The increasing differentiation of the scientific system thus makes scientific discourse – or at least epistemic discourse – problematic for the political system. The potential consequences and complexity

overtax the rationality of political action, so to speak. Rational decision-making and action requires control of the relevant parameters that determine the situation in which action is taken. However, this is insufficiently guaranteed. At the same time, the option of "non-action" is also excluded or risky (Luhmann 1991). The effects of the scientific-technical system require political action without providing the cognitive resources that would enable rational action.

On the other hand, the state cannot rely on a social background consensus regarding technology policy decisions. The individualization of life situations and styles as a result of the dissolution of traditional milieus (Beck 1986) creates changing and contradictory demands on state action. The dynamics of increasing scientific-technical options with a simultaneous loss of system trust in the rationality of the scientific-technical system overstrains the integrative power of the everyday lifeworld. The thematization of these lifeworld problems by new social movements (cf., e.g., Japp 1993) can be seen as a process of the dissolution of the ideology of progress, which previously served as the basis for the legitimation of technology policy decisions in the "old modern age."

With the dissolution of this last substitute for the foundations of meaning of religious world views that have been disenchanted in the course of modern rationalization (cf. Joas 1992, p. 358ff.), society now enters the phase of its "self-production" (Touraine 1984) – since in "reflexive modernity" (Beck) no "meta-social" guarantors of security are available anymore. Ultimately, this means a politicization of areas of life formerly removed from politics, and a dissolution of the boundaries of politics – not in the sense of state omnipotence, but rather a liberation of individuals, groups, and social movements for social debates that question and re-found political decisions (Beck 1993). This process of politicization of technical-scientific issues can be understood as an expression and motor of a social process of *de-differentiation*, a questioning of partial system-specific rationalities and sole competences. The loss of everyday self-evident facts and certainties turns formerly private questions of security into public questions. The technical-scientific system constantly generates problems that it cannot process itself ("trans-science questions"; Weinberg 1972). Decisions that were previously delegated to the political system as a matter of course become the subject of public discourse. In complete contrast to the assumptions of older concepts in the sociology of technology, which expected political decisions to be replaced by "factual rationality" as society became increasingly scientific (cf., e.g., Ellul 1954; Schelsky 1979 [1961]), the consequence of all this is not the end of the political in "technocracy," and the silencing of political debates by "factual constraints," but a (re-)politicization of technical-scientific discourses (Halfmann 1990).

3. Discourse as a medium of social integration

Social controversies about technology and science can be understood as a response to the cognitive and pragmatic ambiguities and uncertainties outlined above. Public, non-specialized discourses occur where subsystem-specific programs for dealing with problems fail and an unquestioned consensus on legitimate solutions to problems has dissolved. Social debates about technology can therefore be understood as attempts to create a new consensus about what is and what should be in the face of existing ambiguities and a lack of socially shared patterns of interpretation and preferences for action. Technology controversies call into question the validity of statements about hazards and potential consequences as well as the legitimacy of decisions and institutionalized decision-making procedures. Problems are discussed whose solution was previously delegated to specialized subsystems (science, politics), or that are newly raised by the specialized systems of problem solving but cannot be dealt with by them.

Technology controversies are thus part of a process of modern socialization, as addressed by Habermas (1981) in his theory of communicative action. For Habermas, lifeworld communication processes – alongside processes of systemic integration – function as a central dimension of socialization, in the sense of the production of socially shared patterns of interpretation and action. At the same time, he sees an enlightening potential bound up in them, which is released in the course of modern rationalization processes.

In processes of lifeworld interaction, validity claims are made with regard to descriptive, normative, and evaluative propositions (as well as expressions and explications) (Habermas 1981, Vol. 1, p. 66). The

> [...] truth of propositions, the correctness of moral norms of action, and the comprehensibility or well-formedness of symbolic expressions are, in their sense, universal validity claims that can be tested in discourses (ibid., p. 71).

In everyday lifeworld communication, world references come into play that are specialized at the level of social systems: Descriptive, normative, and evaluative validity claims are naively asserted in acts of lifeworld communication, i.e., they are generally not questioned. However, they remain – and this is decisive – "referred to discursive redemption" (Habermas 1992, p. 32). They can be problematized at any time, i.e., become the subject of discourse. The concept of discourse refers to

> [...] the central experience of the unavoidably unifying, consensus-building power of argumentative speech, in which various participants overcome their initially subjective views and, thanks to the commonality of rationally motivated convictions,

> simultaneously assure themselves of the unity of the objective world and the intersubjectivity of their life context (Habermas 1981, Vol. 1, p. 28).

The development of discursive or communicative rationality requires the counterfactual assumption of "domination-free communication," i.e., the assumption of an ideal speech situation in which all subjective and objective constraints that hinder an orientation toward nothing but the force of the better argument are eliminated. However, this is not to be understood as an ideal yet to be realized, but rather as a regulative idea that is always already at work in practical discourses against the resistance of existing power relations and unquestioned everyday self-evident facts.[5]

In this respect, discursivity unfolds in the course of *modernization.* To the extent that traditional, religious certifications of validity claims dissolve, validity claims become contingent and can no longer be justified in any other way than discursively. According to Habermas, this also puts "communicative reason" – the enlightening potential of communication processes – into action. With the release of spheres of value (Max Weber) – or the differentiation of specialized systems – the modern process of demystification and rationalization has not only led to an enormous increase in performance in the field of purposeful rational action, which is probably most blatantly expressed in scientific and technological progress, but has also "rationalized" the living world in the sense that the potential of communicative reason was first freed from the unquestioned self-evidentness of traditionally authenticated world views and power relations. Discourses dissolve such self-evident facts; in discourses, descriptive, normative, and evaluative judgments must be justified; claims to validity are set by the participants as quasi hypothetical in order to justify the claim to truth or correctness in the discourse, i.e., in the communication with others. The prerequisite for discourse is thus the willingness to problematize or virtualize validity claims.

> In this way, facts are transformed into circumstances, which may or may not be the case, and norms into recommendations and warnings, which may be correct or appropriate, but also incorrect or inappropriate (Habermas 1971, p. 25).

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5 This is the decisive contrast, but also the point of contact with Foucault's concept of discourse. For Habermas, the elements of the "order of discourse," with which Foucault (1977) describes discourse as a medium of exclusion, of asserting claims to validity against others, are the forces against which "reason" asserts itself as the telos of linguistic understanding. Ultimately, for Habermas, the hope of understanding between equals – based on linguistic theory – is suspended in discourse. For Foucault, every claim to validity ultimately implies the will to power, i.e., to the elimination of other claims to validity, which makes any hope of understanding illusory (cf. Habermas 1985).

However, the willingness to question outdated assumptions – including one's own – implies the chance of reaching an agreement on what is recognized as true or correct by everyone.

However, the integration of lifeworld action and social integration cannot be achieved through communication processes alone. Life practice is constantly required to make decisions "under conditions of ignorance and dissent," which do not allow any delay in enabling discursive clarification. In this respect, it is dependent on the establishment of routines for solving practical problems. Discourses must therefore not prevent "reproduction processes that are dependent on routine operations" (Giegel 1992, p. 75f.). Claims of understanding must therefore be mediated with claims of action, and social integration remains dependent not only on the resource of "understanding" but also on the integration of the sphere of purposeful rational action, i.e., on the guarantee of certainty of action through the success-guaranteed processing of action problems and the stabilization of behavioral expectations. In modern societies, however, the coordination of actions in the sphere of success-oriented, purposeful rational action is differentiated into efficient subsystems. Science, politics, and the economy are systems that have perfected purposeful rational action and constantly produce options for action and decisions. Ultimately, this means that discourses must relate to the rationality of the subsystems; they remain dependent on them for input and must also communicate their results to the systems.

Giegel (1992) sees the opportunity to mediate between lifeworld and system – understood here in the sense of discourse versus decision – in "intermediary negotiation systems," among others. Here, "insights gained through discourse are to be transported to the level of not agreement-oriented decision-making and strategic action" (ibid., p. 103). Giegel sees the specific opportunity of such negotiation systems in the fact that there is no direct intervention in the operational structures of the subsystems, i.e., their performance is not disrupted. They translate the demands of the lifeworld into the language of the systems and encourage the systems to self-reflect, thus increasing their capacity to perceive problems, so to speak, without impairing their mode of operation.

It makes sense to view technology assessment processes as such "intermediary negotiation systems". Technology assessment processes attempt to mediate public discourse on technology with systemic rationalities. They stand between the system and the living world, namely between public controversies about technology, and the scientific and political system. Discursive processes of TA must therefore clarify their relationship to scientific rationality on the one hand, and to institutionalized processes of political decision-making on the other. Following

an outline of organizational problems of formalizing technology controversies in discursive TA processes, these questions are discussed below.

4. TA and discourse: TA as a formalization of public technology controversies

Problems and questions that are typically dealt with in TA processes refer almost automatically to the need for discursive clarification of validity claims. TA should answer analytical questions about the "laws" of scientific and technological development, and clarify cause-and-effect relationships; it should expand knowledge about reality – and even about the future. It should generate data. However, technology should be *evaluated* in TA processes. TA should produce statements on whether and how technology policy decisions or new technologies and technical systems jeopardize social values such as "health," "intact environment," "safety," etc. Claims and interests of different social groups regarding, for example, a fair distribution of opportunities and risks should be ascertained and balanced. However, since a social consensus on values can no longer be assumed in (reflexively) modern societies, the goals of social action are disputed, values such as "security" are not self-explanatory but must be operationalized, and risk perceptions differ depending on the cultural background (Douglas/Wildavsky 1982), TA must deal with normative questions such as "What should we do?" What is a desirable future? What can be considered a positive or negative consequence of technology? What are adequate means for legitimate ends?

TA also takes on a discursive character in that not only questions of normative correctness but also questions of objective truth can ultimately only be satisfactorily clarified through discourse. Particularly under conditions of "reflexive scientification," empirical statements about hazard potentials etc. also prove to be controversial, dependent on measurement methods and the disciplinary scientific paradigms used, and are prone to error (cf., e.g., Freudenburg 1992). The relationship between TA and discourse is therefore obvious: A procedure that aims to generate statements about future developments and evaluate technology on the basis of available objective – in the sense of intersubjectively "recognized" – knowledge and social norms, implies discursive discussion of the empirical and normative foundations of its statements.

Explicitly discursive technology assessment procedures, which emphasize the participatory or public nature of technology assessment, bring the latent discursiveness of TA to bear in concrete terms and make it the organizational basis of the procedure. They strive for an open exchange of all positions relevant

to a technology policy issue and the participation of all potentially affected social stakeholders and interest groups.

In this respect, they tie in with public technology controversies, but transfer the "informal technology assessment" (Rip 1986), which gives expression to the "repoliticization of scientific-technical discourses" in the form of manifest conflicts and public controversies, into formalized processes of knowledge generation and consensus building with the participation of those affected. TA discourses aim to create an arena in which every argument can be given its due and in which every claim to validity must be justified or can be questioned. This is linked to the claim of a "rationalization" of informal debates. The aim is to ensure more socially sensible political decisions through better information, more comprehensive knowledge, and consideration of all relevant interests. To the extent that they want to create a free space in which nothing but the power of the better argument counts, and to the extent that they expect this to objectify or rationalize the debate, TA discourses (at least implicitly) refer to Habermas' concept of discourse. They attempt to transpose the counterfactual assumption of an ideal speech situation into real communication conditions and thus expect the development of rationality, i.e., rely on "communicative reason" – albeit usually without recourse to the social-theoretical implications of Habermas' concept of discourse.

Processes of discursive organization of TA attempt to minimize the restrictions that hinder the development of discursive rationality. This requires the elimination of "*access restrictions*," i.e., no one may be excluded from the discourse as a matter of principle. Similarly, certain contributions or statements may not be excluded from the discourse ("*contribution restrictions*"). And thirdly, there must be no restrictions regarding the criticism of statements, i.e., the questioning of validity claims ("*criticism restrictions*"; cf. Schmid 1992, p. 116).

The realization of these conditions obviously encounters a number of practical problems, some of which are related to the external, not domination-free conditions under which a TA discourse takes place. For example, the linguistic competence of potential participants may not be equally distributed. The time and financial resources available to participants to work on a question or to mobilize knowledge and thus formulate or criticize validity claims also vary.

In addition, the boundary conditions necessary for an ideal speech situation collide with the practical requirements of conducting discourses, which result from the fact that TA discourses – precisely in order to be able to develop their rationalization potential as *organized* discourses – must be "situated" objectively, socially, and temporally, and thus "*closed*."

- Unregulated public controversies are thematically open (*factual dimension*). However, this implies a number of disadvantages in addition to the basic permeability for all conceivable topics. A large number of topics and arguments are introduced without there being any guarantee that arguments have to be related to each other and questions answered, etc. The factual input is often random – technology controversies are not based on a systematic survey of available knowledge.
- Participation (*social dimension*) is unregulated, which means that in principle anyone who feels addressed can participate. However, it remains unclear who is legitimized to speak for whom. Nor does the possibility of participation in principle guarantee that certain groups cannot be de facto excluded because they have no access to "discourse arenas" (e.g., the media), provided that the boundary conditions are not free of domination.
- In principle, public discourses (*temporal dimension*) are never finished; they can be continued at any time. This implies the possibility of constantly citing new reasons for proving or rejecting validity claims. However, this also means that public discourses are indifferent to the necessity of practical decisions. In addition, the temporally unregulated structure implies that discourses can break off without having really dealt with the issues raised, and can be resumed without taking up what has already been discussed.

TA processes attempt to solve these problems of public discourse: The technology discourses are centered thematically. The procurement of knowledge is systematized. Differences in participation opportunities can be compensated for by providing financial or personnel support (counter-experts). However, some of the problems mentioned also remain latent – or are present in discourses as contradictions between the requirements of an ideal speech situation and the practical requirements of the organization. This includes, for example, the problem of representativeness: Who is legitimized to speak for whom if it is practically impossible to admit everyone who wishes to speak? The thematic centering of discourse, which promises rationalization effects, also implies a violation of the principle of minimizing contribution restrictions. This can lead to manifest problems in the implementation of discourses if participants are required to focus on different or contradictory topics. A typical TA problem in this context is, for example, the debate about whether the TA discourse should be "problem-induced" or "technology-induced," i.e., whether the examination of alternatives to a technology in question should be the subject of the discourse

or not.[6] The necessary temporal limitation of the discourse also creates new questions that can burden the thematic discourse: When has enough knowledge been generated? When is the discourse broken off?

All of these questions concerning the social, temporal, and factual organization of the discourse can and usually are addressed by the discourse participants. They characterize the fundamental difficulty of reconciling the requirements of an ideal speech situation with the practical requirements of organizing discourse. If they cannot be clarified, they may lead to a refusal to participate or to the discontinuation of the discourse. In the interest of improving the practical implementation of TA discourses, these questions certainly require further discussion. Only two fundamental problems of the formalization of technology controversies will be discussed here, which are related to the factual/thematic and temporal structure of discourses: The role of science in TA discourses (ultimately a problem of contribution limitation), and the relation of TA discourses to political decision-making (a problem of the temporally and factually open structure of discourses).

5. On the relationship between scientific discourses and TA discourses

The question of the significance of scientific rationality in processes of technology policy decision-making has played a central role in the development of social science risk research ("risk assessment" and "risk communication"), particularly in the U.S. This development can be briefly characterized as a gradual abandonment of the belief in the superior rationality of quantitative engineering risk assessment over risk assessment by laypersons and increased consideration of the social context of the construction of risk assessments (cf. Dietz et al. 1993 for an overview). It has been shown that risk assessments – both by experts and laypersons – always include assumptions about the efficiency and trustworthiness of social institutions, which shape both the estimation of the level of risk and the determination of what is considered a risk (Wynne 1982, 1992). Both the rationalities of lay and expert risk assessment are inextricably linked to the unquestioned

6 See, for example, the statement of the Greens on the report of the Enquete Commission "Opportunities and Risks of Gene Technology" of the German Bundestag (Deutscher Bundestag 1987), or the discussion in the TA discourse on "genetically engineered herbicide-resistant crops" of the Social Science Research Center Berlin, which ultimately led to the environmental groups withdrawing from the process (van den Daele 1993b; Gill 1993). See also Sec. 5.

moral and political assumptions and attitudes of the respective actors. The point of this realization is that although this does not make engineering risk assessment superfluous, it is not sufficient for political consensual risk assessment alone. Risk assessment is primarily a political, not a scientific task:

> Since the very term risk is laden with political and moral implications, it should be open to *continued negotiation and redefinition,* as an essential part of *democratic life* (Wynne 1992, p. 283; original emphasis).

However, expert knowledge is not only relativized due to its attachment to values and "social images." Narrower epistemological justifications point to a crisis of scientific knowledge that manifests itself in risk assessment in particular. In the context of modern risk technologies, questions arise that can no longer be dealt with simply by applied science. Risk analysis is necessarily concerned with uncertainties and ambiguities of various kinds, i.e., in the case of risk analysis, scientific knowledge is confronted with situations "where typically, facts are uncertain, values in dispute, stakes high, and decisions urgent (Funtowicz/Ravetz 1992, p. 253f.). Decisions on whether and how to act must be made under conditions of systematically uncertain or unclear knowledge (see also Perrow 1989) and controversial normative (How safe is safe enough?), or ethical (What is socially acceptable?) evaluation criteria. The traditional relationship between "knowledge and politics" (Torgersen 1986) in political consulting is thus called into question.

> Whereas formerly we had the contrast between hard science and soft values, now we must take hard decisions between discrete alternatives, with only soft scientific inputs to them (Funtowicz/Ravetz 1992, p. 258f.).

The consequence of this is an "enrichment" of normal scientific practice toward "post-normal science" in two ways. Firstly, the circle of those involved in controlling the quality of knowledge and preparing decisions is extended beyond the scientific community ("extended peer communities"). Secondly, non-scientifically generated knowledge ("extended facts") – empirical knowledge of laypersons, qualitative dimensions of risk assessment – must also be included in the decision-making process (Funtowicz/Ravetz 1992; similarly Wynne 1992).[7]

Against the background of such debates and what has been said above about the crisis of scientific-technical rationalization, it seems not unproblem-

7 This is certainly hardly a reality in this radical form. However, when it comes to risk assessment issues, the practice of citizen participation by American authorities is certainly more advanced than in Germany. "Public hearings and citizen review panels are standard instruments used by authorities such as the Environmental Protection Agency" (cf. Fiorino 1990).

atic (which is quite obvious from a traditional, scientific self-image of TA) to organize discursive procedures of technology assessment primarily as a scientific discourse, because scientific discourse – since it is oriented toward truth – is assumed to have a higher factual rationality than political discourse. This will be explained here on the basis of some comments on conceptual considerations made in the context of a TA discourse on "genetically engineered herbicide-resistant crops" conducted by the Social Science Research Center Berlin (WZB) (van den Daele 1993a, 1993b; Bora/Döbert 1993). With the participation of representatives from science and industry as well as representatives of environmental groups, the risks of using genetically engineered herbicide-resistant crops in agriculture were to be discussed. The initiators of the WZB project intended to help "factual arguments" achieve a breakthrough and gave the "scientific-technical discourse" a central role in the process. This restricted the discourse thematically, and, tended to favor scientific arguments over political arguments.

First of all, the question arises as to the thematic significance of scientific discourse in the context of TA: What is the subject of TA discourse? There is no doubt that the subject matter of TA discourses is primarily to be seen in questions of science and technology. Undoubtedly, it is also about "information gathering" and not about replacing decisions to be made in the political system: It is about the "knowledge base of decisions" (van den Daele 1991), and in this respect not about the replacement of institutionalized "political discourses" by TA. The question, however, is what is to be regarded as relevant "knowledge" in the context of technology controversies. The discursive TA project undertaken by the Social Science Research Center Berlin attempted to limit the TA discourse to the discussion of "scientific questions." This meant, for example, that the question of examining alternatives to the use of herbicide-resistant crops in agriculture, which would have implied the – undoubtedly political – evaluation of the sense and benefits of using genetically modified crops against the background of a discussion on the environmental and social compatibility of different forms of agricultural production (intensive versus extensive soil cultivation), was thematiccally excluded. The TA discourse should be limited solely to the generation of data, the scientific "findings themselves," and thus the discourse should be concerned solely with the scientific assessment of the ecological and health risks posed by the technology in question (van den Daele 1993a, p. 11).

On the one hand, this (deliberately) neglected the fact that there is usually more at issue in technology controversies than risk issues. In my opinion, however, such an approach also fails to recognize that it is precisely in questions of risk that ambiguities in the data arise in principle, which ultimately cannot be re-

solved by recourse to "the findings themselves." Risks always involve assumptions about the extent and probability of the occurrence of a damaging event, which can be scientifically substantiated, but from which, as they are fraught with ambiguities, no clear instructions for action can be directly derived. The description of the task of a TA discourse with the words, "Before one asks whether a risk is acceptable, one must ask whether the risk exists" (van den Daele 1993a, p. 30), seems in its supposed triviality to completely ignore the importance of the "social context" – of values and "social commitments" – for the definition of "risk." In the case of hypothetical risks, such as the above-mentioned risk that a pathogenic organism is unintentionally created from harmless starting components through genetic manipulation, it is questionable how plausible the assumption of a possible causal chain leading to the occurrence of damage must be in order to derive the need for safety measures from it. The question "How safe is safe enough?", which is central to technology controversies, is a typical "trans-science question," i.e., a question to be answered politically – in accordance with practical reason. It is also difficult to exclude ethical questions ("How should we live?"), or moral questions about the fair distribution of opportunities and risks, which ultimately also means the (economic, political) interests of those involved.

Limiting the TA discourse to scientific topics implies, over and above the danger of excluding politically significant issues, the danger of closing the discourse to non-scientific arguments in the first place – i.e., "closed peer communities" instead of "extended peer communities." This is the inevitable consequence if one attempts to distinguish a "political discourse," which is at best analytically distinguishable and whose main function is "mobilization," from the "scientific-technical discourse," which is the actual content of TA, and if one assumes a priori that the latter is superior to lay discourses in terms of factual rationality (cf. Bora/Döbert 1993, p. 83f.). This is completely questionable if the distinction between scientific and political discourses is ultimately only based on the characteristics of actors. The scientific-technical discourse is simply represented by the so-called "representatives" of this discourse – i.e., scientists. The political discourse, on the other hand, which is considered deficient in terms of "factual rationality," is represented by the representatives of the new social movements. Such an approach runs the risk of linking the "factual orientation" to what the "representatives" of the scientific-technical discourse consider it to be. With such a hypostatization of scientific-technical rationality, TA discourses – in my opinion – come fatally close to older technocratic theoretical concepts, which saw the "factual rationality" of scientific-technical development as the decisive argument for a technical-scientific suspension of the political per se and for the rule of a technical-scientific

elite. In this context of argumentation, the concept of discourse appears to be superfluous. Discourse could then only be understood as a conversation of "factual rationality" with itself in the form of scientific-technical functional elites. With recourse to Foucault's concept of discourse (1977), one could say that the "order of discourse" has excluded anything other than "technical" arguments from the outset. Doubts about the (factual) rationality of scientific-technical argumentation, as typically articulated by new social movements, would thus be excluded from the TA discourse a priori as "unobjective."[8]

Of course, questions of a scientific and technical nature – about how new technologies work, about chains of events that lead to the occurrence of damage, about data on expected immissions and emissions – remain a central topic of TA discourse. Even laypersons have to engage with the terminology and logic of scientific argumentation when clarifying validity claims, e.g., of empirical statements on the reliability and validity of data. The question is, however, whether the level of purely scientific discourse is necessarily abandoned when scientific statements and thus paradigms are disputed (epistemic discourse). In TA-relevant questions, there is not only a dispute about scientific methods and paradigms that could be continued ad infinitum in the scientific system – under conditions of an ideal speech situation. At the same time, there is – however constituted – pressure to make decisions (see also the following section). The dispute about the assessment of genetic engineering risks, for example, could ideally be continued in the scientific system until a decision is made on the basis of reliable knowledge, if it were not already politically necessary to decide whether or which genetic engineering experiments should be permitted. It is precisely at this point that the scientific (epistemic) discourse turns into a TA discourse. It therefore seems at least questionable if the subject matter of TA is reduced to the generation of knowledge – in the sense of scientific findings. TA discourses, if they want to remain compatible with public technology controversies, would have to be understood as events of practical reason – here in the sense of an undifferentiated lifeworld rationality – that primarily deal with scientific-technical problems.

8 The WZB's TA procedure was accused by the participating environmental groups of having been designed from the outset to favor scientific-technical arguments at the expense of more far-reaching arguments of the environmental groups, which ultimately led to the environmental groups dropping out of the procedure (cf. Gill 1993).

6. TA discourse and institutionalized procedures for democratic decision-making

TA discourses can be understood as "communication systems that organize themselves at the boundary between lifeworld and system" (Giegel). They must therefore not only clarify their relationship to scientific discourses, they must also determine their relationship to political decisions and to institutionalized forms of democratic decision-making. TA's characteristic location in the field of tension between science, the political system, and the public suggests that participatory technology assessment procedures in particular are associated with the idea that TA is designed to replace decisions made by the parliamentary system. This has been formulated as a danger on the part of established institutions and as an opportunity on the part of new social movements. It has been rightly countered that TA procedures are centrally related to political (technology policy) decisions, but cannot replace them (cf. Gloede 1991). In the following, the specific position of TA in relation to the political system will be explained with reference to discourse theory considerations. To this end, it is first necessary to revisit the problem of the relationship between everyday discourse and decision-making.

As has been shown, the fundamental openness of discourse not only offers an opportunity for understanding but also poses a fundamental problem: Reasons can constantly be replaced by new and better reasons, and discussions can in principle always be continued. Discourses therefore lack binding force. Discourses have virtually no inner telos that would put an end to them of its own accord. This would then lead to serious problems of social integration if action were not nevertheless constant, and strategic action were not successfully differentiated in specialized systems (Habermas 1992, p. 54 and passim).

The problem, however, is precisely the relationship between (lifeworld) processes of understanding and (systemic) decisions. This relationship can be understood as being mediated via "*constitutive discourses*." If one understands the lifeworld as a field of both communication-oriented action and strategic, success-oriented action, i.e., also as a life practice that is constantly required to make decisions under conditions of ignorance, one can speak of the lifeworld as a field of action, "[...] in which one constantly switches back and forth from discourse to strategic action" (Giegel 1992, p. 79). In processes of lifeworld communication, decisions are ultimately constantly being made as to when communication can be dispensed with and proven procedures of purposeful rational action or decision-making can be used. In this meta-discourse, the interface between system and lifeworld can be located, so to speak. Systems are to be understood as

fields of action that are removed from the lifeworld discourse. However, they are at least potentially connected to lifeworld communication, insofar as they owe their existence or recognition to "constitutive discourses" (Giegel 1992), in which *rules of alternation between understanding and decision* are decided. Constitutive discourses separate discourses about rules and general preconditions of decisions from discourses about the actual decision. They thus ensure that decisions remain possible despite the fundamental incompleteness of discourses: "Discourse determines that under certain conditions discourse is dispensed with" (ibid., p. 83). Systems would then be "fields of strategic action constituted in an understanding-oriented way" (ibid., p. 84), but which have become independent of lifeworld discourses and have developed a complexity driven by specialization that is more complex than the meaning-making processes of the lifeworld.

In addition to the thematically centered discourses on risks, social consequences, etc., technology controversies are also constantly accompanied by a "constitutive discourse" on the question of who is legitimized to decide, when, and according to which rules. The debate about the legitimacy of decisions of the political system, which is usually an integral part of technology controversies, could be understood as such a discourse. To the extent that TA reacts to this, it stands in the field of tension of constitutive discourses, i.e., public debates on the legitimacy of political decisions and decision-making procedures. For discursively organized processes of technology assessment, this means that they must mediate the fundamentally open structure of the public discourse on technology with the necessity of political decision-making under uncertainty or even dissent. However, insofar as they are neither a substitute for public controversies nor a substitute for parliamentary decisions, they can only develop their function as "intermediary systems."

The relative independence from political decisions is a relief that makes TA suitable for preserving the creativity and openness of public technology controversies, and ultimately for developing the creative potential of the discourse. TA procedures offer the opportunity to take up all claims that are publicly discussed. Unlike in the political system, topics and validity claims are not selected according to, for example, electoral strategy. Furthermore, TA discourses make it possible to initially examine validity claims relatively free from strategic calculations of interest enforcement. The probability that the strength of the better argument alone will ultimately prevail increases with the degree to which the discourse is relieved of decisions. Ultimately, in situations relieved of the burden of decision-making, it is more likely that participants will be motivated to question their own, and seriously examine other claims to, validity.

Consultations that relate directly to political decisions are under pressure from existing differences in power and interests that want to assert themselves. They have to comply with bureaucratic requirements, administrative and legal constraints, etc., which prevent the potential for "socio-political and technological creativity" of the discourse from unfolding (cf. Gill 1993). The relative relief from decision-making that is given in TA discourses offers a certain guarantee that what Giegel (1992, p. 94f.) calls the "*organizational dilemma*" in the translation of lifeworld discourses into systemic decision-making rationality is alleviated: The successful transposition of lifeworld claims into decisions requires the organization of lifeworld discourses, their thematic and argumentative bundling, so to speak, with which, however, restrictions are necessarily created for the unfolding of discursive creativity.

However, the creative potential of discourse must be translated into decisions. TA cannot completely dispense with the claim to influence political decisions, as otherwise it would become functionless for the demands of the living world, such as those organized and articulated in new social movements. Non-binding discourses can, under certain circumstances, develop considerable problem-solving potential. However, their non-binding nature also puts them at risk of remaining politically meaningless. It is therefore necessary to agree on how binding the results of discursive TA processes must or may be for political decisions.

How TA discourses can be constitutively positioned in relation to parliamentary decisions cannot be discussed here. In terms of democratic theory, however, they can be understood as elements of a model of "deliberative politics," as outlined by Habermas (1992). "Deliberative politics" is understood as a democratic organization of opinion-forming and decision-making that emphasizes the active role of citizens in contrast to a liberal – state-centric – understanding of politics, without allowing politics to be absorbed into the community of collectively acting citizens in a republican – anti-state administration – way. Such a model sees the state as a democratically legitimized authority to which decisions are reserved, but which is linked back to the formation of public opinion and will, "which not only controls the exercise of political power, but also more or less programs it" (Habermas 1992, p. 365). In this model, state politics remains dependent on the public sphere not only as a "context of justification" but also as a "context of discovery" (ibid., p. 373ff.). With the latter, Habermas refers to the discursive

potential of the public sphere – its openness to claims and questions of all kinds, its tendency to make traditional self-evident facts contingent.[9]

How TA is to be anchored as an institution of deliberative politics between the public and the state is ultimately to be clarified in "constitutive discourses," which in turn are to be conducted as public controversies, but must ultimately lead to parliamentary decisions. Such "constitutive discourses" have indeed taken place in several countries in connection with the question of establishing parliamentary TA institutions, with varying results (cf. Bryner 1992). However, which form of institutionalization is most compatible with a discursive understanding of TA and is appropriate for processes of "reflexive modernization" will certainly remain the subject of public and parliamentary debate. For example, the establishment of thematically centered policy forums prior to parliamentary decisions is conceivable (Zilleßen 1993), as is the establishment of parliamentary TA institutions with a strong public relations function or political support for social initiatives (associations, social movements) to set up TA discourses on specific topics. Which competencies are assigned to such institutions, and how their results are incorporated into political decisions, etc., is ultimately a question of "constitutive discourses" in the true sense of the word – it requires answers at the level of the legal constitution of modern societies. This is where the legal framework must be created in the parliamentary system that establishes the TA discourse and regulates its relationship to the political system. In this respect, the state must set and control the framework conditions for TA discourses (cf. Giegel 1992, p. 107).[10] The task of institutionalizing TA discourses thus points to a fundamental problem of modern organization of political decision-making, which must keep claims to validity open to criticism at all times and yet requires procedures for producing binding decisions. TA must therefore be integrated into a constitutional organization of political decisions, in which the law

> [...] functions as a mechanism [...] that relieves the overburdened communication efforts of those acting communicatively of the tasks of social integration, without in

9 For the role of the mass media public in technology discourses, rationality potentials such as thematic and participatory openness and a preference for general social values at the expense of particular values and norms are also emphasized from the perspective of media research (cf. Peters 1994). For a theoretical justification of a deliberative understanding of politics, see also the concept of "creative democracy" in Joas (1992).

10 Here, Giegel refers to proposals for social self-regulation of questions of technical design and standardization within the framework of association activities, the democratic organization of which would have to be guaranteed by the state (cf. Eichener/Voelzkow 1991).

principle reversing the restriction of the scope for communication (Habermas 1992, p. 57).

7. Benefits and limits of discourses on technology

Discursive TA processes – this thesis was pursued in the present discussions – can be understood as a formalization of public technology controversies, and are thus simultaneously *an expression* of a crisis of scientific-technical rationalization and a *reaction* to its consequences. Processes of discursive TA participate in the demystification of science insofar as they confront the emergence of science and technology with scientifically- and technologically-produced knowledge about latent and manifest consequences (reflexive scientification) and evaluate them against the background of political and everyday problems of action and decision-making. At the same time, they pose a challenge to the current political decision-making structures by confronting them with knowledge of the consequences and the security demands of everyday life.

However, they also claim to provide an *answer* to the new questions that arise. Insofar as public technology controversies as unregulated discourses lack factual, temporal, and social organization, organized TA discourses are linked to the hope of mobilizing the potential of social rationality – or communicative reason – bound up in technology controversies for technology policy decisions. TA cannot achieve this without reference to the structures of knowledge-generation and decision-making which are institutionalized in specialized subsystems. However, its ultimate goal must be to do justice to the ambivalence of scientific and technological modernization in the confrontation of systemic rationalities with public discourses and to increase the level of rationality of decisions. Whether TA is thus part of a process of "rationality reform," which Beck (1993, p. 192) sees as already underway, or whether this is merely a new institutional arrangement of the systemic and lifeworld rationalities released in the process of modernization, remains to be seen. In any case, it is unmistakable that TA, if it wants to respond to the challenges of "reflexive modernization," must tackle the mediation of lifeworld rationality with scientific rationality, and of the public sphere with the political system.

This claim is confronted with the critical objection that participation does not create decision-making rationality, since the problems of a lack of decision-making rationality in questions of shaping technological development or in decisions under uncertainty are not only due to a lack of representation of interests but also to "complex cognitive and coordination problems" (Wiesenthal 1989,

p. 139; cf. also Wiesenthal 1990 and van den Daele 1993a). Although participation offers an improved consideration of interests and values in political decisions, it is precisely this that blocks the chances of finding innovative solutions to problems or implementing them in society. The stronger assertion of particular interests blocks the opportunities to generate new problem views and perspectives for action. This requires a "relativization of particular rationalities" (Wiesenthal 1989, p. 140ff.). Ultimately, the criticism boils down to the thesis that lifeworld rationalities are undercomplex compared to the problem-solving capacity of social systems which are specialized in scientific, economic, etc. rationality:

- In participatory processes, the tendency to adapt the preferences pursued to the most feasible solution is encouraged because the pursuit of immediate interests is preferred to long-term ones.
- The decision-making problems caused by the fact that individuals often have contradictory preferences when it comes to technology policy issues (e.g., as residents of a planned industrial plant, as employees and consumers) cannot be resolved by the representation of those "affected."
- Moreover, it is quite rational for individuals to forego a contribution to the achievement of collective goods (free-rider phenomenon), which is why the chance that general interests are promoted at the expense of particular interests through participation procedures is low.

It should not be disputed here that participatory processes – whether in concrete planning projects or in technology assessment procedures – are fraught with problems resulting from the restricted rationality of the individuals or groups pursuing their particular interests. However, the criticism referred to above, which is based on the rational choice model of action, neglects the possibility of initiating social learning processes, which exists through the implicit obligation of those involved in discourse to reach an understanding.

First of all, the criticism does not sufficiently acknowledge the fact that the specialized rationalities of the subsystems – which are implicitly assumed to have a higher potential for decision-making rationality due to specialization – are precisely part of the problem. It is difficult to see how systemic rationalities can lead to rational decisions in the face of complex, system-produced, but cross-system problems. Environmental problems are known to be those that cannot be dealt with by systems due to their lack of resonance capacity based on specialization (Luhmann 1986). The argument directed against discursivity that relying on "negotiations" – as an alternative to the lost "authority" of science and politics – only increases the uncertainty of decisions by increasing the number of options and

problem views, so that one can only come to an understanding but can no longer act (Luhmann 1992, p. 139ff.), is pragmatically unsatisfactory. Apart from the stoic waiting for problems to be solved through evolution, it offers no alternatives to social processes of understanding the problems at hand and the possibilities of dealing with them.

What is more decisive, however, is that the critique ignores the *creative potential* of discourses. This is rooted in the very characteristic that critics characterize as a shortcoming of discourse: The openness to topics and arguments and the non-commitment to preferences. Preferences or particular interests can be called into question in discourses because the normative claim to validity associated with them must be justified. Contradictory preferences become perceptible as contradictory. The possible consequences of unilaterally pursuing economic or ecological preferences, for example, can be discussed in TA discourses. The consequences of pursuing objective "a" at the expense of objective "b" can be made transparent. Finally, through their inherent tendency to question validity claims, discourses can mobilize social rationality beyond the one-dimensional, individual-utilitarian rationality of "homo oeconomicus" by equally considering and relating pragmatic aspects (questions of action coordination to achieve goals), normative aspects (questions of justice, the social distribution of opportunities and risks of decisions to be made), and ethical aspects of action situations (questions of the good life, of preferences).[11]

In fact, the problems of reflexive modernization require more than just improving the representativeness of decision-making processes. It requires the development of new problem views and preferences in the course of problem-solving action, i.e., creativity in the course of problem processing. What is required is the questioning of established goal orientations and the creative handling of the unavoidable ambivalence of the achievements of (technical) modernity (Bauman 1992). What is demanded in the critique of discursivity: "creation of ideas" or "institutional innovations" (Wiesenthal), is, however, inherent as potential in the discursive confrontation of different interests and rationalities. Discursive procedures of technology assessment question existing definitions of action situations and thus improve the chances of rational action by opening up the possibility of introducing additional knowledge and additional evaluation

11 Cf. the reference by Habermas (1992, p. 387ff.) to the distinction between three dimensions of social integration in Peters (1993): the "functional coordination of action," which requires a cognitive orientation toward events and conditions in the objective world, the "moral regulation of conflicts," and the "ethical safeguarding of identities and ways of life."

criteria into the technology policy decision-making situation. In this way, they enable precisely what criticism assumes to be necessary in view of new problems, but which cannot be achieved with the principle of participation: The relativization of original cost and benefit calculations and trade-offs taken for granted and proven by the "inclusion of further decision criteria" (Wiesenthal 1989, p. 153).

Of course, this creative potential of discourse can only unfold if the "boundary conditions" under which such discourse takes place allow it. In particular, the necessary motivation of the participants to set aside their own interests in favor of a focus on cooperative problem-solving should be considered here. In this respect, skepticism about participatory processes is justified. However, a lack of motivation for problem-solving-oriented action is to be assumed here less in fundamental contradictions between subjective rationality of action and collective goods than in the historical-structural conditions under which discourses on technology take place. The asymmetrical distribution of de facto decision-making power over technological innovation processes suggests a strategic approach by both opponents and proponents of a technology. Discourses, which initially do not change the distribution of resources for the assertion of interests, will always be suspected by new social movements of merely being conceived as events for the integration and silencing of protest. Conversely, it is unlikely that the proponents of a technology – usually the players in the scientific and technological innovation system – will expose themselves to the risk of being tied into a consensus that massively limits their power to define and act.

Consensus as the result of a TA discourse is extremely unlikely under the given structural conditions. In addition to the divergences of interest mentioned above, this naturally includes above all the problems of communication between the subsystems affected by technology policy issues and with the "living world". The resulting divergent views of problems and evaluations of technology represent the core of the crisis of scientific and technological rationalization. Nevertheless, technology controversies do not have to grow into endless conflicts. However, at least "rational dissent", in the sense of an understanding of what is controversial, should be expected from TA discourses, i.e., consensus at the "level of communicative understanding" (about what is controversial and the respective viewpoints represented), with existing dissent at the "level of collective acceptance" of what should apply in the case at hand (Miller 1992, p. 39). According to Max Miller, this makes it possible to transform infinite conflicts into conflicts that can be resolved if what is collectively valid (the background consensus necessary for any understanding) is sufficient to establish an understanding of differences and what is collectively recognized as valid. There are many indications in

modern technology controversies that such a basis for understanding – e.g., a common understanding of what is recognized as a legitimate argument, a common "rationality" – is currently lacking; however, a democratic alternative to "negotiations" is not in sight. Following Miller's argument, discourses on technology should be understood as the nucleus of a new structure, as an expression of the search for new forms and institutions of conflict resolution and decision-making, which can function as a procedural substitute for a no longer sufficient consensus on the "social rationality" to be assumed in relation to processes of mechanization – or as procedures for understanding the no longer self-evident "common good," if one wishes to use the central term of another current debate on the state of modern societies (cf., e.g., Honneth 1993).

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