CHAPTER 3

HARALD HEINRICHS

ADVISORY SYSTEMS IN PLURALISTIC KNOWLEDGE SOCIETIES: A CRITERIA-BASED TYPOLOGY TO ASSESS AND OPTIMIZE ENVIRONMENTAL POLICY ADVICE[1]

INTRODUCTION

Advising those in power is an old business: depending on the historical-cultural context, wise men, gurus, holy men with magic forces, fortune-tellers or (self-appointed) prophets stand as advisors by the side of rulers and political leaders. In modern societies, scientific and technical know-how is ascribed particular rationality, so that politicians today like to surround themselves with scientifically trained experts as advisors, even if they may continue to listen to their private gurus behind closed doors. They hope to obtain instrumental factual knowledge and ensure legitimacy for their decisions in democratic communities. In fact, only good decisions that solve collective problems and are beneficial to the majority of the population find public acceptance and secure the retention of power for those who govern in democracies. And this is the point in politics (Luhmann 2000).

Policy advice has been enormously expanded and differentiated since the middle of the 20th century. There is science-based advice on all political levels, in diversified thematic fields and policy areas: governmental and parliamentary advice (ad hoc or institutionalized), advice to political parties, expert activities, personal advisors of politicians, or think tanks, which also provide the interested public with expertise (e.g., Barker and Peters 1993; Murswiek 1994; Gellner 1995; Cassel 2000; Glynn et al. 2001, 2003). This expansion, however, has not automatically led to more unambiguous decisions and higher acceptance by the public. On the contrary: the paradoxical effect of an expertise / counter-expertise inflation is observed, which promotes both the scientification of politics and the politicization of science (Weingart 1988, 2001). The publicly apparent dissent among experts in many science-based decision-making processes has weakened scientific expert authority and its legitimation function for politics. The traditional 'social contract' between science, politics and the public with (apparently) clear role allocations has thus become brittle (G. Bechmann and Hronszky 2003). The science-politics interaction as part of advisory processes must be renegotiated according to these analyses and adapted to changed social conditions. But there are no easy solutions for the difficult relationship between (scientific) expert knowledge, forming of the societal will and political decision-making.

Sabine Maasen and Peter Weingart (eds.), Democratization of Expertise? Exploring Novel Forms of Scientific Advice in Political Decision-Making – Sociology of the Sciences, vol. 24, 41–61.

Against the background of these assessments I will reconstruct in this article the extent to which science-based policy advice is prepared to meet the current challenges of the emerging field of 'science – politics – the public' (Krevert 1993): What possibilities for optimization can be identified using the example of government- and parliament-related environmental policy advice in Germany and the US?

At first I will briefly outline the concept of 'pluralistic knowledge society' as the current context of policy advice in both countries. Following this, I will address important findings of social-scientific research on forms, functions and processes of policy advice. After the analytical frame has been set, I will present central determining factors of environmental policy advisory systems with the example of a German-American comparative study. The criteria-based typology serves as an orientation tool for the assessment and optimization of advisory structures. Finally, I will present some design options for policy-oriented knowledge communication as a possible approach towards proactively facing the challenges of the knowledge society in this field.

POLITICS AND EXPERTISE IN THE CONTEXT OF PLURALISTIC KNOWLEDGE SOCIETIES

Policy advice does not take place in a vacuum. The historically given differentiation structures and the distribution of power, the collectively shared and subgroup-specific value beliefs and basic orientations, the respective conflicting interests and knowledge claims are of central significance for the function and process of advice.

It may thus be meaningful to have a panel of wise experts serving politics as remote prompters aloof from the public debate in hierarchically organized societies: supposedly unambiguous knowledge flows from science to politics, which will then take and enforce indubitable – because factually uncontested – decisions. A modern democracy makes different demands on advisory processes: apart from political control, modern societies rely on societal self-control, civil society and the personal responsibility of their citizens. Moreover, they are characterized by a predominantly positively assessed pluralism of values, interests and knowledge. The concept of a pluralistic knowledge society, which I will expound in the following, covers central macrosociological aspects of this change in Western democracies that has taken place in the past century.

The progressing differentiation in modern societies has been described by numerous authors since the end of the 19th century (Weber 1976; Luhmann 1984; Durkheim 1999; Parsons 2000). The focus has been on the respective socio-structural and socio-cultural differentiation modes and the corresponding socio-political integration mechanisms. At the end of the 20th century a shift from industrial societies to information societies and knowledge societies was diagnosed (Stehr 1994; Bell 1996). Especially in the US, but also in other countries with democratic systems and market economies, a growing social complexity, as well as a pluralization of knowledge claims, interests and values took place (Bohmann 1996).

The current society formation in countries like Germany and the US can be conceptualized as a pluralistic knowledge society following these macrosociological analyses (Heinrichs 2002: 4–38). In addition to the growth of social complexity in the socio-structural perspective there is a significant pluralization of values and inter-

ests (Inglehardt 1995; Schimank 1996; Sebaldt 1997). Thus, for example, absolute values such as freedom or human rights are differently interpreted depending on the social position and there are a variety of subgroup-specific value orientations. And social interest pluralism manifests itself in that more than 1,500 interest groups are registered in the lobby list at the German Federal Parliament and approx. 18,000 at the US Congress (Sebaldt 1997: 76; Jäger and Welz 1998: 299).

Of special interest in our context is the pluralism of knowledge and science diagnosed by various authors (e.g., Gibbons et al. 1994; Stehr 1994, 2003; Nowotny 1999; Nowotny et al. 2001). Explicit (scientific) knowledge becomes an increasingly important characteristic of pluralistic knowledge societies. More and more sectors of society are based on systematic knowledge, but at the same time the uncertainty and contingency of pluralistic stocks of knowledge is growing. With regard to scientific knowledge, disciplinary differentiation and segmentation must be taken into account in the same way as recent forms of inter- and transdisciplinary knowledge production, which are designated mode-2 and separated from traditional science (Gibbons et al. 1994). Moreover, different forms of knowledge such as professional practical knowledge or cultural everyday knowledge are also considered to be relevant for social design and decision-making processes (e.g., Krimsky 1984; Wynne 1991; Stehr 1994). The heterogeneity of social groups and actors leads to diversified interpretations of reality in a socio-cultural respect, which represent a challenge for 'socially robust' knowledge and decision-making processes (Nowotny et al. 2001).

These reflexive analyses of scientific knowledge and also of policy-advising expertise have thrown light on the conditionality and limitedness of scientific knowledge: its social construction and demarcation, its relativity, its co-produced non-knowledge, its non-determination and uncertainty, as well as its politicization and industrialization and the – unavoidable – influence of basic orientations, value concepts and interests in trans-scientific expert work.[2] The demystification of scientific knowledge claims as well as public expert controversies have changed the social role of (scientific) experts as disseminators of scientific knowledge in practical contexts (Kleimann 1996: 183–215). The fiction of an unrestricted position of 'freely hovering intelligence' (Mannheim 1995) and of an almost inviolable expert status, as propagated in technocratically conceived 'science societies,' is no longer valid in 'knowledge societies' (Kreibich 1986; Stehr 1994; Stehr 2003).

For such a differentiated and pluralized society, the communicative and responsive understanding of state and democracy focuses above all on the integration of so far insufficiently integrated circles of society. Citizen involvement procedures and other participatory instruments have been developed and applied (Zilleßen 1993; Joss and Durant 1995; Renn et al. 1995). In this sense, advisory systems can be understood as part of the functional intersystem networks, i.e., as part of the social integration mechanisms.

Beyond culture-specific differences, the preceding discussion suggests that there are socio-structural, socio-cultural and socio-political master trends on the macrosociological level, which have triggered similar processes of social change in Western democratic societies. This does not mean that there is a complete universalization of social life in countries like Germany and the US. How these master trends are dealt with, for instance, in regulatory processes, remains dependent on national contexts

(for the time being). In this regard, within a large-scale comparative study on chemical regulation, Brickman et al. (1985) showed the relevance of political, social and cultural differences between the US and European countries. And new comparative studies on the meso- and microsociological level will have to show the extent to which international harmonizations or differentiations in policy strategies and regulatory practices will be brought about in the age of globalization (Halffman 2003). Nevertheless, the processes of changed macrostructures apply to Germany and the US, which are referred to in this article for comparative purposes. Both countries can be described as pluralistic knowledge societies in this respect.

The outlined conditions have consequences for the organization of policy advice. The classic knowledge transfer model of instrumental policy advice, in which apparently unambiguous knowledge flows to politics to evoke more rational political decisions in a hierarchical society, has become problematic. Instead, a higher differentiation level in advisory processes seems appropriate in order to accommodate the wide range of knowledge claims, value orientations and interests by a reflecting, transparent and democratic management of expertise pluralism. In the following, I will therefore reconstruct central conceptual models and empirical findings on (environmental) policy advice.

FINDINGS OF SOCIAL-SCIENTIFIC RESEARCH ON POLICY ADVICE

Science, politics and the public rely on each other in democratic societies: the science system has systematic knowledge at its disposal, and politicians legitimized by elections make decisions for which they must try to win public support. The detailed basic features of the interaction relationships are historically variable. Habermas, for example, distinguished more than 30 years ago three fundamental models of the knowledge-value relation between science and politics: decisionism, technocracy and pragmatism (Habermas 1964). In the decisionistic model, politics defines values and goals, and science should deliver instrumental knowledge to achieve the goals. In technocracy, science becomes the dominant institution, because science is believed to identify the 'one best way.' Pragmatism finally is according to Habermas a middle way, in which science and politics have an interdependent, discursive relationship and values and knowledge can be related effectively to each other.

After Habermas numerous – conceptual and empirical – studies were conducted on forms, functions and processes of interaction (e.g., Weiss 1974; Badura 1976; Bruder 1980; Wingens 1989; Jasanoff 1990; Nowotny 1993; Renn 1995; Weingart 1999; Rich and Oh 2000). These studies showed the diversity of advisory practice and the bandwidth of the science-politics-public relationship. At this point, I will selectively address those studies which are central to the empirical comparative study of environmental policy advice in Germany and the US.

The two-community approach identified ideal-typical characteristics of science and politics: truth vs. power, theory vs. practice, cognition logic vs. action logic, facts vs. values, abstraction vs. concretion, complex language vs. simplifying language, long-term time horizon vs. short-term time horizon, modifiable models vs. non-recurring life circumstances, principle of reproducibility vs. principle of irreproducibility, substantial rationality vs. instrumental rationality (Caplan 1979; Wingens

1989). These fundamental characteristics of the systems of science and politics were later criticized as being too undifferentiated, since neither science nor politics are uniform actors (Mayntz 1994: 17–18; Murswiek 1994: 106).

Accordingly, a culture-specific variability of policy advice has been diagnosed (Renn 1995). In ideal-typical terms, a competition model (US), trusteeship model (Southern Europe), consensus model (Japan) and a corporatism model (Northern Europe) can be distinguished. For the two countries compared in this article this means: the US model (adversarial) is oriented to scientific expert dispute, in which data interpretation is in the foreground, whereas expert judgements going beyond scientific argumentation are less relevant. This model is based on the assumption of the methodological objectivity of scientific knowledge. The Northern Europe model (corporatist), in contrast, brings experts and political representatives together. The procedures are formalized and conflicts of interests and different possibilities of influence are recognized and dealt with. The experts, who are often close to interest groups, not only operate as data interpreters. They are conferred a special expert status which puts them in a position to introduce trans-scientific expert judgements (see also Brickman et al. 1985: 315).

Apart from the culture-specific variability of the forms of interaction, a differentiation of interaction functions has also been diagnosed (Boehmer-Christiansen 1995). Going beyond the legitimation and instrumental advising of policy, the full range of functions includes arbitration, decision delay, problem solving, persuasion and others. According to these analyses, the forms and functions of policy advice seem to be more multifaceted than abstract models of the science-politics relationship suggest.

Finally, studies were conducted which analysed the processes of interaction between science and politics beyond rationalistic 'ideal concepts' of a linear transfer of knowledge from a micro-perspective. These studies emphasized the significance of the situational context of the decision-making process, the cognitive limits of information processing by decision-makers and the special nature of scientific expertise (Hammond et al. 1983: 288f.). Moreover, they pointed out that the organization- and person-dependent stock of knowledge and the tacit knowledge of the decision-makers are an important reason for the utilization of expertise. Dealing with information is thus closely linked to implicit stocks of knowledge, preceding explicit knowledge and structuring information behaviour. Expertise is consequently just one source of information for political decision-makers, and information processing is context-dependent. Information does not determine the policy decision and information is chosen selectively. From this perspective, policy advice is not to be understood as a linear process, but as a "web of communication" (Rich and Oh 2000: 173f.).

Based on these findings, integrative approaches of dialogistic policy and public advice were developed in the late eighties. Especially in Great Britain, Canada and the US, analyses and recommendations for reorganizing scientific expertise in the political decision-making process were presented (CSTA 1999; Halliwell et al. 1999; Smith et al. 1999; EPA/SAB 2000; OXERA 2000). In these studies, some central elements can be identified that are also related to the functional change of experts and expertise under changed socio-political boundary conditions described above:

balanced committees, nature of expertise, scientific uncertainty, review procedures, transparency, openness, participation, integration of local knowledge, dialogue orientation. The driving force for these modifications lies above all in securing the credibility of science-based decision-making processes.

In Germany, too, in the nineties, proposals for changing scientific policy advice were submitted, which tie less into the decisionistic and more into the pragmatic model (Krevert 1993; Renn 1999a; 1999b). This is not surprising against the background of the corporatist advisory model of Northern Europe which relies on expert judgements.

In those concepts, politics plays a moderating role in order to continuously and systematically relate diverging knowledge claims, value concepts and interests to each other. In this way, consensus should be explored and dissent elaborated to enable social integration. Policy advice is seen as an analytical-deliberative process of knowledge compilation and knowledge assessment. Scientific, political-administrative and civil society actors are to be incorporated in the same way as citizens (Renn 1999b: 544). In summary, it may be stated that innovative advisory procedures in many Western countries aim at more efficiently accommodating the pluralism of knowledge, values and interests in socially complex societies and processing it for decision-making.

The social-scientific findings on policy advice described in this section show that a renunciation of traditional science-politics models and naïve rationality concepts is both empirically observed and normatively recommended. In view of these observations, a traditional knowledge transfer model in hierarchically organized (industrial) societies can be contrasted today with a model of advice as communication and negotiation. The central question for a comparative analysis of policy advice in Germany and the US is thus: How far does current environmental policy advice meet the requirements of integrative policy advice in a pluralistic knowledge society?

PERFORMANCE OF CURRENT ENVIRONMENTAL POLICY ADVICE: GERMANY-US COMPARISON

The topic of environmental policy is particularly well suited for a (comparative) analysis of advisory organization and practice due to the enormous complexity of society-environment interdependencies. Whether issues of climate change, biodiversity, land use or hormonally active chemicals are involved, politicians require knowledge on cause-effect relationships and options for action for informed decision-making. Moreover, the dynamics of these comparatively young policy fields reflects the processes of social change described earlier). Thus, a change from command-and-control approaches to more co-operative policy strategies is seen for both Germany and the US (A. Bechmann 1995: 463f.; Lester 1995: 22f.) This development corresponds to the broader trends of political control and societal self-control that have developed to cope with the complexity of pluralistic knowledge societies.

Both in the US and in Germany, diversified advisory activities have become established for governments and parliaments since the institutionalization of environmental policy. The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the US Environmental Protection Agency (EPA)

use in-house and agency-based expertise as well as external advice. For advisory systems in the US the Federal Advisory Committee Act (FACA) is central, which was passed by Congress in 1972 as part of the trend towards greater openness in government. This Act was intended to contribute towards reorganizing the then unclear advisory activities to ensure a fair participation of external actors and transparent advisory processes. Central requirements are (Long and Beierle 1999: 4):

- establish a written charter that explains the mission of the committee;
- give timely notice of committee meetings in the Federal Register;
- have fair and balanced membership on the committee;
- open committee meetings to the public, whenever possible;
- have the sponsoring agency prepare minutes of committee meetings;
- provide public access to the information used by the committee;
- grant to the federal government the authority to convene and adjourn meetings; and
- terminate within two years unless the committee charter is renewed or otherwise provided for by statute.

Both science-oriented expert advisory committees and more politics-oriented policy level committees must be implemented pursuant to FACA (Long and Beierle 1999: 5f.) Two of the three panels under consideration in this article, the institutionalized Scientific Advisory Board and the ad-hoc Endocrine Disruptor Advisory Committee fall within FACA.

It may be stated that both Germany and the US have a comprehensive advisory system in the area of environmental policy. In the following, by means of the case studies of seven environmental policy advice systems I will show to what extent the advisory forms enable pluralistic scientific and politically value-related claims to be incorporated into decision-making in a way that is democratic, fair and technically efficient.[3]

In Germany, three institutionalized advisory systems established by the executive, or funded institutionally by the executive, and one ad-hoc advisory system in Parliament were investigated. In the US, three advisory systems in the issue area of 'endocrine disruptors' were analysed.[4] Table 1 gives an overview of the advisory panels and their characteristics.

The reconstruction of advisory practice is based on guided interviews with persons from the panels, representatives of relevant ministries, parliamentarians, representatives of industrial and environmental associations and journalists as well as document analyses. The case study analyses of each of the seven advisory systems, which I cannot address here in detail, show above all panel-specific details that make apparent the context-relatedness of advisory processes. The results of the case studies are predominantly in agreement with the social-scientific findings on forms, functions and processes of interaction presented in the above chapter:

- First of all, more decisionistically (e.g., NAS Committee) and pragmatistically organized (e.g., Enquete Commission) advisory systems can be distinguished on an abstract level following the analytical perspective of the Habermas advisory models. Technocratic policy advice in the sense that science predefines the goal

Table 1: Overview of the advisory panels and their characteristics

Advisory Panel	**Characteristics**
German Advisory Council for the Environment (SRU)	Scientific expert panel of the German Federal Government; national/European environmental policy
German Advisory Council on Global Change (WBGU)	Scientific expert panel of the German Federal Government: international environmental and development policy
German Council for Land Conservation (DRL)	Institutionally funded council composed of scientists and practitioners; regional/national nature/land conservation policy
Enquete Commission 'Protecting Humans and the Environment'	Commission of the German Parliament composed of experts and parliamentarians; national sustainability policy
NAS Committee on Hormonally Active Agents	Scientific expert panel of the US National Academy of Sciences (NAS) on behalf of the US Environmental Protection Agency (EPA); issue-specific knowledge processing
Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC)	Commission on behalf of EPA composed of scientists and experts from administrative, industrial, environmental and public-health associations; issue-specific programme development
SAB / SAP Subcommittee on Endocrine Disruptor	Commission on behalf of EPA composed of scientists and experts; issue-specific programme evaluation

- and route and politics only follows cannot be found. However, it should also be noted for future studies that science increasingly is the social system that creates political action problems by its discoveries (example: climate change) and inventions (example: biotechnology), for the solution of which it is then indispensable (G. Bechmann and Grunwald 2002: 114; Stehr 2003). Panels such as the German Advisory Council on Global Environmental Change (WBGU), which largely defines and elaborates topics independent of the political client and puts political action problems on the agenda while simultaneously supplying action knowl-

edge, undoubtedly exert an influence on political objectives. New (scientific) knowledge thus at least preforms the areas in which politics must set goals.

- Below this abstract level of analysis the case studies show that the ideal-typical two-community approach in large parts does not apply to advisory practice: blurring the dichotomies, whether cognition logic vs. action logic, facts vs. values, theory vs. practice or substantive rationality vs. instrumental rationality is nothing unusual in concrete advisory processes in the opinion of the large majority of those interviewed.
- Concerning the interaction functions, further functions of policy advice were identified – pools of ideas/background knowledge (see below) – which confirm studies pointing out that there is a wider range of advisory functions besides legitimation and instrumental knowledge.
- The culture-specific design of policy advice (only) applies to a limited extent, according to the empirical analyses. Although corporatist forms in fact dominate in Germany (confidence in expert judgements, balanced membership on the Enquete Commission) and the competition model prevails in the US (importance of methodological objectivity of science and separation of scientific data interpretation and political judgement), the Endocrine Disruptor Screening and Testing Committee (EDSTAC) is an example of the fact that there are also corporatist advisory forms in the US. In this advisory system values, interests and knowledge are deliberately brought together in a corporatist form to enable rational coping with the topic, which is characterized by political controversy and scientific uncertainty.
- Finally, the case studies indicated that the interaction processes are not rational knowledge transfer processes from person A to person B, but that problem definitions, information and stocks of knowledge are selected, recontextualized and transformed in both directions of the advisory relations. It will have to be further examined in micro-sociological studies how the associated processes of (re-)construction and shifts of meaning take place in detail.

In spite of the variety, variability and context-dependence of advisory processes, four central cross-panel dimensions, with which the advisory systems are confronted both in Germany and in the US, can be identified. A criteria-based categorization of environmental policy advisory systems along these dimensions may serve as an orientation tool for interactions among science, politics and the public. In the following, I will outline the dimensions, the associated criteria, which result from the material, and the categorization of the advisory systems.

Dimension 1: Distance from Politics

Advisory processes cannot be considered separately from the respective political conditions that prevail and reflect the given distribution of power in a particular historical situation. A current example is the Bush Administration's (attempted) influence on advisory structures and panels in the US. Some observers have expressed concern about the efforts of the Administration to install 'advice without dissent,' where panels with formerly heterogeneous membership, so-called 'balanced commit-

tees' are restructured to become 'administration-friendly' (Michaels et al. 2002). Even if no relationship of dependence or a direct instrumentalization was diagnosed for any of the panels investigated in the present study, the extent of political influence is the central dimension of environmental policy advice systems.

Distance from politics is determined by planning, appointing and accompanying the panels. The criteria to assess this dimension are focused on the following aspects:

- from the large number of conceivable problem areas politics narrows down the topics to be potentially dealt with ('political agenda setting');
- policy-makers determine the panel's possibilities and limits of action by strategic council orientation;
- the stocks of knowledge to be referred to are selected according to technical but also political criteria;
- policy-makers select the disciplines from which they expect to receive the necessary expertise;
- policy-makers appoint the experts according to subject-related criteria but also according to political and in part personal preferences;
- participation of policy-makers in the production of expertise is a far-reaching possibility of exerting political influence.

The advisory systems investigated can be categorized based on these criteria from 'close to politics' through a medium position up to 'distant from politics.'

Panels organized close to politics such as the Enquete Commission in Germany or the Endocrine Screening and Testing Advisory Committee (EDSTAC) in the US are considerably marked by politics. As the following statements of policy-makers and experts interviewed for this study show, the advisory process is politically influenced from the selection of the problem areas to be dealt with up to participation in the preparation of expert reports:

> … I have always intended for the EDSTAC to address issues that lie at the complex interplay between science and policy. Let there be no doubt that the EDSTAC's recommendations must be firmly and thoroughly grounded in sound science. However, the issues that EDSTAC is charged with addressing also have a policy dimension. The interplay between science and policy is another reason why I believe it is worthwhile pursuing a consensus objective with a group that is as broad and diverse as the EDSTAC … (policy-maker, EPA).

On the one hand, policy-relevant expertise can be produced with concrete problem solution competence due to the close co-operation between experts and politics. On the other hand, closeness to politics can adversely affect the rationalization and legitimation power of scientific expertise in public discourse:

> … Politics has to like the output. That is clear. Science has a serving function, that means politics defines the event… (expert, Enquete Commission, translated).

Advisory systems positioned in the middle are also politically influenced by appointment procedures and panel design, but these panels gain strength in rationalization and legitimation since expertise production takes place independent of the political client. These panels – e.g., the German Advisory Council for the Environment

(SRU) – are thus positioned between the poles of decision preparation close to politics and scientific enlightenment:

> … but then we expect concrete policy recommendations and concrete discussions of policy-making (…), they don't always want to support practical policy-making. Instead, they wish to be more abstract and more general in their recommendations … (policy-maker, German Environmental Ministry).

Panels distant from politics, finally, are least marked by the political calculations of the clients. Although the institutional boundary conditions are also set politically here, these advisory institutions have considerable scope in organizing the process. Distance from politics, which is beneficial due to the legitimation function of scientific independence, is paid for by disadvantages concerning the usefulness for shaping policy. These problems became especially apparent in the case of the NAS Committee on Hormonally Active Agents: no consensus was reached and therefore it could just be used by policy-makers as background knowledge and data collection, but not as an instrument for making and legitimating decisions.

In view of the trans-scientific nature of expertise and the unavoidability of expert pluralism, transparency with respect to the planning, appointment and accompaniment of a panel as well as expert selection appears useful. In the German advisory systems in general the non-scientific, political influences are not made systematically explicit. This is in line with the more corporatist approach. Although especially in the Enquete Commission a wide range of different opinions are incorporated by the party-driven appointment of experts, expert diversity is not above party politics and not intentionally balanced; it results from party-political calculations (see also Brown et al. in this volume). With regard to the other advisory bodies, political influences with respect to appointment and council orientation are insufficiently transparent.

For the American panels, which are closer to politics than the NAS Committee, a greater sensitivity regarding political distance can be observed. The targeted appointment of balanced committees and greater transparency in expert selection enable – particularly in EDSTAC – expert pluralism to be dealt with productively under changed boundary conditions. The Federal Advisory Committee Act, which regulates this process formalization in a binding manner, plays a special role here.

Dimension 2: Policy Function

How expertise is used and processed depends on the – explicit or implicit – allocation of political functions. In total, four central patterns of using expertise can be identified: decision preparation (instrumental), argumentation aid/reference point (with respect to legitimation/rationalization), increasing the pool of ideas and more general enlightenment. What political function(s) is (are) fulfilled by a panel can be assessed by the following criteria:

- positioning of the panel (more policy- or more science-oriented);
- reference level (concrete problem-specific or abstract-generalizing);
- time perspective of the expertise (short-term, medium-term or long-term).

Thus, for example, a panel that is strongly policy-oriented and deals with concrete problems on a short-term basis, such as the Endocrine Disruptor Screening and Testing Advisory Committee, serves to prepare decisions:

> … How can we say, we were part of the advice, but then turn our back on it? So we had a higher interest in the outcome … (policy-maker, EPA).

On the other pole of this dimension there is expertise that is more science-oriented and makes abstract, generalizing statements of long-term significance. This expertise is rather used as background knowledge and influences political perception and interpretation patterns only slowly (e.g., German Council for Land Conservation (DRL) or the NAS Committee on Hormonally Active Agents):

> … this is more (…) indirect, much more indirect a voice (…). The council can make points in the argumentation, serve as reference point and influence the direction of the discussion … (expert, DRL).

Advisory systems in a socially complex society with differentiated advisory contexts have to fulfil different political functions. This requires a specific organization of advice in each specific case. The heterogeneity of the German advisory system is compliant in this respect with the requirements of a pluralistic knowledge society. But the individual panels and their expert reports are hardly coordinated. Moreover, especially the SRU or WBGU advisory systems reveal the effort to simultaneously fulfil different political functions. In the worst case this may lead to no function being well fulfilled.

The advisory structure of the American Environmental Protection Agency shown by the case study of endocrine disruptors represents a structured and coordinated advisory organization with clear policy functions. Different panel types were appointed function-specifically to generate background knowledge (NAS Committee), develop consensually strategic recommendations (EDSTAC) and evaluate the EPA programmes based on this expertise for decision preparation. In this way, different advice contexts are complied with. The analysis of the American advisory systems points to the fact that clear positioning with respect to advisory services is beneficial for meeting the requirements of differentiated advice contexts and enabling targeted advice.

Dimension 3: Dealing with Pluralism of Knowledge, Values and Interests

Any policy advice in which scientific expertise is related to political problems goes beyond a purely scientific discourse. It is trans-scientific, because the advisory work is marked by the conditions that specific signals are sent to politics (Weinberg 1972; Rip 1985). Therefore, apart from different stocks of knowledge, the value and interest background of the experts is also of relevance in the advisory discourses. The way in which the pluralism of knowledge, values and interests is dealt with in the advisory process may greatly vary: the spectrum ranges from pluralism being a non-topic through mixed forms up to the proactive handling of these aspects. The panels can be assessed on this dimension according to the following criteria:

- pluralism is made explicit in the advisory work in order to be able to deal with it more deliberately (topic);
- pluralism is represented and accepted but not dealt with systematically (mixed form);
- pluralism remains largely implicit (non-topic).

The pluralism of knowledge, values and interests of modern societies is partially taken up by the German advisory systems. The interdependencies of knowledge, values and interests are reflected by most interviewees, but hardly actively discussed in the advisory processes of SRU, WBGU and DRL. The interviewees rather held the opinion that different value- and interest-related positions must be balanced in the course of advisory discussions:

> … Of course, there are always differences in opinion. Committee members, who claim what is not proven should not bother us. And there are others, who have the opposite standpoint. Somehow we adjust to each other … (expert, SRU).

Pluralism is thus represented in the advisory discourses. It is accepted and pragmatically dealt with. In the Enquete Commission, the pluralism of knowledge, values and interests is much more apparent to those involved from the very beginning. A consensus is aimed at by discussions and negotiations. But no systematic treatment of the different levels of discourse takes place here either.

This way of dealing with pluralism, which relies on negotiation rather than on reflection, corresponds to the culture-specific model of corporatism and to the special role of expert judgements in Germany.

The relevance of dealing with these aspects as transparently as possible is shown by the American study. A non-topic approach of fundamental value concepts and interests observed as a trend in the NAS Committee appears especially problematic for issues that are characterized by scientific uncertainty and political controversy.[5] The dominating orientation of the American competition model towards the methodological objectivity of scientific knowledge, and the attempt to maintain a demarcation line between facts and values, seems questionable under conditions of cognitive uncertainty and normative ambivalence:

> … We were asekd how do we felt about it. There was this (...), he was one person of the Troika, he said he had three children and that he cared, because he want to give them a nice environment … (and other said) … like, there is no problem, chemicals have improved the life, I don't remember. The ones from industry said that the people tend to make things out of nothing. And one guy from the industry said it's nice that we are together in this room, because I never would have expected that (…) would shake my hand, so he marked me as an activist … (expert, NAS Committee).

Especially if pluralistic basic assumptions remain implicit or are ignored, this may lead to grave misunderstandings and aggravate the advisory work, as happened within the NAS Committee. The EDSTAC process, on the contrary, has shown that a disclosure of pluralistic claims is helpful for the rationalization of advisory processes. A proactive discussion of these implicit relations also facilitates a clear differentiation of knowledge, uncertain knowledge and non-knowledge. In this way, blurred areas of value- and interest-oriented opinion as well as theoretically known and empirically verified aspects can be better elucidated.

Dimension 4: Communication, Interaction, Inclusion

The fourth dimension of environmental policy advice systems relates to the external relations of the panels, which are characterized by typical communication, interaction and inclusion patterns. A differentiation can be made here between input communication (activities for expertise production) and output communication (activities for expertise dissemination). The advisory systems work in an excluding, including or including-dialogistic manner depending on the degree of interrelations with their advice contexts. The categorization of the panels on the dimension 'input communication' is based on four criteria:

- The first criterion determines whether the selection of topics is cooperative or autonomous. Whereas a cooperative topic selection, in which different political actors may be involved, permits a better consideration of political needs, the autonomous selection of topics allows new scientific topics to be brought closer to politics.
- The second criterion relates to knowledge integration. Is a wide range of different knowledge claims taken into account in expertise production or is narrowly defined, specific knowledge used for a detailed analysis?
- The third criterion shows whether access to the advisory process is transparent for the public or whether expertise production takes place behind closed doors. For the generation of response by political, sub-political and medial actors, transparency seems to be as important as the participation possibilities of relevant actors, for example, by making comments.
- The fourth criterion finally concerns the style of communication. Does information acquisition for expertise production predominantly take place in written form via literature, documents etc. or is it complemented by face-to-face communication such as informal exchange of opinion or formal hearings with relevant actor groups?

In the dissemination of results, which is designated here as output communication, the comparative analysis of the seven advisory systems also revealed cross-panel patterns.

- The most important criterion for this dimension relates to the type of advice; is state-oriented policy advice performed or is policy and public advice aimed at, in which target groups of civil society are included in the advisory system?
- In close relation to this, the second criterion concerns the type of knowledge dissemination. Is the aim to disseminate expertise exclusively to the sponsoring clients or to widely spread the results to sub-political actors and the media?
- The third criterion considers whether media work is active or passive. Professional media work is indispensable for effective public communication in modern media societies.
- The fourth criterion finally concerns the style of communication. The dissemination of results is primarily performed by means of expertise reports, complemented by abstracts, executive summaries, target-group-oriented text editing, press releases, etc. In addition, there are also face-to-face activities such as press

conferences, (informal) journalist meetings, workshops for dissemination to individual target groups, etc.

Regarding the requirements of integrative policy and public advice, the analysis of the German advisory systems has revealed weaknesses. The inclusion of central political and sub-political actors like the media is only insufficiently systematized. The science-oriented advisory systems SRU, WBGU and DRL aim at broad-based knowledge integration and selectively involve different actor groups in the advisory process for both input and output communication. But the advisory work is largely non-public and there are only few opportunities for face-to-face communication. Elements such as public hearings or target-group oriented dissemination workshops and information events only take place sporadically. The media work of the advisory systems also appears worth improving:

> …Yes, it is true that we do not have the resources in our office, that we can or want to do offensive, perhaps even aggressive public relations. We are primarily a scientific advisory body exclusively for the government and we pay less attention to the public. However, we aim at reaching the public … (expert, SRU).

Although all the panels perform media work, they largely take insufficient note of the mechanisms of media production. This impairs the connectivity to the political and public agenda.

The American advisory systems offer more integrative policy and public advice. Whereas the NAS Committee tended to work in an exclusive manner, the other two panels (EDSTAC and SAB/SAP) were established under the Federal Advisory Committee Act (FACA). The dialogistic-inclusive input and output communication, which is marked by public access and face-to-face communication, has proven useful for policy relevance in the opinion of those interviewed:

> … From the beginning this was a transparent process. Every time we had a meeting we had at the end set aside time for public input. So there were some people. So the process was tracked by people from outside the committee. The dates of the meetings were made public on the internet, there was nothing done behind closed doors. Consequently, we had feedback from the public throughout the entire process. So there were no surprises in the end. When the final report came out, everybody in the public who was interested knew what this was saying, because it was discussed right from the beginning … (expert, SAB/SAP Subcommittee).

Even though integrative policy and public advice is resource-intensive (see Brickman et al. 1985) it seems that in complex science-based issues with scientific uncertainty and political controversy the broad inclusion of heterogeneous participants in the end raises the chance for lasting collective decisions.

POLICY-ORIENTED KNOWLEDGE COMMUNICATION – A POSSIBLE WAY?

Based on the criteria-based typology we can state that the environmental policy advice systems in Germany and the US only in part comply with the changed social conditions and the demands of integrative policy and public advice. The dominating corporatist model in Germany is not sufficiently systematized for the requirements of a pluralistic knowledge society. It is inadequately structured with a view to political functions, expert/expertise utilization, dealing with the pluralism of knowledge, val-

ues and interests and the integration of demands and actors. The US model, which is complemented by corporatist elements, is more in compliance with the requirements. However, the strong orientation to the methodological objectivity of scientific knowledge seems to be problematic, especially in trans-scientific advice contexts. In sum, it may be stated that many elements of modern policy advice are realized in the advisory systems investigated. But a further optimization of the individual advisory panels and of the advisory system as a whole appears necessary in order to master the challenges of socially complex societies. In the following, some design options will be proposed.

Design options in the sense of 'advisory advice' can be derived from analyses of pluralistic knowledge society, with regard to policy advice and the criteria-based typology of advisory processes, in order to organize advisory systems in a democratically fair and factually efficient manner. In this context it is important to be aware of the transition from a relatively static industrial society, in which supposedly unambiguous knowledge was politically implemented in hierarchical structures, to a process-oriented knowledge society, in which a comprehensive communication network continually takes up, processes and reflects demands. Policy advice is thus less conceivable as one-sided knowledge transfer than as politically initiated, moderated and structured knowledge communication including values and interests. For this purpose, policy advice in the sense of a 'one-way transfer' of scientific expertise to governmental decision-makers must be changed to dialogistic, policy-oriented knowledge communication. The following design options can be formulated for the organization of the advisory panels with a view to the criteria-based typology.

These design options can contribute towards realizing an organization of advisory systems satisfying the demands of pluralistic knowledge societies such as Germany or the US. Even though the advisory processes finally are embedded in the varying

Table 2: Design fields – Design options

Design field	**Design options**
Distance from politics	Disclosure of political influences, precise task description, transparency in the selection of experts and stocks of knowledge, appointment of balanced committees.
Political function	Clear definition of the political function, function-specific equipment and organization of the advisory panel.
Knowledge, value, interest pluralism	Systematic reflection of fundamental values and interests in knowledge discourses; disclosure of the limits of knowledge, of uncertain knowledge and non-knowledge.
Communication, interaction, inclusion	Stronger inclusion of relevant actor groups, more input-output communication.

Table 3: Advisory steps – Advisory functions

Advisory steps	**Advisory function**
Orientation advice	Systematic knowledge preparation for orientation concerning new (or existing) problem fields; scientific expertise central; consideration of professional practical knowledge and cultural everyday knowledge by dialogistic input/output communication.
Strategy advice	Development of problem solution strategies; scientific knowledge, professional practical knowledge, cultural everyday knowledge (topic-dependent); broad-based policy recommendations for decision preparation.
Evaluation advice	Evaluation of programme efficiency and goal reaching; scientific expertise central; professional practical knowledge and cultural everyday knowledge complementary.

political, social and cultural traditions, the further development of the existing advisory systems relates above all to a more sophisticated differentiation, systematization and structuring of previous advisory processes in order to achieve a higher degree of context-sensitivity. To what extent dynamic processes of globalization and transnationalization stimulate an assimilation of advisory procedures at least in Western democracies is an interesting research question for future comparative analysis.

Besides optimizing the individual advisory systems, policy-oriented knowledge communication also aims at a better coordination of the individual advisory processes to avoid duplication of work, overlapping and inefficiencies, and to structure different advisory aspects more clearly. Three steps of policy-oriented knowledge communication can be differentiated, which form a joint communication network and continually take up, process and evaluate scientific and social demands:

The design options for the organization of advisory processes and the three-step concept of policy-oriented knowledge communication provide a contribution to the structural adaptation of the advisory system to the social complexity and pluralism of modern societies. More participation is not advocated as an end in itself, but with the aim of a function-specific integration and coordination of knowledge, values and interests by adequate participation of scientific, political and sub-political actors and citizens. It is hoped that a targeted organization of environmental policy advice enables a higher differentiation level beyond technocratic constraints and post-modern arbitrariness in advisory processes.

Universität Lüneburg, Germany

NOTES

1 This study is based on my doctoral thesis, which is published under: Heinrichs, H. (2002): *Politikberatung in der Wissensgesellschaft. Eine Analyse umweltpolitischer Beratungssysteme,* Wiesbaden.

2 As an overview see: Felt et al. 1995: 114–48, Maasen 1999: 45–50. For specific aspects of the social conditions of science and science for policy see: Weinberg 1972; Nelkin 1979; Knorr-Cetina 1985; Jasanoff 1990; Cozzens and Woodhouse 1995; Gieryn 1995; Martin and Richards 1995;.

3 Advisory system is defined here as the action and communication relationship of actors directly and indirectly involved the advisory process.

4 In the USA – as in Europe – more than 87,000 synthetic substances are in use as industrial and agricultural chemicals. More than 1000 compounds are added every year. The question of whether and how specific chemicals adversely affect humans and animals is thus of high relevance. Since the 1960s, experts have pointed out that synthetic substances can have carcinogenic, mutagenic and teratogenic effects. The politicians responded and imposed numerous regulations in order to reduce or completely avoid the application of individual chemicals. However, the political measures related to current toxicity, carcinogenicity, mutagenicity and teratogenicity alone. In the past two decades, however, numerous field studies and laboratory experiments have been carried out, which suggest subtle effects of synthetic substances on the hormonal system of humans and animals. Numerous clinical pictures ranging from reproduction disturbances through neurobiological effects up to impairment of the immune system are related to the so-called 'environmental endocrine hypothesis.' The test procedures so far used do not pay attention to the effects of chemicals potentially disturbing the hormonal system. Due to the enormous complexity of the problem and the continuing scientific uncertainties, it is possible for the actors involved to come to different conclusions concerning risks and necessities for political action. (Colburn et al. 1996; Krimsky 2000).

5 In this regard see also Hilgartner (2000). He demonstrates in his work on the National Academy of Sciences to what extent the official 'face' of the NAS in the foreground differs from the 'internal' production prosses in the background.

REFERENCES

Badura, B. (eds.), (1976), *Seminar: Angewandte Sozialforschung. Studien über Voraussetzungen und Bedingungen der Produktion,* OXERA *Diffusion und Verwertung sozialwissenschaftlichen Wissens*, Frankfurt a.M.: Suhrkamp.

Barker, A. and B.G. Peters (eds.), (1993), *The Politics of Expert Advice. Creating, Using and Manipulating Scientific Knowledge for Public Policy*, Pittsburgh: University of Pittsburgh Press.

Bechmann, A. (1995), 'Umweltpolitik als gesellschaftlicher Lernprozeß – Erfahrungen aus 25 Jahren Umweltpolitik in Deutschland', in L. Steubing (ed.), *Natur- und Umweltschutz: Ökologische Grundlagen, Methoden, Umsetzung*, Jena: Fischer, pp. 460–80.

Bechmann, G. and A. Grunwald (2002), 'Experimentelle Politik und die Rolle der Wissenschaften in der Umsetzung von Nachhaltigkeit', in K.-W. Brand (ed.), *Politik der Nachhaltigkeit*, Berlin: edition sigma, pp. 113–29.

Bechmann, G. and I. Hronszky (eds.), (2003), *Expertise and Its Interfaces. The Tense Relationsship of Science and Politics*, Berlin: edition sigma.

Bell, D. (1996), *Die nachindustrielle Gesellschaft*, Frankfurt/M.: Campus.

Boehmer-Christiansen, S. (1995), 'Reflections on scientific advice and EC transboundary pollution policy', *Science and Public Policy* **22**, 3: 195–204.

Bohmann, J. (1996), *Public Deliberation. Pluralism, Complexity, and Democracy,* Cambridge, MA: MIT Press.

Brickman, R., S. Jasanoff and T. Ilgen (1985), *Controlling Chemicals: The Politics of Regulation in Europe and the United States*, Ithaca, NY: Cornell University Press.

Brown, M.B., J. Lentsch and P. Weingart (2006), 'Representation, expertise, and the German Parliament: A comparison of three advisory institutions', in S. Maasen and P. Weingart (eds.), *Democratization of Expertise? Exploring Novel Forms of Scientific Advice in Political Decision-Making – Sociology of the Sciences, vol. 24,* Dordrecht: Springer, pp. 81–100.

Bruder, W. (1980), *Sozialwissenschaften und Politikberatung*, Opladen: Westdeutscher Verlag.

Caplan, N. (1979), 'The two-communities theory and knowledge utilization', *American Behavioral Scientist* **22**: 459–70.

Cassel, S. (2000), *Politikberatung und Politikerberatung. Eine institutionenökonomische Analyse der wissenschaftlichen Beratung der Wirtschaftspolitik*, Bern: Verlag Paul Haupt.

Colburn, T., D. Dumanoski and J.P. Meyers (1996), *Our Stolen Future*, New York: Dutton Signet.

Cozzens, S.E. and E.J. Woodhouse (1995), 'Science, government, and the politics of knowledge', in S. Jasanoff, G. Markle, J. Petersen and T. Pinch (eds.), *Handbook of Science and Technology Studies*, London: Sage Publications, pp. 533–53.

CSTA – Council of Science and Technology Advisors (1999), *Science Advice for Government Effectiveness (SAGE)*, Canada.

Durkheim, E. (1999), *Über soziale Arbeitsteilung. Studie über die Organisation höherer Gesellschaften*, Frankfurt a.M.: Suhrkamp.

Environmental Protection Agency (EPA)/Scientific Advisory Board (SAB) (2000*), Toward Integrated Environmental Decision-Making,* Washington.

Felt U., H. Nowotny and K. Taschwer (1995), *Wissenschaftsforschung. Eine Einführung*, Frankfurt a.M., New York: Campus.

Gellner, W. (1995), *Ideenagenturen für Politik und Öffentlichkeit: Think Tanks in den USA und in Deutschland*, Opladen: Westdeutscher Verlag.

Gibbons, M., C. Limoges, H. Nowotny, S. Schwartzman, P. Scott and M. Trow (1994), *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies,* London: Sage.

Gieryn, T.F. (1995), 'Boundaries of science', in S. Jasanoff, G. Markle, J. Petersen and T. Pinch (eds.), *Handbook of Science and Technology Studies*, London: Sage Publications, pp. 393–443.

Glynn, S., P. Cunningham and K. Flanagan (2001), *Science and Governance: Describing and Typifying the Scientific Advice Structure in the Policy Making Process – A Multi-National Study*, ESTO Poject Report, JRC Institute Prospective Technological Studies Sevilla.

Glynn, S., P. Cunningham and K. Flanagan (2003), *Typifying Scientific Advisory Structures and Scientific Advice Production Methodologies (TSAS),* Draft Final Report, University of Manchester.

Habermas, J. (1964), 'Verwissenschaftlichte Politik und öffentliche Meinung', in R. Reich and W. Bretscher (eds.), *Humanität und politische Verantwortung. Eine Beitragssammlung,* Stuttgart: Rentsch, pp. 104–20.

Halffman, W. (2003), *Science/Policy Boundaries: National Styles*?', discussion paper of the workshop *Auf dem Weg in die Wissensgesellschaft*, Institute of Science and Technology Studies, Bielefeld University, February 6–7, Bielefeld.

Halliwell, J.E., W. Smith and M. Walmsley (1999), *Scientific Advice in Government Decision-Making. The Canadian Experience. A Report in Support of the Work of the Council of Science and Technology Advisors*, Ontario, Canada: JEH Associates Inc.

Hammond, K.R., J.L. Mumpower, R. Dennis, S. Fitch and W. Crumpacker (1983), 'Fundamental obstacles to the use of scientific information in public policy making', *Technological Forecasting and Social Change* **24**: 287–97.

Heinrichs, H. (2002), *Politikberatung in der Wissensgesellschaft. Eine Analyse umweltpolitischer Beratungssysteme,* Wiesbaden: Deutscher Universitätsverlag.

Hilgartner, S. (2000), *Science on Stage: Expert Advice as Public Drama*, Stanford, CA: Stanford University Press.

Inglehardt, R. (1995), *Kultureller Umbruch*, Frankfurt a.M. and New York: Campus.

Jäger, W. and W. Welz (eds.), (1998), *Regierungssystem der USA*, München: R. Ouldenburg.

Jasanoff, S. (1990), *The Fifth Branch: Science Advisors as Policymakers*, Cambridge, MA: Harvard University Press.

Joss, S. and J. Durant (1995), *Public Participation in Science: The Role of Consensus Conferences in Europe,* London: The Science Museum/European Commission.

Kleimann, B. (1996), 'Das Dilemma mit den Experten – Ein Expertendilemma?', in H.-U. Nennen and D. Garbe (eds.), *Das Expertendilemma*, Berlin, Heidelberg, New York: Springer, pp. 183–215.

Knorr-Cetina, K. (1984), *Die Fabrikation von Erkenntnis. Zur Anthropologie der Wissenschaft*, Frankfurt a.M.: Suhrkamp.
Kreibich, R. (1986), *Die Wissenschaftsgesellschaft*, Frankfurt a.M.: Suhrkamp.
Krevert, P. (1993), *Funktionswandel der wissenschaftlichen Politikberatung in der BRD. Enwicklungslinien, Probleme und Perspektiven im Kooperationsfeld von Politik, Wissenschaft und Öffentlichkeit*, Münster: LIT Verlag.
Krimsky, S. (1984), 'Epistemic considerations on the value of folk-wisdom in science and technology', *Policy Studies Review* **3**, 2: 246–67.
Krimksy, S. (2000), *Hormonal Chaos. The Scientific and Social Origins of the Environmental Endocrine Hypothesis*, Baltimore, MD: Johns Hopkins University Press.
Lester, J.P. (ed.), (1995), *Environmental Politics and Policy: Theories and Evidence*, Durham, NC: Duke University Press.
Long, R.C. and T.C. Beierle (1999), *The Federal Advisory Committee Act and Public Participation in Environmental Policy*, Discussion Paper 99–17, Washington. Resources for the Future.
Luhmann, N. (1984), *Soziale Systeme. Grundriß einer allgemeinen Theorie,* Frankfurt a.M.: Suhrkamp.
Luhmann, N. (2000), *Die Politik der Gesellschaft*, Frankfurt a.M.: Suhrkamp.
Maasen, S. (1999), *Wissenssoziologie*, Bielefeld: Transcript Verlag.
Mannheim, K. (1995*), Ideologie und Utopie*, Frankfurt a.M.: Klostermann.
Martin, B. and E. Richards (1995), 'Scientific knowledge, controversy, and public decision making', in S. Jasanoff, G. Markle, J. Petersen and T. Pinch (eds.), *Handbook of Science and Technology Studies*, London: Sage Publications, pp. 506–27.
Mayntz, R. (1994), 'Politikberatung und politische Entscheidungsstrukturen: Zu den Voraussetzungen des Politikberatungsmodells', in A. Murswiek (ed.), *Regieren und Politikberatung,* Opladen: Westdeutscher Verlag, pp. 17–29.
Michaels, D., E. Bingham, L. Boden, R. Clapp, L.R. Goldman, P. Hoppin, S. Krimsky, C. Monforton, D. Ozonoff and A. Robbins (2002), 'Advice without dissent', *Science Magazine (editorial)*: 298.
Murswieck, A. (1994), *Regieren und Politikberatung*, Opladen: Westdeutscher Verlag.
Nelkin, D. (1979), 'Scientific knowledge, public policy, and democracy: A review essay', *Knowledge: Creation, Diffusion, Utilization* **1**: 106–22.
Nowotny, H. (1993), 'Experts and their expertise: On the changing relationship between experts and their public', *Bulletin of Science, Technology and Society* **1**: 235–41.
Nowotny, H. (1999), *Es ist so. Es könnte auch anders sein. Über das veränderte Verhältnis von Wissenschaft und Gesellschaft,* Frankfurt a.M.: Suhrkamp.
Nowotny, H., P. Scott and M. Gibbons (2001), *Re-Thinking Science. Knowledge an the Public in an Age of Uncertainty*, Cambridge, UK: Polity Press.
Oxford Economic Research Associates Ltd. (OXERA) (2000), *Policy, Risk and Science: Securing and Using Scientific Advice*, Oxford.
Parsons, T. (2000), *Das System moderner Gesellschaften*, Weinheim: Juventa.
Renn, O. (1995), 'Styles of using scientific expertise: A comparative framework', *Science and Public Policy* **22**, 3: 147–56.
Renn, O. (1999a), 'Sozialwissenschaftliche Politikberatung. Gesellschaftliche Anforderungen und gelebte Praxis', *Berliner Journal für Soziologie* **4**: 531–48.
Renn, O. (1999b), 'A model for an analytic-deliberative process in risk-management', *Environmental Science & Technology* **33**, 18: 3049–55.
Renn, O., T. Webler and P. Wiedemann (eds.), (1995), *Fairness and Competence in Citizen Participation*, Dordrecht: Kluwer Academic Publishers.
Rich, R.F. and C.H. Oh (2000), 'Rationality and use of information in policy decisions. A search for alternatives', *Science Communication* **22**, 2: 173–211.
Rip, A. (1985), 'Experts in public arenas', in H. Otway and M. Peltu (eds.), *Regulating Industrial Risks. Science, Hazards and Public Protection*, London: Butterworths, pp. 4–110.
Schimank, U. (1996), *Theorien gesellschaftlicher Differenzierung*, Opladen: Leske + Budrich.
Sebaldt, M. (1997), *Organisierter Pluralismus: Kräftefeld, Selbstverständnis und politische Arbeit deutscher Interessengruppen*, Opladen: Westdeutscher Verlag.
Smith, W. and J. Halliwell (1999), *Principles and Practices for Using Scientific Advice in Government Decision Making: International Best Practices*, Report to the S&T Strategy Directorate Industry, Canada.

Stehr, N. (1994), *Arbeit, Eigentum und Wissen: Zur Theorie von Wissensgesellschaften*, Frankfurt a.M.: Suhrkamp.
Stehr, N. (2003), *Wissenspolitik*, Frankfurt a.M.: Suhrkamp.
Weber, M. (1976), *Wirtschaft und Gesellschaft*, Tübingen: Mohr.
Weinberg, A. (1972), 'Science and trans-science', *Minerva* **10**, 2: 209–22.
Weingart, P. (1988), 'Verwissenschaftlichung der Gesellschaft – Politisierung der Wissenschaft', *Zeitschrift für Soziologie* **12**, 3: 225–41.
Weingart, P. (1999), 'Scientific expertise and political accountability: Paradoxes of science in politics', *Science and Public Policy* 26, 3: 151–61.
Weingart, P. (2001), *Die Stunde der Wahrheit. Zum Verhältnis der Wissenschaft zu Politik, Wirtschaft und Medien in der Wissensgesellschaft*. Weilerswist: Velbrück Wissenschaft.
Weiss, C.H. (1974), 'The circuitry of enlightenment. Diffusion of social science research to policymakers', *Knowledge: Creation, Diffusion, Utilization* **8**, 2: 274–81.
Wingens, M. (1989), *Soziologisches Wissen und politische Praxis. Neuere theoretische Entwicklungen der Verwendungsforschung*, Frankfurt a.M.: Suhrkamp.
Wynne, B. (1991), 'Sheep farming after Chernobyl: A case study in communicating scientific information', in B.V. Lewenstein (ed.), *When Science Meets the Public*, Washington, DC: American Association for the Advancement of Science.
Zilleßen H. (1993), 'Die Modernisierung der Demokratie im Zeichen der Umweltproblematik', in H. Zilleßen, P.C. Dienel and W. Strubelt (eds.), *Die Modernisierung der Demokratie*, Opladen: Westdeutscher Verlag, pp. 17–39.