

Expansion of Expertise in the Governance of Science and Technology

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National Consumer Research Centre

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Abstract

This dissertation focuses on the expansion of expertise in the governance of science and technology. The phenomenon refers to the process of increasing involvement of new actors in the debate and decision-making concerning new applications of science and technology. This process has taken place in Western societies during the last decades due to an increased level of general education and emergence of new institutions, which enable new actors to participate and also critically evaluate issues that previously were the responsibility of scientists and technological experts alone. Modern biotechnology is an example of an area in which these phenomena have had a central role in recent years.

The expansion of expertise raises issues that are interesting for research both theoretically and practically. Although this phenomenon can be interpreted through some existing theoretical frames, it also provides interesting perspectives on how to renew those frames. For example, interesting questions are how and on what conditions the expansion of expertise takes place in different arenas of technical decision making, and how it happens in societies that are at different stages of development. From the practical point of the view, it is evident that an uncontrolled expansion of expertise can harm both the efficiency of scientific and technological development and those actors who do not benefit from their involvement or are not interested in or are not provided the means to influence that development. Therefore, consideration of the expansion of expertise is necessary for practical reasons.

The key argument of this dissertation is that although previous theories have raised issues related to the expansion of expertise, this phenomenon is still viewed as separate from its context. Context here refers to the field in which the expansion of expertise takes place. In order to describe the context, the dissertation introduces the concept of “policy arena.” By combining two dichotomic dimensions (actor induced: placid/polarized and institutional: hierarchic/participatory) four different types of arena are introduced and explored. The framework is elaborated and tested through three types of triangulation: theoretical, methodological and empirical. Each type of arena favours different types of expertise, their expansion, conflicts and roles in decision-making. The concept of “arena effect” is proposed to describe the influence of different arena characteristics on the expansion of expertise.

The dissertation is an article dissertation, including four papers that are published in scientific journals and an extensive introductory chapter that discusses and weaves together the papers. The introductory chapter contributes to the theory of the expansion of expertise, and comments on the recent debate on the so-called “normative theory of expertise.” The four articles of the dissertation also contribute to specific research questions that are related to citizen participation, risk pre-assessment, foresight and research education.

KEYWORDS

arena effect, biotechnology, citizens, expansion of expertise, foresight, governance, participation, policy arena, requisite variety, risk, science and technology policy

Tiivistelmä

Asiantuntijuuden laajentuminen tieteen ja teknologian hallinnassa

Väitöskirja keskittyy asiantuntijuuden laajentumiseen tieteen ja teknologian hallinnassa. Ilmiöllä tarkoitetaan länsimaisissa yhteiskunnissa viime vuosikymmeninä tapahtunutta uusien toimijoiden mukaan tuloa tieteen ja teknologian sovelluksia koskevaan keskusteluun ja päätöksentekoon. Koulutustason nousu ja uusien instituutioiden muodostuminen ovat antaneet aiempaa useammille toimijoille ja kansalaisryhmille mahdollisuuden osallistua ja kriittisesti arvioida asioita, jotka aikaisemmin kuuluivat vain teknologian kehittäjien ja asiantuntijoiden vastuulle. Moderni bioteknologia on esimerkki alasta, jolla nämä ilmiöt ovat Suomessakin olleet viime vuosina keskeisessä roolissa.

Tutkimuksellisesti asiantuntemuksen laajentuminen on kiinnostava ilmiö sekä yleisteoreettisesti että käytännölliseltä kannalta. Vaikka laajentumisen prosessi on tulkittavissa jo joidenkin olemassa olevien teoriakehysten avulla, samalla se tarjoaa kiinnostavia mahdollisuuksia näiden kehysten uudistamiseen. On esimerkiksi kiinnostavaa, miten ja millä ehdoin asiantuntemuksen laajeneminen tapahtuu erilaisilla tiede- ja teknologiapäätöksenteon areenoilla ja eri kehitysvaiheissa olevissa yhteiskunnissa. Käytännölliseltä kannalta on ilmeistä, että asiantuntemuksen hallitsematon laajeneminen voi aiheuttaa haittaa sekä tieteen ja teknologian kehittämisen tehokkuudelle että niille osallistumaan joutuville tahoille, jotka eivät hyödy osallisuudestaan tai joille ei tarjoudu mahdollisuutta tai joilla ei ole edes kiinnostusta vaikuttaa kyseessä olevaan kehittämiseen. Tämän vuoksi asiantuntijuuden laajentumisen pohtiminen on myös käytännölliseltä kannalta tarpeellista.

Väitöskirjan keskeinen argumentti on, että vaikka asiantuntemuksen laajentumiseen vaikuttavia tekijöitä on nostettu esiin aiemmissa tutkimuksissa, ilmiö nähdään edelleen liian riippumattomana kontekstistaan. Tällä tarkoitetaan sitä kenttää, jolla asiantuntijuuden laajentuminen tapahtuu. Tämän kontekstin kuvaamiseksi väitöskirjassa esitellään politiikka-areenan käsite. Yhdistämällä kaksi dikotomista ulottuvuutta, (toimijalähtöinen: vakaa/polarisoitunut ja institutionaalinen: hierarkkinen/osallistuva) tarkasteltavaksi tuodaan neljä erityyppistä politiikka-areenaa. Kehystä rakennetaan ja testaan teoreettisen, metodologisen ja empiirisen triangulaation avulla. Keskeinen havainto on, että kukin areenatyyppeä suosii tietynlainen asiantuntijuutta sekä sen laajentamiseen liittyviä asetelmia ja konflikteja.

Väitöskirjassa luodaan areenavaikutuksen (arena effect) käsite kuvaamaan erityyppisten areenoiden vaikutusta asiantuntijuuden laajentumiseen.

Väitöskirja on tyypiltään artikkeliväitöskirja, jossa neljä julkaistua tieteellistä artikkelia sidotaan yhteen erillisen laajan johdantoluvun avulla. Johdantoluvussa kehitetään teoriaa asiantuntijuuden laajentumisesta ja kommentoidaan viimeaikaista keskustelua asiantuntijuuden normatiivisesta teoriasta (normative theory of expertise). Väitöskirjan neljä artikkelia luovat lisäksi uutta tietoa erityiskysymyksistä, jotka liittyvät kansalaisten osallistumiseen, riskien ennakoarviointiin, ennakoititoimintaan ja tutkijakoulutukseen.

AVAINSANAT

areenavaikutus, asiantuntijuuden laajentuminen, bioteknologia, ennakointi, kansalaiset, osallistuminen, politiikka-areena, riskit, teknologinen variaatio, tiede- ja teknologiahallinta

List of original publications

The dissertation consists of the present introductory chapter and the following papers:

- I** Rask, Mikko (2003). The Problem of Citizens' Participation in Finnish Biotechnology Policy. *Science and Public Policy* Vol. 30, No. 6, 441-454.
- II** Rask, Mikko (2006). Closure in Risk Debates. Pre-Assessment of Finnish Forest Biotechnology. *Technological Forecasting and Social Change* Vol. 73, No. 6, 705-730.
- III** Rask, Mikko (In Press). Foresight: Balancing between Increasing Variety and Productive Convergence. *Technological Forecasting and Social Change* (22 pages).¹
- IV** Bruun, Henrik—Langlais, Richard—Rask, Mikko—Toppinen, Aino (2005). Moving to Mode 2: Re-Mode-ing Research Education in University Departments. *The International Journal of Learning and Change* Vol. 1, No. 1, 46-65.

In the ensuing introductory chapter, these papers will be referred to by the Roman numerals **I—IV**.

Contributions of the author

Papers I—III are solely the work of the author. Bruun was the initiator of **Paper IV**, in which Rask was not only a co-author, but was responsible for conducting the problem analysis of the empirical material, and contributed to the theoretical framework, the literature review and the formulation of the recommendations.

The fact that order and creativity are complementary has been basic to man's cultural development; for he has to internalize order to be able to give external form to his creativity. Otherwise, as the painter Delacroix lamented in his diary, his tumultuous imagination would erupt in more images than he is able to hold together or utilize, as in fact it often does in nocturnal dreams.

- Lewis Mumford (1967, p. 39)

1 Introduction²

The governance of science and technology (S&T) has traditionally been the business of dedicated experts and authorities. In some cases, such as when making decisions about funding research in astronomy or establishing a new research programme in steel technology, it may still be that way. In other cases, such as when defining future strategies for research and development (R&D) in alternative energy, or making decisions about the application of plant gene technology in an ecosystem context, the situation is different. There are multiple critics, stakeholders, industrial players, consumers, citizens and counter-experts who have a say in the topic under decision. Many observers of governance processes currently think that the more uncertainty and ambiguity related to the issues to be decided, the greater the need for involving a large variety of experts and other societal actors. Still others think that such “expansion of expertise” only endangers rational and responsible decision-making. The opinions on this issue remain divided.

My own first encounter with the dilemma related to the “expansion of expertise” was in 1997, when as a young researcher I had the opportunity to participate in the first parliamentary technology assessment study in Finland. The assessment was of plant gene technology in food production (Salo, et al. 1998), and I was included in an expert team whose other members were a professor in plant physiology and a professor in systems analysis. Having just finished my MA thesis on Mumford's (1970; 1967; 1963) elaborate argument about expert domination in technological development, I was suddenly to become a representative of the expert cohort. Our task team analysed the implications of plant gene technology from various knowledge perspectives: technical, ethical, health-related, environmental, social, economic and regulatory. Due to the broad scope of the assessment, we had to gauge alternative perspectives and arguments, and thus expand our own restricted expertise through more than fifty interviews with experts and stakeholders from relevant fields. While I was proud of the final achievement of our work, a 200-page report, something bothered me when it was placed on top of the half-meter-tall pile of documents that was de-

livered to each of the parliamentary members of the Committee for the Future, our main customer.

My concern was triggered by a reaction from a parliamentarian, later to become Minister of Labour, Tarja Filatov, who said that the whole technology assessment business would occupy only a handful of technically trained and technophilic members of the parliament. She pointed out that none of the parliamentarians could devote much of their time to the reading of exhaustive reports in the midst of continuous information overload (see Rask, et al. 1999, p. 123-124). If Mumford's thinking had convinced me that there are serious problems with narrow and technocratic decision-making on S&T, my first experience with technology assessment only reinforced it by revealing that it is difficult to broaden the institutionalized interests in technological issues.

The analysis of difficulties concerning the expansion of expertise in the Finnish arena of S&T became the starting point of this dissertation. I soon figured out that particular aspects of this arena may have an impact on the way in which decision-making and expert advice are organised. One of those aspects is, as I realised through personal observations and related studies (Eela 2001; Lemola 2001; Rask 2001), the high level of trust in experts and authorities. My view is shared by two Finnish researchers, Kuitunen and Lähteenmäki-Smith (Manuscript), who state that Finnish technology policy is elitist and undemocratic: decisions are taken by experts and civil servants with a technical background, not by elected politicians or parliamentarians. They explain that tendency by the fact that issues of R&D are generally perceived as being distant from everyday life and therefore requiring technical expertise that politicians and citizens lack.

The reverence for experts, however, is not only a Finnish idiosyncrasy. Martin (1990, p. 14-16), for instance, has claimed that the standard model of technical decision-making in Western societies remains one where politicians and government bureaucrats make decisions on the basis of advice from experts. Schwarz and Thompson (1990, p. 14-16) explain that the established way of thinking about the nature of science and technology decision-making sees it as having a "substantive technical core."³

A high level of techno-optimism and a lack of public criticism are other particular elements in the Finnish science and technology policy arena. A relevant example is the common perception among Finns of the applications of modern biotechnology. While the great majority of Europeans oppose genetically-modified (GM) food, the perceptions of Finns have generally been surveyed as being positive to it (Gaskell, et al. 2003; Midden, et al. 2002). Another example is the decision in 2000 by the Finnish municipality of Eurajoki to accept, as the first municipality in the world, the deposition of high-level nuclear waste in its bedrock (Kojo 2005, p. 6). Both issues have stimulated some degree of public debate in Finland. Compared to many other Western countries, however, the debates have been modest and have

generally not resulted in serious legitimacy crises over public policy-making (see, e.g., Bauer & Gaskell 2002; Durant, et al. 1998).

In addition to the previous examples, there is also more generic evidence of the Finns' positive attitude to their scientific and technological institutions. According to a recent science barometer (TSV 2004), for example, based on a survey of 1054 randomly selected citizens, more than 70% of Finns have a high trust in universities, and 64 % in research organisations, while half of the population has a high trust in national research funding agencies, such as the Academy of Finland and Tekes, the Finnish Funding Agency for Technology and Innovation. By comparison, only 23% of Finnish citizens have a high trust in non-governmental organisations and 10% in political parties (Naumanen 2004; *Tiedebarometri 2001*).

There are no straightforward ways, however, of measuring trust in experts or public understanding of science and technology. Surveys in particular can be criticized, since they do not take into account different kinds of public understanding of science (see, e.g., Hill & Michael 1998). There are also semantic problems that can lead to paradoxical conclusions, such as the 1997 Eurobarometer on biotechnology, according to which the same Finns who at that time were positive toward "biotechnology" were at the same time among the most negative toward "genetic engineering" (Miettinen & Väliverronen 1999, p. 17-18; EC 1997). Despite the analytical qualifications, taken together, the historical trends, survey findings, personal observations and similar interpretations by other researchers support the hypothesis of the particular nature of the arena of Finnish science and technology policy. Policy-making is elitist and expert-driven, and it is embedded in a techno-optimist and consensual cultural environment.

Miettinen and Väliverronen (1999) explain the consensual nature of Finnish science policy with the special political and economic history of Finland, which is characterized by strong legalism, orientation toward consensus and lack of tradition in critical debate (see also, Rusanen 2002). They argue that science and technology are seen in Finland as a continuation of a nation-building project, and thus as something of common national interest. Lähteenmäki-Smith and Kuitunen (2006), who recently conducted a survey of the actors in Finnish technology policy, explain its elite-based structure through the success it is broadly perceived to have had in recent decades. Finland has ranked high in several international comparisons of investments in the R&D sector and in competitiveness more generally.⁴ In other words, the high rate of success can suffocate critical perspectives and calls for change.

In my view, both kinds of explanation are needed to account for the particularities of the conduct and context of Finnish science and technology policy. What we do not understand very well yet are the implications of those characteristics for the development and renewal of governance practices. Is there a danger of an institutional lock-in due to the good perform-

ance indicators and the “placidity” of the context? How can the Finnish system implement the requirement of the European Commission to have more inclusive forms of governance in the field of biotechnology, for example (EC 2002a, 2001)? How can the Finnish system adapt to the supposedly increasing complexity and prominence of the social context of science and technology? In order to tackle these questions and also to re-examine whether they are based on valid assumptions about the nature of Finnish S&T policy and its arena, a set of additional questions arises: Who are the current actors in science and technology policy-making? What issues are considered relevant for policy-making? How are issues included in or excluded from the agendas of decision-making? What kinds of option and threat do the actors see for institutional renewal?

One of the main problems for Finnish S&T policy is that despite increasing calls for the renewal and democratization of policy, the actual changes have often been minor.⁵ However, this is neither a Finnish nor a recent problem only, as literature describing different countries and contexts of S&T policy indicates.⁶ Even though some new practices of what I call “expanded expertise” have been introduced and others have been tested during last decade or two, there also seem to be more general factors that delimit the good intensions for renewal and democratization.

My contribution to these issues is based on the articles of this dissertation that analyze the process of the “expansion of expertise”⁷ from various points of views in the Finnish context and beyond. The main focus of the articles is on two different policy arenas: biotechnology policy-making and foresight activity (*Papers I-III*). My understanding and theorizing of the “arena effect” draw largely from the empirical findings of these papers. *Paper IV* has a more self-reflective role in the dissertation. It studies the changing condition of the doctoral dissertation process and the increasing pressure of “extra-academic” criteria on research education. Research education can be understood as the “upstream” of expertise⁸, in which academically-certified experts are trained. Policy-making and public controversies over new technologies are the “downstream,” where the adequacy of their expertise is tested. As will become clear, the expansion of expertise raises issues in both contexts.

In addition to the issues of the expansion of expertise, the papers included in this dissertation also contribute to more specific discussions and research questions. The research topics and approaches of the four papers are summarized in *Table 1*.

Table 1 Research topics, approaches and methods

Paper	Research topic	Research approaches and methods
I	Citizen participation and policy styles	Case study, categorization, discussion
II	Risk pre-assessment and dynamics of risk processes	Case study, discussion, methodological elaboration, social arena analysis, theoretical reconstruction
III	Foresight and the trade-off between variety and convergence	Comparative case study, conceptual refinement, discussion, qualitative theory-building and testing
IV	Changes in the modes of research education	Conceptual refinement, discussion, participatory observation, surveying

An overview of the main themes of the papers is given in *Table 2*. (Full abstracts, identifying the themes, approaches, theoretical discussions and main results of the papers are provided in *Appendix 1*).

“Expansion of expertise” refers to the process of involvement of new actors and knowledge perspectives beyond the academically and professionally established elite. It is a multiform process that raises also broader issues than the mere difficulty of introducing new actors in established structures of policy and debate. In this introductory chapter I take a synthetic look at this phenomenon and try to understand and interpret its dynamics and limits at a more general level. For this purpose, I review scholarly discourses on issues related to the expansion of expertise. From this literature, I reconstruct some key arguments concerning the social driving forces of this phenomenon (as it happens as a spontaneous social process); identify emerging policy approaches based on the expansion of expertise; look at the rationales for adopting such strategies; and finally, review the recent discussion on the so-called normative theory of expertise that deals with the challenge of finding reasonable limits to the expansion process. As a result of this literature study, I define the three general research questions of the dissertation—all relating to the characteristics of different types of policy arena and their influence on the expansion of expertise.

Mobilizing the empirical findings of the four papers of the dissertation and reflecting on them in light of other scholarly research puts me in a position to answer the research questions. There are distinct characteristics in the policy arenas that create what I call an “arena effect” that influences the way in which strategies based on the expansion of expertise can be performed. My thesis thus become that earlier theories of the expansion of

Table 2 An overview of the papers

<p>Paper I The first paper is a study of citizen participation and policy styles in Finnish biotechnology policy. The paper explores how citizen and stakeholder inputs are conveyed into the practice of policy-making and how policy-makers think those inputs should be integrated. The study concludes that policy-makers have conflicting ideas of the appropriate role of citizens and stakeholders in the control of biotechnology. The paper argues that new participatory practices cannot be effectively adopted and developed, if they are largely incompatible with existing policy styles and thinking patterns.</p>
<p>Paper II The second paper elaborates a method for risk pre-assessment and analyses how the emergence and intensification of a risk conflict challenged policy-making in the arena of Finnish forest biotechnology. In this paper I study the actors and issues of the conflict, and explore the dynamic of the risk process. The study identifies paralyzing tendencies in the making of Finnish forest biotechnology policy. These are explained through the emergence of three “closure mechanisms”: “closure by redefinition of authority,” “closure by polarization” and “closure by exclusion.” Finally, the paper explores options for policy intervention.</p>
<p>Paper III The third paper is a comparative case study of the actors and their involvement in a sample of foresight exercises in fifteen European countries. The study examines the breadth and depth of participation in foresight, and foresight coordinators’ experiences with the increasing of “requisite variety,” the variety of actors and knowledge perspectives. The study reports supportive evidence for the existence of a trade-off between high “requisite variety” and productive convergence. Paper III also specifies and exemplifies the trade-offs, and collects lessons on how to reconcile the mutually exclusive inclinations.</p>
<p>Paper IV The fourth paper discusses the “Mode 2 effect” on research education. A distinction between two types of university departments, Mode 1 and Mode 2, is suggested. The paper focuses on “Mode 1 departments in transition” and discusses the means whereby they can renew and expand their research education content, in a way that helps future experts better cope with the rapidly changing and turbulent social context of research. We suggest several measures that support doctoral students in communicating across epistemic boundaries and developing additional academic skills. Paper IV argues that a trade-off between Mode 1 and Mode 2 types of skills and curricula is needed in research education.</p>

expertise have not paid enough attention to phenomena depicted by the notion of “arena effect.” Consequently, increasing sensitivity to the arena effects helps better understand the dynamics and limits of the expansion process, and provides new insights for the design of future S&T policies.

The remainder of this introductory chapter is structured as follow. Section 2 is a presentation of the theoretical discussions and the “problematique”⁹ related to the expansion of expertise. I also explain the selected terminology and define three overarching research questions that orient the discussion of the following sections. The overall research questions are detailed at the end of the theoretical section (Section 2.7). Section 3 provides an overview of the research methodology and methodological principles adopted in the papers. Section 4 responds to the research questions and explores, on a more synthetic level, the expansion of expertise and its limits. Section 5 concludes the introduction by suggesting new directions for the study of the expansion of expertise.

2 Expanding expertise: theoretical issues and problems

Issues related to the expansion of expertise are discussed in a number of scholarly discourses. The social study of science and technology (e.g., Collins & Evans 2002; Jasanoff, et al. 1995), sociology of public understanding of science (e.g., Irwin 1995; Wynne 1995), risk studies (e.g., Jaeger, et al. 2001; Slovic 2000) and studies in technology assessment and foresight (e.g., Joss & Bellucci 2002b; Martin 1996) are academic fields that are most closely linked to this dissertation. A commonly shared premise in those discourses is the idea that rationalistic, technology-centred and expert-based decision-making in science and technology is in a state of crisis. The controversy over biotechnology, one of the main empirical cases of this dissertation, has often been used as an example of two symptoms of the crisis: the insufficiency of democratic legitimacy and the difficulty of effective policy-making (see, e.g., Bauer & Gaskell 2002; Gaskell & Bauer 2001; Levidow 1999b; Durant, et al. 1998). Expansion of expertise, and the introduction of participatory forms of governance in particular, have generally been recommended as remedies to the assumed problems of technical decision-making (see, e.g., Asselt, et al. 2001; Frewer, et al. 2001; Klüver, et al. 2000; SPP 1999; Joss & Durant 1995).

Along with the increasing adaptation, experience and evaluation of the participatory approach, attention has focused on the need to define its reasonable limits. An example is Collins and Evans's (2002) proposition for a "Normative Theory of Expertise" (NTE). Their paper has sparked much discussion (Sismondo 2008; Lynch & Cole 2005; Collins & Evans 2003; Jasanoff 2003; Rip 2003; Wynne 2003; Collins & Evans 2002; Gorman 2002), which indicates the topicality of the issue.¹⁰ The sharp tone of their commentators, however, points to a potential difficulty in the formulation of an NTE.

In the subsequent paragraphs of this theoretical section, I invite the reader to follow what is already known about the phenomenon of expansion of expertise, and to consider what still remains to be known. In particular, I discuss the following questions: How should the expansion of expertise (and its neighbouring concepts) be defined? What are the social driving forces of the expansion of expertise? What kinds of practices, approaches and policy initiatives are attached to it? What rationales has it been ascribed as a strategy for policy-making? How are the limits of the expansion of expertise defined by normative theories of expertise? And, finally, pointing to my own particular research questions: How do the different charac-

teristics of policy arenas (creating an “arena effect”) influence the expansion of expertise? Can better knowledge of the “arena effects” help in the design of better strategies?

Since I find Collins and Evans’s (2002) proposition for an NTE a theoretically interesting and noteworthy attempt to study the limits of the expansion of expertise, I take some of their notions as the starting point for my discussion. Since I do not share their conceptual starting points completely, however, I make a tactical move and adopt the term “expansion of expertise”¹¹ (instead of their parallel term, “extension of expertise”) as the key concept of this dissertation. In so doing, I hope to make clear the main differences between the approach of this dissertation and that of Collins and Evans. One of those differences is that I explore the arenas and limits of the expansion of expertise mainly from an empirical and contextual viewpoint, whereas Collins and Evans explore the limits axiomatically, as a theoretical dilemma. Another difference, a consequence of my empirically grounded approach, is that I take expertise to be interwoven with human and political interests, whereas Collins and Evans aim at distilling “pure” forms of expertise based on the quality and status of propositional knowledge.

2.1 Key concepts¹²

Expertise, notwithstanding the tactics discussed above, is the focal concept of this dissertation. I understand it generally as either experience-based or academically certified knowledge, skills and competences.¹³ According to Abbott (1988, p. 16), the structural form of expertise is called a “profession.” The latter is constituted by organisations for managing associations, for control and for work. Culturally, professions legitimate their control by attaching their expertise to values with general cultural legitimacy and, as Abbott argues (*op. cit.*), the emphasis is increasingly on values such as rationality, efficiency and science.

By the *expansion of expertise*, I refer to the process of involvement of new actors and knowledge perspectives beyond technically or professionally certified elites. This is an abstract way of referring to the broadening of the actor basis in decision-making related to science and technology. However, consideration of the implications of the involvement of un-established actors (e.g., laymen or businessmen participating in the risk management of genetically modified organisms) entails issues exceeding the mere number of social interactions and knowledge components. The new actors bring along different professional cultures, worldviews and knowledge perspectives. They also exercise new ways of negotiation, influence and agreement. Assuming that a productive interplay between the different actors (and what they represent) is an intended goal, this requires new kinds of competences by the “organisers,” or “coordinators.” They have to be

able to arrange the new processes in a productive way and then absorb the heterogeneous results of those processes. The expansion of expertise is a multiform process.

Collins and Evans (2002) describe this process (which they call the “extension of expertise”) in a similar way. They equate the process with the widening of the domain of technical decision-making beyond the technically qualified elite (op. cit., p. 235). They often refer to “public participation” in decision-making and, in more technical terms, to the widening of the actor basis of technical decision-making beyond the core of certified experts through the involvement of non-experts and experience-based experts.¹⁴

Collins and Evans (2002, p. 249), however, make an explicit distinction between “rights based on expertise” and “rights accruing to other stakeholders.” The former are based on competence, the latter on political interests. While such a distinction can be theoretically instructive, and even supported with relevant arguments (they aim at a normative theory of expertise, and therefore make a prescriptive assumption), it is nevertheless too rigid a starting point for empirical research. In a risk conflict or similar policy process, the borderline between scientifically and politically legitimized roles of the actors is constantly under review. This is also the perspective of the social arena theory applied in *Paper II* (and resource mobilization theory more generally): the “rights” of the actors, being either experts, public authorities or other stakeholders, are to a large extent earned in a “game” in which various social resources are needed to make an impact. (This is not to deny that there are also institutional rules that deliver the rights.) Thus, for example, if policy-makers perceive themselves as marginalized in such a game, they can proceed to acquire strategic competences, e.g., in risk communication (cf., Levidow 1999a, p. 61); as the official expertise is reconstituted, this can lead to a shift in the policy process, and in the way that the rights of actors are delivered. Another example, from the study of organizational fields (Greenwood, et al. 2002; Abbott 1988), is that even the self-control (and jurisdiction) of professions through professional associations is political in nature. The point is that the scientific and political components in the making of expertise are interwoven. An empirical study of the “expansion of expertise” therefore cannot be based on a narrow (or theoretically predefined) understanding of the constituents of expertise.

The domain of *technical decision-making* is where Collins and Evans make their key argument. They define it as follows:

By “technical decision-making” we mean decision-making at those points where science and technology intersect with the political domain because the issues are of visible relevance to the public: should you eat British beef, prefer nuclear power to coal-fired power stations, want a quarry in your village, accept the safety of anti-misting kerosene as an airplane fuel, vote for politicians who believe in human cloning, support the Kyoto agree-

ment, and so forth. These are areas where both the public and the scientific and technical community have contributions to make to what might once have been thought to be purely technical issues. (Collins & Evans 2002, p. 236)

The definition of “technical decision-making” is, for Collins and Evans (2002), wide-ranging, since it covers two broad domains, that of the political on the one hand and that of science and technology on the other.¹⁵ All of their examples of decision-making, however, refer to situations in which the scope of decision is between conflicting alternatives, such as: should you eat British beef (or not); want a quarry in your village (or not)? These examples open a narrow and “tip of the iceberg” view of decision-making. It is true that people encounter such choice questions in their everyday lives; if not through personal decision-taking, then at least through media and public debates. Equally true, however, is that all choice situations are preceded by often long and complicated processes of agenda-setting. For example, the way in which the consumption of beef in Britain is subjected to (special) control and monitoring, as part of the nutritional risk management system, influences decisions on beef-eating. Since an increasing number of people are not only influencing decision-making in the narrow sense, but also the processes of technical agenda-setting, a broad view of influence is needed to cover these different aspects. In *Paper II*, following Lukes (1974) and Hukkinen (in press; 2002b), I have adopted a broad conception of technical decision-making, consisting of three dimensions: “decision-making” (in the narrow sense), “agenda setting” and “interest shaping.” Despite risking a schematic (and thus simplistic) approach to the study of technical decision processes, I think that the view of three-dimensional power helps make important distinctions that would otherwise be neglected.

In the title of this dissertation I have adopted the term *governance* to refer to (technical) decision-making in the public domain. “Governance” is a general but contested concept among political scientists (see, e.g., Lyall & Tait 2005; Heffen, et al. 2000; Rhodes 1996). According to Renn’s (2005, p. 78) general definition, it refers (at the national level) to “. . . the structure and processes for collective decision-making involving governmental and non-governmental actors.”¹⁶ I use the term “governance” as an umbrella concept, to refer to the decision processes in the policy arenas that are analyzed in the articles of this dissertation. Due to this pragmatic intent, I am not going to delve into the definitional nuances of the concept. However, since each paper of this dissertation strives to understand policy-makers’ and experts’ alternative ways of thinking and framing of issues related to the expansion of expertise, I also rely on Irwin’s (2008, p. 584) definition of governance, which acknowledges this “cognitive dimension” as a relevant component of governance activity. According to Irwin, governance “...en-

compasses the range of organizational mechanisms, operational assumptions, modes of thought, and consequential activities involved in governing a particular area of social action..." My own conception of modern governance thus includes the idea of public authorities interacting with increasingly heterogeneous groups of experts and non-experts, and making decisions in cognitively and institutionally fluid conditions.

2.2 Social driving forces

The process of expansion of expertise can be viewed from two opposite perspectives. One perspective sees it as a spontaneous social process, in which the social context of research and policy is transformed via the interactions of increasingly knowledge-based and reflexive actors. The second regards it in terms of policy strategies and exercises that are based on the intentional and directed expansion of expertise.¹⁷ An example of a linkage between the two dimensions at the most general level is the claim by Nowotny, et al. (2002, p. 12) that a social system can respond to the increasing complexity of its environment by increasing its internal complexity and thus the potential for interacting with the environment.

The driving forces of the expansion of expertise, i.e., the causes of the general transformation of the societal context of S&T, are only anecdotally treated in the papers of this dissertation. Instead, the focus is on the study of the institutional and strategic conditions and implications of that process in specific policy arenas. In *Paper IV*, however, my co-authors and I discuss the driving forces by using the thesis of "Mode 2" knowledge production from Gibbons, et al. (2000). A major premise in their argument is that the large investment in general university education by many countries over the last three decades is one of the main explanations for the radical increase in the supply of competent knowledge producers for organizations outside the academic system. This has taken place at the same time as the significance of scientific knowledge for both societal and industrial development has grown exponentially (see Delanty 2001).

In addition to Gibbons, et al. (2000), many other social theorists have analysed the driving forces of the same social change by paying particular attention to the role of S&T in the process. The theory of *reflexive modernisation* (Beck 2000; Giddens 1990) is one of the main sociological accounts of the transformations of modern society. That theory is used here as a way of completing the limited analysis of the driving forces of the expansion of expertise; it is a commonly used explanation for the crises of rationalistic and expert-based decision-making in S&T.

According to Beck (2000), reflexive modernization is a process containing two stages. In the first stage, there is an "automatic" transition from industrial to risk society, where risks are produced as part of the processes of

modernization but are not yet the subject of sustained public or political conflict. In the second stage, the industrial society raises a growing realization of the dangers involved, which then calls into question the health of the structures of society (see also, Lupton 1999, p. 66-67). Giddens (1990, p. 36-37) characterizes reflexivity as a defining feature of all human action, involving the continual monitoring of actions and their contexts. In the modern society, this implies the weighing up and critical assessment of institutions and claim-makers, including those who speak with the voices of the “expert” (see also, Lupton 1999, p. 72-77).

Jaeger, et al. (2001) complete the picture of the process of reflexivity. They argue, referring to Scott (1995), that the evolution of organizational theory has been “from perceiving organizations as monolithic entities with fixed goals, rules, and borders, to perceiving them as reflexive bodies that observe the performance of other organizations and learn to adjust to changing social conditions.” Modern organization theory, in other words, has acknowledged organizations as self-reflective entities that even build special agencies to collect, process and integrate social feedback as a means of redirecting their own behaviour. The point, as Jaeger, et al., (2001, p. 279) put it, is that:

... predictions about outcomes have become so uncertain that purely internal deliberations about future actions are unlikely to lead to reasonable decisions. To make decisions feasible, then, institutions define their tasks in accordance with how they are perceived by the outside world. They generate options in a trial and error process and assess outcomes by pre-testing for social acceptance. At each stage of decision-making, institutions reflect about their goals and strategies by looking at their performance through the lenses of outside observers.

Self-reflexivity, in other words, is required of any organisation in order to raise the quality of decision-making.

Following the diagnoses of the self-reflective process, one ends up with a complex picture of the dynamics of social action. The process of reflexivity seems to drive societies toward a “game theoretical” condition,¹⁸ in which each actor monitors other actors, and actors base their actions on the expectations of other actors’ moves (and criticisms). While this diagnosis of the dynamics of social action can be one-sided, it points, however, to an important contextual underpinning of this dissertation. The demand for self-reflexivity increasingly drives science and technology policy agencies to adopt external viewpoints in their strategies. At the same time, however, they encounter the risk that their identities as agencies based on expertise are eroded. There is a built-in need, then, for those agencies to balance between the adaptation of external criteria and viewpoints and the assurance of their identity and traditional role.

2.3 Emerging approaches based on the expansion of expertise

Thinking about how S&T policy institutions and agencies have responded to the social driving forces described above can be put to a historical perspective. To start with, the history of science and technology policy is not particularly long. Although there is a history of “passive” S&T policy before World War II⁹, many historically-oriented accounts take the post-war era to be the formative period for modern S&T policy in the Western context (see, e.g., Etkowitz & Leyderdorff 2000; Gibbons, et al. 2000; Caracostas & Muldur 1998; Allardt 1997; Freeman 1991). In the first decades of the post-war era, there was a tendency in the governance of S&T to believe in autonomous basic research and in large-scale military projects. From that point of view, the tendency to append additional social criteria and knowledge perspectives to the governance of S&T is a phenomenon of more recent times.

Increasing awareness of the risks and side-effects of new technologies has been one of the triggers to that process. Douglas (1985, p. 5), for example, describes the emergence of risk perception research as follows: “The fears and conscience of Western industrial nations have been roused by nuclear radiation, chemical wastes, asbestos and lead poisoning. In response, an important new subdiscipline of the social sciences has emerged which addresses questions asked by industry and government about the public perception of risk.” The evolution of the expansion of expertise in the governance context of S&T can be sketched through the institutionalization of three fields: risk analysis, technology assessment and the “participatory approach.”

McDaniels and Small (2004, p. 3-7) characterize *risk analysis* not as a distinct branch of science, but as a “hybrid discipline,” in which the current state of scientific and technological knowledge is made accessible to society as input to risk management decisions. The “prehistory” of risk analysis can be located in various contexts, such as early developments in probability theory, medicine, environmental health, chemical toxicology, reliability analysis, health and safety regulation, and so on. Many accounts of the history of risk analysis, however, identify the 1970s as the starting point of professionalization and formal risk analysis. Golding (1992), for example, in his analysis of the history of risk research in the U.S.A., identifies the new legislation of the early 1970s, concurrent as it was with the establishment of federal bodies such as the Environmental Protection Agency (EPA), as being formative for the rise of risk analysis. In the following decades, according to McDaniels and Small (2004, p. 5), “. . . the continued growth of research and applications addressing issues in risk analysis, and their extension to include a broad spectrum of scientific, social, and political perspectives. . .” has led to an “interdisciplinary evolution” of the field.

Current thinking within the field of risk analysis also underlines the importance of broad-based deliberations as an additional element to techni-

cal expertise. Stern and Fineberg's (2000, p. 24-25) argumentation is illustrative of this position:

Reliable technical and scientific input is essential to making sound decisions about risk. Scientific and technical experts bring indispensable substantive knowledge, methodological skills, experience, and judgement to the task of understanding risk. . . But science is not necessarily neutral and objective in its ways of framing problems . . . Risk decisions are ultimately public policy choices.

Stern and Fineberg's (2000) conclusion is that good science is a necessary but not sufficient basis for good risk characterization. Their view is that risk experts are needed, e.g., because many hazardous substances and activities have non-obvious and delayed effects that can be uncovered and quantified only with highly technical methods. Broad-based deliberation, on the other hand, is needed to help determine what kind of analysis a decision requires; to include information from different sources; to determine when analysis is balanced; and to determine how to synthesize the results of analysis to make them useful to participants in the decision-making. Stern and Fineberg's (2000) conclusion is typical of recent scholarly thinking in the field of risk analysis.

The beginning of the formal history of *technology assessment* (TA) is the year 1972, when the Office of Technology Assessment (OTA) was established within the U.S. Congress. Despite the abolition of the OTA in 1995, the policy art called technology assessment is still practiced in a variety of places (see LaPorte 1997). The evolution of TA has often been described as a series of paradigmatic shifts, from a forecasting-oriented and reactive TA (analysing the social impacts of technologies, and identifying related policy options) to proactive, constructive and participatory forms of TA (for the paradigms of TA, see, e.g., Eijndhoven 1997; Cronberg 1996; Rip, et al. 1995). Participatory technology assessment (pTA) refers, according to Joss and Bellucci (2002a), to the methods and procedures of assessing socio-technological issues that actively involve various kinds of social actors, assessors and discussants. They see the beginning of pTA as being in the late 1980s, with the experimentation that occurred in a few countries, most notably Denmark. The Danish Board of Technology held so-called "consensus conferences," which involved citizens in the centre of the assessment process. In the Netherlands, so-called "constructive TA" was developed by academics together with industry for the purpose of rendering the process of technology development more responsive to the needs of potential users through interactive assessment procedures. Since the early 1990s, pTA has become widely established (see Joss & Bellucci 2002b; Rip, et al. 1995).

If the participatory component in TA has been strengthened during the 1980s and 1990s, there is a longer history of the "*participatory approach*"

as a mode of policy analysis and policy-making. Participation, according to Geurts and Mayer (1996, p. 26-27), both in the public and private sector, reached a temporary peak in the late 1960s and early 1970s as part of an overall movement in Western societies towards further democratisation (see also, Glenn 2003; Jamison 1999b, p. 2-5). Many approaches and models that are relevant for participation stem from this period. An example is the concept of the “participation ladder” that distinguishes several modes of participation in policy development, and attaches them to the different phases of the policy cycle.²⁰ The interest in the participatory style of policy, according to Geurts and Mayer (*op. cit.*), has not, however, been steady, but cyclical. They claim that after the mid-1970s, participation became less popular due to temporary support for hierarchic and authoritarian models of policy development. They also hypothesize that in the late 1980s participation emerged again as a new dominant policy image, but with a pragmatic motivation, if compared to the ideological motivation of the preceding participation phase.

Parallel storylines of the emergence of research fields based on “integrative” research and problem-solving could be told of many other approaches. Examples of such approaches established during recent years are transdisciplinary research²¹ (Bruun, et al. 2005; Nowotny, et al. 2002), futures studies (Bell 1997a, b), integrated assessment (Rotmans 2001) and foresight (Martin 1996). There are also several theoretical approaches that have proceeded toward more practical considerations and applications. The diagnosis by Gibbons, et al. (2000) of “Mode 2,” for example, has been followed by the vision of Nowotny, et al. (2002) of an “Agora,” as a place for the making of socially-robust knowledge. The “post-normal science” approach (Ravetz 1999; Funtowicz & Ravetz 1990) has resulted in the development of practical tools for uncertainty assessment and communication (Petersen, et al. 2003). Habermas’ (1998; 1997) theory of communicative action has been applied both in the design and the evaluation of participatory models of environmental discourse (Renn, et al. 1995b), and so forth.

It is not an aim of this dissertation to review all approaches of policy and research based on the ideas of increasing participation and integration of heterogeneous knowledge perspectives. Notwithstanding that qualification, there are enough approaches to claim that the expansion of expertise is not only a tendency in the social environment of S&T, but that it is also gaining terrain in the core work of strategy and governance.

Recently the development of new approaches has been accelerated by high-level policy proposals. Recommendations for more inclusive forms of governance have been made, for example, by the European Commission (EC 2002b, 2001), the *OECD* (2001), the International Risk Governance Council (Renn 2005) and, in Finland, by an international evaluation panel of public administration (Bouckaert, et al. 2000).

2.4 Rationales for the expansion of expertise as a policy strategy

Since this context of science (i.e., Post-Normal Science) is one involving policy, we might see this extension of peer communities as analogous to earlier extension of franchise in other fields, as allowing workers to form trade unions and women to vote. In all such cases, there were prophecies of doom which were not realised. (Ravetz 1999, p. 651)

Despite some problematic tendencies with the expansion of expertise (which we will review in Section 2.5), it is highly esteemed as a strategic approach. Ravetz (1999), for example, has suggested using the expression “extended peer communities” as a way to guarantee the quality and safety of scientific research under the condition of what he calls “Post-Normal Science.” Post-normal science refers to issue-driven science, in which, typically, “facts are uncertain, values in dispute, stakes high, and decisions urgent” (Ravetz 1999, p. 649). Genetically modified foodstuffs are a paradigmatic example of an issue of environmental debate that relates to such science (op. cit., p. 647). The best way to meet the problems generated by post-normal science, according to Ravetz, is through the establishment of “extended peer communities” that consist not only of stakeholders with some form of institutional affiliation, but of “all those with a desire to participate in the resolution of the issue” (op. cit., p. 651). Ravetz acknowledges the risk that implementing the regulatory and evaluative function of the extended peer communities will dilute the authority of science; he takes it as the price, however, for assuring the quality of science.

In addition to Ravetz, several other authors have argued for the necessity of the expansion of expertise as a strategic approach for policy. The rationales²² for the expansion of expertise, especially for increasing participation in policy-making, can be divided into two broad lines of argument (for the rationales see, e.g., Bellucci, et al. 2002; OECD 2001; Klijn & Koppenjan 2000; Joss & Durant 1995; Fiorino 1990). The *pragmatic argument* considers wider participation as a way to improve and facilitate decision-making by, for example, making decisions more informed and socially acceptable. The *normative argument* stresses the intended function of rendering the process of decision-making democratic (see Bellucci, et al. 2002).

There are also alternative classifications of the rationales in the context of risk decisions, such as Fiorino’s (1990), who identifies three compelling rationales for broad participation. First, the “normative rationale” derives from the principle that government should obtain the consent of the governed; a related principle is that citizens have the right (embodied in laws) to participate meaningfully in public decision-making and to be informed about the bases for government decisions. Second, the “substantive rationale,” according to Fiorino (1990), holds that relevant wisdom is not limited to scientific specialists and public officials, and that the participation by

various groups and individuals will provide essential information about a risk situation. Third, the “instrumental rationale” maintains that broad public participation can decrease conflict and increase acceptance of and trust in decisions made by public agencies (Fiorino 1990). Considering the contents of Fiorino’s substantive and instrumental rationales (i.e., information & social acceptance), they can be seen as overlapping with the category of pragmatic arguments, as found in Bellucci, et al. (2002). Fiorino’s (1990) category of normative arguments is equivalent to the similar one in Bellucci, et al., (2002).

The pragmatic and normative rationales can be weighted differently in the different arenas of technical decision-making. Quite often, however, both rationales are referred to and considered as the complementary benefits of the participatory approach. Ravetz (1999), for example, despite his ascribing a “Promethean” role to the extended peer communities as the carriers of democracy in the domain of technical decision-making, claims that broader democratic participation is only one component of *quality* in science and policy (see also, Funtowicz & Ravetz 1990).

In addition to the compelling rationales for expanding expertise, policy-makers also face conflicting quality criteria, such as the need for technical and economic rationality, and the necessity for ensuring the accountability and responsibility of decision-making agencies (see Renn, et al. 1995a, p. 361). *Trade-offs*²³ between the different criteria are necessary since all criteria can be supported by pragmatic and normative arguments, but the latter criteria can be in conflict with the demands for participatory policy-making.

2.5 Are there limitations to the expansion of expertise?

The problem can be stated quite simply: Should the political legitimacy of technical decisions in the public domain be maximized by referring them to the widest democratic processes, or should such decisions be based on the best expert advice? The first choice risks technological paralysis: the second invites popular opposition. (Collins & Evans 2002, p. 235-236)

Collins and Evans (2002) note that the definition of the limits of what they call the “extension of expertise” is perhaps not today’s practical problem but, with no clear limits to the widening of the base of decision-making, it might be tomorrow’s. They argue that science studies has tried to resolve the legitimacy problem of modern science and technology by showing that “the basis of technical decision-making can and should be widened beyond the core of certified experts . . .” (Collins & Evans 2002, p. 237), but have failed to show the limits of that process (a failure that they call the “Problem of Extension”). Collins and Evans claim that attachment of the widest democratic process to technical decision-making results in technological

paralysis. They think that the commitment of technical decision-making to irrelevant issues and concerns creates unnecessary hindrances in the way of technical development projects.

Parallel to the rationales for the expansion of expertise, the limitations to that process can be classified in two broad categories of arguments. The claim by Collins and Evans (2002) that the expansion of expertise can lead to technological paralysis is a *pragmatic argument*. It refers to the decreasing productivity and efficiency of technical decision-making due to the inclusion of public concerns.²⁴ Another similar argument is Renn's (2005, p. 50) assertion that an increasing number of actors and viewpoints makes it difficult to reach either a consensus or any kind of joint agreement. Rip's (2001) notion of the "intra-murality trap" refers as well to the general difficulty of organised participatory exercises in providing productive results by, to paraphrase Rip (2004, p. 425), "capturing the variety out there, and getting the main contenders together and interacting."

The *normative arguments* for the limitation of the expansion of expertise do not refer to the negative consequences of decision-making, but to the negative quality of the decision-making process itself. Henkel and Stirrat (2002, p. 183), for example, claim that participatory practices tend to feed irresponsibility in decision-making by shifting the responsibility for the consequences of the projects from the agencies onto the people participating. To argue that accountability for the outcomes of decision-making is an attribute of representative democracy (see, e.g., Renn, et al. 1995b, p. 361) is for Henkel and Stirrat (2002) a way of claiming that increasing participation is harmful to democracy. An additional normative argument, not explicitly for the limitation of the expansion of expertise, but for *prudence* in organising such activities, is the notion that the time and effort of the participating actors be appreciated as sparse resources that have to be treated with care and respect (Renn 2005, p. 51).

More arguments for the necessity of limiting the expansion of expertise can be drawn from critical studies of the participatory approach. Daele, et al. (1997, p. 97-98), for example, list several flaws of participatory exercises, based on a case study of a large-scale participatory technology assessment (pTA) in Germany. They argue that in their case study, pTA involved neither new knowledge nor democratisation, nor did it help resolve conflicts, but tended instead to "rationalize" the deliberation and restore the credibility of the experts. Fundamental problems are also identified by Kothari (2002, p. 152), who argues that participatory approaches tend to simplify complicated social relations and conceal and even reify inequalities by constructing dichotomies of power and oppositional social grouping. Renn (2004, p. 310-315) has also examined critical claims concerning deliberative forms of democracy, including, e.g., suspicions about the ignorance and incompetence of the participants and about regulatory imprecision, as well as concern that deliberation becomes a new source of conflict.

None of the diagnosed flaws of the participatory approach justify the conclusion that it should be rejected. A more appropriate interpretation is that the quality of the related processes should be improved. I believe we are on the way to scientifically developing such processes and, within certain limits, there is much room for making improvement.

2.6 Normative theories of the expansion of expertise

In order to tackle the problems resulting from unlimited expansion of expertise, Collins and Evans (2002) sketch an outline of a “Normative Theory of Expertise” (NTE). The purpose of their theorizing is to facilitate the study and consideration of legitimate roles for expertise in technical decision-making.

The NTE is based on a series of conceptual distinctions. First, Collins and Evans (2002, p. 245) distinguish expertise from political rights in decision-making; they give examples such as Lysenkoism²⁵, which they cite to remind us of the threat that scientific research can be subverted by “big-Politics.” Second, the authors suggest new categories of expertise, including the following: *contributory expertise* (the capability to contribute to scientific research), *interactional expertise* (the capability to interact between scientists and other actors), and *referred expertise* (the capability to understand a scientist’s contribution to a discipline).

The third conceptual distinction relates to different types of science (Collins & Evans 2002, p. 267-269): *normal science* refers to cases where “. . . there are no major disputes, and the science is as settled as it ever can be.” In that case, scientists have an unproblematic role as consultants to decision-making. *Golem science* is “. . . science which has the potential to become normal science, but has not yet reached closure to the satisfaction of the core-set.” An example of a question belonging to Golem science is whether the stomach linings of rats are affected by certain kinds of genetically modified potatoes. *Historical sciences* are those “. . . in which it is not to be expected that there will be any closure in the core-set debate in the foreseeable future.” The reason for the improbable consensus in historical sciences is that they deal with unique historical trends, the modelling of which is too complicated to be done accurately. An example of such science is the study of the ecological effects of genetically modified organisms. The term *reflexive historical sciences* refers to historical sciences in which “. . . the potential for uncertainty becomes even greater as the long-term outcomes are affected by the actions of humans themselves.” An example is the science of global warming, in which input variables include political and ethical debates.

In applying the concepts they introduce, Collins and Evans analyze some classic case studies, e.g., Wynne’s study of Umbrian sheep farmers (Wynne

2000), and generate some theses and interpretations of the legitimate roles of expertise in different decision situations. In general, they claim that one of the major problems in the past has been the exaggeration of the importance of referred expertise of the wider community of scientists, in other words, attributing authority to scientists to speak on subjects outside their specialization (op. cit., 259). They highlight the potentially high value of interactional expertise in risk conflicts: in the case of the Umbrian Sheep farmers, for example, they consider that scientists should have had interactional expertise in order to absorb the expertise of the farmers (op. cit., p. 256). Collins and Evans also claim that different types of science are connected with different processes of decision-making. In the case of Golem science, they state that the scientific “core-set” will eventually reach a consensus and, for that reason, technical decisions should be made by specialists. In the case of historical sciences, there is no hope that any major increase in scientific input will reach certainty. For that reason, “. . . society needs certified and experience-based expertise in the scientific fields belonging to the problem, as well as political input” (op. cit., p. 269). With historical science, there is also room for permanent institutions that are designed to meld the expert and the inexpert. In the case of reflexive historical science, they think that there is no hope of “certainty” without social or cultural regulation. They suggest that, in addition to permanent institutions for the regulation of science, new kinds of social institutions for the regulation of social life can be required. Their success requires the necessary participation of the lay public (op. cit., p. 269).

Most commentators of the article by Collins and Evans appear to agree with the point of striving for a normative theory of expertise (Jasanoff 2003; Lynch 2003; Rip 2003; Wynne 2003; Gorman 2002). What the commentators criticize, however, is the “politically alienated” way in which the theory has been formulated, and the discontinuous way that the new research agenda is presented with regard to earlier research in Science Studies. The criticism, as far as it concerns the validity of the theory, can be summarized in the following allegations: 1) NTE introduces a de-contextualized treatment of expertise and lacks the specificity needed in the recognition of relevant expertise (Rip 2003); 2) NTE implies a narrow and propositional framing of the issues of science and technology (Wynne 2003); 3) NTE introduces conceptual boundary problems, especially with the concept of the “core set” (Wynne 2003); and 4) NTE suggests a theoretical solution to problems that can best be solved via political interventions (by social scientists) (Rip 2003).²⁶

In the field of risk analysis, there has recently been another attempt, in striking affinity to Collins and Evans’s proposal for the NTE, to create a normative theory for the selection of relevant expertise. The model, called Risk Management Escalator, or RME (see Renn 2005, p. 49-54, 2004), is based on a distinction between four types of risk problems, each connected to dif-

ferent types of actors and management strategies. *Simple risk problems* are considered to be best solved through an “instrumental discourse” among risk management specialists (agency staff), and possibly with the directly affected groups. *Complex²⁷ risk problems* are connected to an “epistemological discourse” among agency staff and external experts representing different science camps. The incorporation of public concerns and perceptions is not considered useful in the resolution of (cognitively) complex problems (Renn 2004, p. 298). *Risk problems due to uncertainty* call for a “reflective discourse,” with a focus on the balancing between over- and under-protection. When uncertainty is the key issue, the input of the risk specialists has to be supplemented by the inclusion of stakeholder concerns, economic budgeting and social evaluations. Finally, *risk problems due to ambiguity* require a “participative discourse,” i.e., an arena where conflicting arguments are openly discussed. High levels of ambiguity, according to Renn (2005, p. 52), require the most inclusive strategy for participation, due to the broad range of issues. An example is the debate on genetically modified food: it involves concerns about, e.g., the loss of personal agency when selecting and preparing food, the long-term impacts of industrialized agriculture, trust in regulatory institutions and the moral implications of tampering with nature (see also, Hampel, et al. 2000; Levidow 1999b). Ambiguous issues, in other words, open the debate about what problems are actually raised.

The overlap between the NTE and RME models is remarkable, considering that they have been created independently of each other (the authors do not refer to each others’ works), and in different academic contexts (the NTE in the field of science studies, the RME in the field of risk studies). The most conspicuous similarity between the two models is the assumption of four types of sciences/risks, considered as being the basis for suggestions of legitimate roles for expertise in technical decision-making. Perhaps because of the different backgrounds, though, the two models also diverge. In addition to differences in the categories applied, the models differ in their orientation. For Collins and Evans, the effort to build the NTE is driven by an *academic problem*: to find a clear rationale for the expansion of expertise (Collins & Evans 2002, p. 237). For Renn (2005, p. 54; Renn 2004), the purpose of the RME scheme is practically-oriented: to provide theoretically and ethically supported *guidelines for a design discourse* that aims at selecting the appropriate risk assessment policy, defining priorities in risk handling and organizing the appropriate involvement procedures.

In the review of the debate on the NTE, it was already noted that several commentators criticize the theory for its inflexibility and even “curiously decontextualized” treatment of expertise (Rip 2003, p. 420). Van Asselt (2005) raises a similar concern with regard to the RME, by arguing that the linking of risk characteristics (complexity, uncertainty and ambiguity) to specific forms of discourse and strategy is too rigid.²⁸ By focusing on the types of science (NTE), or characteristics of risk (RME), normative theories

of expertise can suggest which experts (or non-experts) should partake of in different types of technical decisions. They cannot, however, explain why the suggested forms of participation in some contexts succeed and in other contexts meet resistance or even fail. My claim is that more attention is needed on the implications of the characteristics of different policy arenas on the way in which the new practices can be implemented. This is the task of the study of the “arena effects,” to which the latter part of this introduction, after the presentation of the methodology, is devoted to.

2.7 Research questions

Since the expansion of expertise is an increasingly prevalent strategy in the governance of science and technology, and since there are both theoretical and practical reasons for identifying its limits, I think it is important to explore whether such limits can be identified in a more flexible and contextually sensitive way than has been done thus far. For this purpose, I define my research questions (RQ) as follows:

RQ 1 What are the characteristics of the policy arena that influence the expansion of expertise?

RQ 2 How do the characteristics of different types of policy arenas—causing an “arena effect”—influence the expansion of expertise?

RQ 3 Can better knowledge of the “arena effect” help design better strategies based on the expansion of expertise?

The concept of “policy arena” is central to all these questions. It refers to the symbolic location of political actions that influence collective decisions or policies (see Renn 1992 and Paper II). Policy arenas are demarcated by the issues, not by geographical or organizational boundaries. The structure of the arena is defined and characterized by the institutional rules, and patterns of interaction and resource mobilization by the actors involved. The concept of “arena effect” refers to the way in which the structural characteristics of a policy arena affect the governance processes that take place in it.

The research questions are answered in Section 4. In the next section (Section 3), the methods and materials of the case studies are explained.

3 Methodology

Doing research on processes related to the expansion of expertise is largely an empirical and descriptive endeavour. Therefore, each paper in this dissertation is based on original empirical research. Interviews are the primary source of the empirical material in *Papers I, II* and *IV*. The total number of interviews was 51, and they were carried out during 2002-2004. A large body of additional documentary material, consisting, for example, of media, policy and judicial documents, was analysed for *Papers I* and *II*. The primary empirical material for *Paper III* consisted of 16 benchmark reports (varying between 20 and 50 pages) produced by foresight coordinators in 15 European countries.²⁹

Empirical study of the expansion of expertise is complex in nature. It involves interaction with various actors, such as policy-makers, business managers, scientific experts, stakeholders and critics. Each actor has his or her own interpretation of the processes that were studied. Therefore there are no *a priori* factors that would make a researcher's interpretations more accurate than those of the other actors involved; rather, the researcher's own position is subject to deconstruction.

In order to secure an in-depth understanding of the studied phenomena and in order to increase the relevance and validity of the findings, I have followed two general methodological principles: *triangulation* (Mickwitz 2006, p. 36-37; Denzin & Lincoln 2000; Taylor & Bogdan 1998, p. 80-82) and *communicative validity* (Silverman 2004; Tuunainen 2004, p. 47).

I have applied three kinds of triangulation: empirical, methodological and theoretical. *Empirical triangulation* is the application of manifold documentary materials for the study of the same phenomenon. For example, in *Paper II*, the analysis of the policy actors' stated objectives in regard to Finnish forest biotechnology was based on two kinds of empirical material: 24 interviews that were transcribed and coded, and the official statements from 62 organizations, including the actor groups represented by the interviewees, in response to a proposal by the Ministry of Agriculture and Forestry for a national gene technology strategy (MMM 2003). *Methodological triangulation* is the application of multiple research methods to the study of the same phenomenon. For example, in *Paper III*, the analysis of participation in foresight was based on 16 benchmarking reports provided by European foresight coordinators. A qualitative content analysis of the research material was first carried out co-operatively by an international task team that I was member of; I then conducted a formal content analysis of

the same material by using the ATLAS.ti programme.³⁰ *Theoretical triangulation* means the study of the same phenomenon or research problem from multiple theoretical perspectives. The “expansion of expertise” is a theoretically postulated phenomenon about which only theoretical perspectives can be had. Exploring it both from the “downstream of expertise,” through the policy-focused lenses of the social arena theory in *Paper II*, and from the “upstream of expertise” through the research-focused lenses of Mode 2 discourse in *Paper IV*, is an example of theoretical triangulation.

Communicative validity means the testing of the validity of the analysis through a discourse with those investigated. I found it useful, for *Papers I and II*, to secure my understanding of the biotechnology-related issues with the researchers and policy-makers whom I interviewed. In regard to *Paper III*, I was fortunate to be engaged in an EU-funded *ForSociety* ERA-Net project. This allowed me to receive feedback directly and through a formal monitoring exercise³¹ from the foresight coordinators, as well as to discuss with social scientists and policy-makers the analysis and practice of foresight activities. As a methodological principle, communicative validity represents the idea of reflexive social science (Jaeger, et al. 2001, p. 279; Beck, et al. 1994): research can fruitfully explain social actions if the actors on whom the research is performed can comprehend its theoretical reasoning. The idea of reflexive social science is best exemplified by the research process leading to *Paper IV*. The interviews and discussions in which “Mode 2” challenges in my own research environment were explored, served as a trigger for our laboratory researchers’ reflection on its current and future model of research education.

In addition to the general methodological principles, specific research methods have been applied in each case study. *Papers I, II and III* apply multiple methods for the analysis and evaluation of actor groups, issues and processes in different policy arenas. *Paper IV* is a discussion paper with less focus on the methodological aspects; even there however, systematic research methods have been applied, including a literature review, interviews and formal evaluation criteria. Some new research methods have also been developed, particularly in *Paper II*, which refines and elaborates the method of the social arena analysis toward a method for risk pre-assessment. *Paper III* contributes to methodological understanding by studying the limits of the foresight method.

The role of theory has been to contextualize, target and enrich the analysis. Different theoretical models have been applied in order to focus on specific aspects of the expansion of expertise. Thus, processes related to the expansion of expertise are studied from the perspective of policy styles and paradigms of participation in *Paper I*; from the perspective of “arena rules” and patterns of social resource mobilization in *Paper II*; from the perspective of trade-offs between different governance criteria in *Paper III*; and from the perspective of competing modes of research education in *Paper IV*.

The discussion on the expansion of expertise provides a synthesizing theoretical framework and perspective on the key issues of this dissertation.

The dissertation also elaborates theory in relation to other analytical frameworks and empirical case studies. The strategy in theory-building can be called “grounded generalism” (Hukkinen 2002a), as a search for explanations for arena-specific processes. Theoretical concepts such as “closure by polarization,” in *Paper II*, and the “arena effect” (developed further in this introduction) are introduced as *heuristic models*. Their function is to identify and interpret empirical findings, and to help reflection on their origins and implications. Heuristic models do not aim at universal explanations. This would not be feasible due to the idiosyncratic nature of the studied social processes. Heuristic models combined with empirical examples, however, can provide “real-life models” of ideas and lessons emerging from particular arenas. Such models can be helpful in analogical reasoning, as means for identifying kindred situations and utilizing lessons from past experience (see, e.g., Bruun & Toppinen 2004; Markman & Moreau 2001). Thus for example the findings concerning the arena of Finnish biotechnology policy can help us understand and generate ideas on how to deal with situations where either the “silence of the public,” or “polarization,” is among the issues. Similarly, the concept of the arena effect can orient our consideration toward the bearings of different types of arena upon the expansion of expertise.

Finally, the structure of this dissertation follows the form of an *article dissertation*. This structure has been chosen instead of the traditional monograph because it is increasingly the recommended way of writing doctoral dissertations in Finland. There is also another, more philosophical reason, relating to our discussion of “Mode 2” and to the processes of expansion of expertise that take place in the arena of research education. In *Paper IV* we propose article dissertations as a measure that supports a “smooth transition” toward Mode 2 research education. As we note in that paper, an article dissertation guides a research student to publish in scientific publications during the writing of the dissertation (an especially relevant factor, if the funding of the student is based on projects in which articles are the expected outputs); it also effectively instructs the student of the practices of feedback and co-authoring. These are helpful skills in a Mode 2 type of environment, in which research performance is continuously measured, high quality contributions are expected, and science is becoming more and more international, accountable and collaborative. The downside of the article dissertation is that it involves multiple criteria of *coherence*³² instead of a single one. Each article, published in a scientific journal, is a coherent contribution to some specific research question and scholarly debate. It is therefore difficult to put together a set of such articles in a way that involves neither overlapping nor discontinuous parts. This is a methodological limitation that pertains to the structure of an article dissertation.

In the next section (Section 4) I explore ideas (and metaphors) related to the expansion of expertise and its “arena effects.” The main research questions of this dissertation are answered.

4 Exploring the arena effects of the expansion of expertise

In Section 2 of this introduction, I presented two normative theories of expertise, the NTE and the RME. Both of them provide theoretically reasoned models for the identification and association of relevant experts and governance approaches with different types of sciences and risks. While both approaches are instructive in providing general guidelines, they have been criticized for their rigidity and insensitivity to contextual variation.

Taking this criticism seriously, I claim that more attention should be paid to contextual and arena specific factors. This can be done through an empirically grounded analysis of the expansion of expertise.³³ Such an analysis should focus on the main characteristics of policy arenas that influence the expansion process. I argue below that the different characteristics of the arenas favour different types of expertise, their expansion, conflicts and roles in decision-making. I call this the “arena effect.”

In principle, the arena characteristics that influence the expansion process are innumerable. They consist of different configurations of actors, practices and institutional settings. From the perspective of the social arena theory and its view of the dynamics of arena processes (see Renn 1992 & Paper II), the characteristics can be divided into two main types: *actor-induced* and *institutional*. When considering the different settings that the actor-induced characteristics imply for the process of the expansion of expertise, I suggest a distinction between two extremes, those of *placid* and *polarized* arenas. “Placid arena” refers to there being a low intensity of public debate and a low level of mobilization by opposite social forces (in regard to the issues of technical decision-making). “Polarized arena” in contrast refers to a high intensity of debate and a high level of mobilization by social forces in opposition to each other. As we will see next, the two different types of arenas raise different issues and challenges for the expansion process.

Independent of the actor-induced characteristics, arenas can also be divided into two main types based on their institutional profiles: *hierarchical* and *participatory*. If the established culture of policy-making is characteristically elitist and centralized, and it favours exclusive processes in decision-making and expert advice, arenas are hierarchic. Finnish science and technology policy, and biotechnology policy in particular, is an example of a hierarchic arena (Kuitunen & Lähteenmäki-Smith Manuscript). Alternatively, if involvement of actors and knowledge perspectives that are external to

technically and professionally established elites is the starting point for decision processes, then an arena can be called participatory. An example of such an arena in the context of policy advice is European foresight.³⁴ In parallel with the distinction between placid and polarized arenas, also hierarchic and participatory arenas pose different issues and challenges for the expansion process.

The notion of “arena effect” may seem to be overly generalized. My point, however, is that within particular policy arenas we should begin to look at these effects more closely. Only through a sweeping study of arena effects can we learn what issues and problems they involve, what “consideration sets” they open, and how the issues and problems can be responded to. (A synthesis of the empirical findings of the papers is presented in *Figure 1* in Section 4.5.) In the following sections, I discuss each of the four arena characteristics. The discussion focuses on the following questions: What kinds of issues are related to the four arena characteristics? How do the issues affect the strategy of the expansion of expertise? What approaches are available for dealing with the issues? The aim is not to provide an exhaustive presentation of the issues that influence the strategy of the expansion of expertise. However, a synthetic view of the issues enables me to discuss whether the concept of the “arena effect” is useful, and whether a study of arena effects can help to discern topics that are relevant for strategic expansion of expertise.

4.1 Placid arenas

Placid arenas are characterized by a low intensity of public debate. There is also a low level of mobilization by opposite social forces, such as industrial organisations and the environmental NGOs that are critical of them. The issue of the “silence of the public” is among those that belong to a placid (or calm) policy arena. The relative “silence” of Finns in regard to the development and introduction of gene technology was also my original inspiration for beginning to do research on Finnish biotechnology policy. I found it peculiar that at the same time as a fierce public controversy about gene technology was raging in other parts of Europe, evidence of a similar public debate in Finland was difficult to find. I also found it interesting that Finns seemed to approve of their public authorities and experts in spite of top-down biotechnology policy, when similar policies by their colleagues in many other countries had met with increasing distrust and criticism (see, e.g., Bauer & Gaskell 2002; Durant, et al. 1998).

The “silence of the public” is a relational concept and can be understood only through comparison with other contexts, in which the situation is more or less the opposite, i.e., where there is a high intensity of public debate and, in the case of conflict, oppositional social forces are being mobi-

lized. Indeed, a situation of conflict is generally thought of as a more interesting object of research than one where it is absent. The former is easily seen as manifesting real problems, such as the question of fair allocation of risks and resources, whereas the latter does not seem to manifest problems at all.³⁵ Despite the apparent lack of any problem perspective, however, the “silence of the public” issue raises some interesting questions: What kind of a state and signal is it actually? How can this signal be interpreted by policy-makers? How can they respond to it?

John Graham’s (2001) study, *Technological danger without stigma: the case of automobile airbags*, is among the few case studies that start from somewhat similar premises. Graham addresses the issue of how the positive public perception and absence of public outrage concerning automobile airbags has influenced the related risk regulation. The author presents the following conclusion about the effects of the “silence of the public”:

Without heightened public concern about airbags, it is difficult to imagine how the side effects of airbags will be minimized while the benefits of the technology are retained and enhanced. More lives may be lost unnecessarily if this technology does not become somewhat more stigmatized in the minds of the public.

Graham (2001) makes the argument that public outrage can be a necessary condition for sound public policy.³⁶ This is because a critical public effectively scrutinizes new technologies, which leads to stringent regulation of dangerous technologies.³⁷ “Silence of the public,” according to Graham’s interpretation, is a dysfunctional state, because it allows and even supports the application and development of dangerous technologies. If what Graham found in the case of airbags points to the “silence of the public” as being a signal, it is worth asking whether policy-makers tend to interpret the signal as a tacit sign of the success of existing policies, or, instead, as an early warning of emerging (technological or institutional) problems.

Paper I, in which the cognitions of civil servants responsible for Finnish biotechnology are studied, answers some of those questions. Most of the civil servants interviewed interpret the “silence of the public” as a tacit sign of success in national biotechnology policy. Some of them support their belief with evidence from the science and technology barometers (TTR 2001; EC 2000), which indicate positive perceptions by Finns about biotechnology and public R&D institutions. None of them refer to any problems that could be caused by the low intensity of public debate.

The positive interpretation by policy-makers of the silence of public debate causes restrictions for the expansion of expertise; it does not encourage the policy-makers to shift public participation to the core of strategic thinking and action. There are at least two kinds of explanation for this. First, a “positive reading” involves a detachment from the issues of “cit-

izenry.” If policy-makers have not been forced to devote their time and thinking to the issues of citizens’ participation, their ideas concerning the role of the citizenry in policy-making remain weak and ambiguous, as *Paper I* indicates. An example is the contradictory argumentation by the two civil servants interviewed: one of them thinks that “...citizens’ opinions strongly affect policy-making and the focusing of the research financing,” whereas the other does “...not see that citizens’ concerns would have any influence on the activities” (see *Paper I*).³⁸ A detached orientation to issues of participation involves a framing of the expansion of expertise as an exotic question of *style* rather than as a relevant strategic approach. Second, the economic and educational potentials underlying a placid arena (see, *Paper I*) maintains a “positive reading” of the status of public debate. This reading compromises the more critical and democratic ambitions of the expansion of expertise.

To summarize, a placid arena raises issues of the different values and functions of public debate and social scrutiny (which are, in this context, lacking elements). The silence of the arena can also prevent processes of policy renewal. For example, in the rare instance when the public authorities in Finland aimed at a new opening for a structured public debate on biotechnology (viz., the “Hanasaari conference,” in *Paper I*), they ended up with traditional education of public in science. The case indicates that too much distance between policy-makers’ cognitions and the new way of acting leads to counterproductive results. Considering the expansion of expertise as a policy strategy, a placid arena raises the issue of how to motivate change, and of how to ensure that the new initiatives do not remain subordinated to the predominant paradigms of policy-making.

4.2 Polarized arenas

Polarized arenas are characterized by a high intensity of debate and a high level of mobilization by social forces in opposition to each other. The process of polarization begins with the manifestation of the conflicting goals (and there can be several of them) of the policy actors. In pursuit of their goals, actors mobilize heterogeneous means, including (conflicting) evidence and (antagonistic) cultural values. As a result of the contextually-contingent process of polarization, surprising configurations of actors and issues can emerge (such as industrial organisations and environmental NGOs co-building an anti-GM technology agenda). Polarization challenges existing ways of policy-making and increases the relevance of the expansion of expertise as a strategic option. Since polarization can jeopardize effective decision-making, it raises the question of how policy-makers can find means for more effective action while still protecting a “rational” mode of action.

In the beginning of 2003, when I started my orientation to the study of Finnish forest biotechnology, the landscape of the national biotechnology policy began to change dramatically. That was largely due to the accumulating effects of a small but energetic NGO, the People's Biosafety Association (PBA). It was the first Finnish environmental NGO devoted to Finnish biotechnology issues.

From its beginning in 2000, the PBA started to mobilize a continuous anti-GM campaign, with a special focus on GM trees. It arranged activities such as citizens' petitions, legal action against public regulatory agencies and various media campaigns against gene technology—issues that had only been seen in other European countries. The scientific community responded to the critical claims not only by correcting unscientific claims in the public media, but also to some extent by mobilizing a pro-GM campaign. An illustrative example is the case of genetically modified birch—the Finnish national tree under pressure. Professor Tuomas Sapanen, together with his group at the University of Joensuu, was awarded the Eco Foundation's Environmental Award 2004 for the development of non-flowering GM birches³⁹; the same honour was interpreted contradictorily as both an act of irresponsibility and as an environmental assault by the opposing camps of experts and activists, respectively. The course of events led to an intensifying process of polarization. The conflict culminated in the destruction, by unknown saboteurs, of a GM tree field test site in Punkaharju in the summer of 2004.⁴⁰ As documented in *Paper II*, this was the moment when the European controversy over biotechnology landed in Finland.⁴¹

The particular characteristics of the polarization of the Finnish forest biotechnology debate can be summarized as follows. First, the PBA effectively “filled a vacuum” in public debate. This contributed to a critical overtone in public discussion. Second, forest industries have become resistant to R&D activities linked with modern biotechnology. They have even contributed to an anti-GM campaign through their sustainability policies and forest certificates. Third, the number of driving forces in the arena of forest biotechnology is small. The two dominant groups that are building a positive agenda for forest biotechnology are (forest) biotechnology scientists and public financiers. Since the Finnish research funding system favours funding co-operation between the public and private sectors, the withdrawal of the industrial partner from the usual “core-set” of R&D projects has caused severe funding problems for forest biotechnology researchers. The funding problem, combined with the low number of driving forces and the difficulty of building socially acceptable regulation and research agendas, have resulted in a “paralysis” of the national forest biotechnology policy. *Paper II* calls this process “closure by polarization.”

Polarization challenges policy-making in various ways. *Paper II* makes the claim that the paralysis of the Finnish forest biotechnology policy process is sub-optimal for most actors. Its continuation will undermine the for-

est biotechnology research base, and suspend most direct routes towards applications. Nor are there signs that the paralysis would have stimulated investments in alternatives to forest gene technology, as required by the critics.

The difficulties resulting from the “closure by polarization” are studied in *Paper II* from the perspective of social resource exchange by applying social arena theory and method (Jaeger, et al. 2001; Renn 1992). This involves a “rational actor” perspective on the study of the arena effects. Actors, according to this theoretical assumption, are “rational” in the sense that they are presumed to be goal-oriented, and pursue their goals in the most effective manner by mobilizing such social resources that help them best attain their goals (see Jaeger, et al. 2001, p. 175-176). It is also hypothesized that a broad set of social resources is needed for influential action, and that relying on one or few resources involves an inflationary tendency. These hypotheses are supported by the empirical findings. The successful action of the environmental NGOs, for example, in regard to their objectives related to regulation, has been accompanied by their mobilization of the social resources on a broad scale. The less successful action by the key regulatory agency, the BGT (e.g. through the continued defeats in legal processes), has instead been accompanied by its reliance on a narrow set of social resources, political authority and scientific evidence.

Regarding the patterns of social resource exchange and other particularities of the policy process, *Paper II* generates options for more effective policy. One line of options regards different ways of explicating and reframing prevailing knowledge perspectives and problem interpretations. The other line focuses on the composition of the actors and competences that are available in the policy arena.

Included in the first line of interventions is the suggestion that the key regulatory agencies identify and “blow up” dissonances, instead of pursuing consensus-seeking and “neutral” balancing between the key actors and their different safety and marketing requirements. The identification of the dissonance is suggested as an amenable way toward conflict resolution (cf., Hukkinen, et al. 1990). Dissonances are covered over through ambiguous statements by actors and organisations; the dissonances can be found both among and between the actor groups. An example is the ambiguity of public financiers on the issue of genetic modification of wood material. It is argued in *Paper II* that more coherent and well-articulated positions by the financiers would better allow deliberation on feasible lines of development. In addition to the discovery of dissonances, other intervention options are found in the open-endedness of the agenda-setting process. This allows a high potential for reaching a “closure by redefinition of the problem” (e.g., Pinch & Bijker 1999; Misa 1997). In other words, there can be untapped ways of framing the research needs in a way acceptable to most actors. An example is the suggestion by some molecular biologists to develop “organic

GMOs” by focusing forest biotechnology research on the screening and further development of genetic mutations within natural tree populations.⁴²

The second line of intervention options focuses on the actors and available competences in the policy arena. *Paper II* suggests that since the number of the driving forces in Finnish forest biotechnology policy is limited, among the most critical issues is to involve additional actors and stakeholders. Since there are, however, different kinds of obstacles for some of the actors’ entering the arena, a study of the “entrance barriers” is needed for their closer inspection. Some of these barriers are studied in *Paper II*. In the case of the forest companies, for example, there is evidence of a trade-off needed between their value commitments and reputations. However, the problem they express with the lack of evidence for the economic profitability of forest biotechnology investments could be solved, or at least mitigated, by commissioning an inquiry into the issue (see *Paper II*). Another example of the entrance barriers is the current way of organizing public consultations e.g., through public hearings on GM field tests. Currently, consultations are loosely organized and lack a clear and influential connection to the decision process, and could in these respects be improved.

Paper II also generates other alternative means related to the expansion of expertise. Examples include an idea of establishing an institute that gathers and cultivates the knowledge and competence related to the commercialization and socio-economic issues of forest gene technology⁴³; suggestions for policy-makers to build up new competences in risk communication and trans-disciplinary issues, and finally, a general recommendation for the key regulatory agencies to switch toward a more open and participatory style of policy-making.

The preceding suggestions call for more inclusive processes and expanded knowledge frameworks. This is not the only available direction, however. There are also characteristics in the arena that speak for an exclusive rather than inclusive approach. First, many of the issues of Finnish forest biotechnology derive from its being in the early phase of the policy cycle (e.g., Barkenbus 1998). Actors’ awareness of the options and risks of this technology is rising, but only gradually. Stabilization has taken place only on a few, if any, of the issues. Second, the debate on the future risks of forest biotechnology indicates that not just complexity, uncertainty and ambiguity, but also a high degree of ignorance prevail (see, e.g., Asselt & Rotmans 2002). An example is the hazards of gene flow from a GM tree population to a wild adjacent population. Most of the interviewees for *Paper II* acknowledge the risk, but they have failed to work out any examples of the hazard scenarios. These are features in the debate that call for better expert knowledge. In *Paper II* I propose that a platform for broader social debate and criticism could be built by commissioning a risk scenario exercise by a selected group of experts, such as forest tree breeders, population ecolo-

gists and molecular biologists. More generally, considering the possibility of additional actors contributing to the policy process, it seems that the creation of a “forceful focus” (Rip 1986) would be a prerequisite. This requires a higher level of knowledge and an elaboration of some targeted issues.

To recapitulate, the most remarkable aspect of the polarization of the arena of Finnish biotechnology policy is that it transforms the expansion of expertise from an issue of style into one of *power* and influence, and even of organisational survival. We have seen that both inclusive and exclusive approaches are needed to solve policy problems in a polarized arena. Considering the means that are available for increasing an actor’s influence in a policy process (e.g., wilful polarization of actors’ opinions and attitudes or politically biased framing of the problems), only some of them fit into the remit of public agencies. Therefore, whereas in the placid arenas balancing was needed between policy-thinking and action, in the polarized arena the need is for balancing between “rational” and influential action.

4.3 Hierarchic arenas

The hierarchic policy arena, as policy arenas often are, is the place of an elitist, centralized and exclusive culture of expert advice and decision-making. The hierarchic arena represents the *enemy*, the cultural contradiction of the expansion of expertise. Hierarchic arenas involve compromising and re-orienting arena effects that influence the expansion process. An extreme case is when the expansion process acquires the ritualistic and performative characteristics of “Quasi-Expansion” (see below).

Even hierarchic arenas have to be renewed, however, to better cope with the complexities of the societal context. The issue then becomes to find a balance between a reactive and a proactive approach to a renewal of policy culture. A reactive approach means waiting for the negative lessons to emerge, whereas a proactive approach means acting before problems or conflicts are culminated. The former approach may prove inadequate and costly, whereas the latter puts the identities of experts and agencies under strain.

A possible reason for adopting a reactive rather than a proactive approach to policy renewal can be in what Collins and Evans (2002) call the “Problem of Extension,” i.e., the fear that wider democratic processes result in technological paralysis. The case studies in this dissertation suggest, however, that this fear is not necessarily substantiated. It seems that the “Problem of Extension” does not materialize in a hierarchic arena.

The Finnish case of biotechnology policy can be taken as an example. Collins and Evans (2002) suggest that, in the first phase (of a series of events leading to the “Problem of Extension”), technical decision-makers meet increasing societal criticism, which actualizes the “Problem of Legit-

imacy.” This is what has happened in the conflict about Finnish forest biotechnology (*Paper II*). A key regulatory agency, operating under a model of “best expert advice,” drifts into a legitimatization crisis, due to various forms of social critique. In the second phase, according to the same authors, the extension of expertise is suggested as a remedy to the “Problem of Legitimacy.” In the Finnish case, the remedy is prescribed by European Union regulation and its requirement to hold public hearings. In the third phase of the Collins and Evans’s model, the extension of expertise leads to technological paralysis. This view is also shared by Finnish researchers and civil servants whom I interviewed: EU regulation is perceived as a force that induces paralysis in R&D activities. Deviating from the schema of Collins and Evans, however, new strategies based on the extension of expertise were not fully adopted in Finnish biotechnology policy. Despite efforts by national authorities to organise “structured public discussions” and regulatory public hearings, the results have been something akin to public education of science and safeguarded rituals of public involvement, with no actual links to decision-making. As long as the building of new, democratic processes for biotechnology-related decision-making has been targeted, there has been a mismatch with the target (or at least a long delay with it), and financial and human resources have been wasted.⁴⁴ This situation can be called the “Problem of Quasi-Expansion,” and it should be distinguished from Collins and Evans’s (2002) “Problem of Extension.”

Another possible reason for adopting a reactive approach to policy renewal can be found in the strength of policy cultural traditions. The expansion of expertise implies increasingly complex processes of decision-making and redefinitions of responsibilities, which can be seen as threats to the traditional way of policy-making and trust-building. In a benchmark study of European foresight exercises (see Klüver, et al. 2006b, and Paper III), we identified several cultural characteristics in different national contexts that are inimical to foresight as an open and participatory approach. Examples include tendencies of policy culture, such as scienticism (in Bulgaria), corporatism (in Denmark), lack of a culture of collaboration (in Malta), and questioning of politically-independent actors within the policy system (in the Netherlands).

Whatever the particular tissue of a national political culture that explains the hierarchic characteristic of a policy arena, the arena involves an inimical orientation to the expansion of expertise. That orientation results, most notably, in a tendency toward “Quasi-Expansion” that can be defined as noncommitment to the expansion of expertise. Quasi-Expansion seems to be a typical problem in the organising of participatory processes in a hierarchic arena. It manifests itself in under-investment of the social resources in the participatory process; in unfortunate compromises of interest by the organisers; and finally, in the ambiguity and ineffectiveness of the expansion process.⁴⁵

Quite interestingly, “Quasi-Expansion” and the “Problem of Extension” are interlinked limitations to the expansion of expertise. Quasi-Expansion feeds disappointment in efforts to build wider democratic processes. It prevents processes and conditions that contribute to the “Problem of Extension.” Thus, the Problem of Quasi-Expansion has to be resolved, at least to some extent,⁴⁶ before one can start solving the Problem of Extension. The situation is analogous to organising field tests of GMOs: risks have to be taken in real-life conditions (by studying GMOs in natural ecosystem interactions), in order to gain proper understanding of them (the environmental risks of the GMOs); the final test of the limits of the expansion of expertise is in the real-life context of decision-making. If Quasi-Expansion is a hazard mode of action, the strategy of the expansion of expertise is a risk mode.

Commitment to the expansion of expertise can be a tool for reforming a hierarchic policy arena in a proactive way. Foresight, for instance, is commonly conceived of as a tool for reforming a hierarchic, top-down or otherwise rigorous culture of innovation policy into a more participatory, interactive and flexible one (*Paper III*). In a recent report on foresight (Klüver, et al. 2006b) we found that specifically in the EU’s entrant countries, such as Romania and Bulgaria, this is the main stimulus for policy-makers to introduce the foresight practice. The functionality of foresight as a tool for reform of policy culture, however, depends on the activities in the broader institutional setting. In a monitoring exercise of the Klüver’s, et al., (2006a&b) reports, we found that the trend of increasing participation in foresight is most often associated with a more general shift in governmental approaches (see, Bedsted, et al. 2007, p. 12-19). This is the case, for example, in the Danish foresight programme, which is linked to the government’s globalization strategy, with the intention of broadening the basis for the strategic intelligence needed for the political prioritization of research programmes. This is also the situation in the UK. According to a UK respondent in the monitoring exercise, “[t]he work of foresight should be considered alongside of the broader Government initiatives of which it forms a part.” In the UK these initiatives include the Government’s guidelines on scientific analysis in policy making,⁴⁷ and a ten-year investment framework for science and innovation, enhancing a new mode of public engagement that builds on “upstream” dialogues to inform policy-making.⁴⁸

A broader shift of national policy approaches toward the expansion of expertise can support foresight as a tool for policy cultural change. Developments in the broader institutional setting, however, raise issues of functionality. Who or which institute should take the flagship role in the development of a new participatory culture of policy-making? Could it be the responsibility of, for example, some ministerial agency that is applying the foresight practice? In many countries there are several governmental programmes and enabling mechanisms for undertaking such development (examples are the UK Government’s Sciencewise programme,⁴⁹ and

the Danish Board of Technology). It follows, as was expressed by a UK foresight coordinator who was interviewed, that "...the understanding of participation and a methodology that reflects this understanding is likely to rest in building capacity *within and beyond foresight programmes*." The more prominent the role a policy agency takes in the battle for policy renewal, the more it puts its capacity and identity under strain.⁵⁰

To conclude, hierarchic arenas tend to compromise the expansion of expertise, and involve a problem of "Quasi Expansion." The problem of Quasi Expansion can be solved through a stronger commitment to the expansion of expertise. This may require, however, that a broader shift in policy culture takes place. Adopting a flagship role in such a process puts the identities of policy agencies under strain. This calls for agencies to balance between compliance with their traditional norms and their adoption of a proactive strategy.

4.4 Participatory arenas

A participatory arena involves actors and knowledge perspectives external to technically and professionally established elites in processes related to expert advice and decision-making. Metaphorically speaking, this is the *home territory* of the expansion of expertise. "Foresight" is an example of such an arena, since recent definitions of foresight take participation as one of its key components⁵¹ and extensive participation is generally recognized as its current trend (see, e.g., Salo, et al. 2004; Barré 2001).

The participatory arena is the exception rather than the rule among the arenas of technical decision-making. Foresight, for example, has generally an indirect advisory function, rather than the direct function of decision-making in the process of S&T policy.⁵² Since the expansion of expertise is a trend that modifies governance practices, however, we can expect participatory arenas to become more general in the future. Therefore it is of a more general interest to explore what happens to the expansion process in a participatory arena.

My empirical perspective on participatory arena is based on an EU-coordinated benchmark study on "science-society dialogues" in foresight (Klüver, et al. 2006b). This is a narrow perspective, but still provides a viewpoint on other kinds of limitations of the expansion process than those caused by a hostile policy culture. It is difficult to explain some of those limitations merely by referring to a policy-cultural resistance, since S&T policy of today favours foresight and its prevailing participatory approach.

A starting point of any foresight exercise is that it aims at "out-of-the-box thinking," i.e., at generating thoughts that move away in diverging directions so as to involve a variety of visions that sometimes lead to new ideas, solutions and decisions. This is why a great variety of actors and knowledge

perspectives is generally welcomed in foresight. Another important starting point of foresight is that it aims to be relevant for public policy. The visions generated by foresight exercises have to be recontextualized in the realm of policy-making. This is difficult, however. There are internal limitations in the arena of foresight, which makes it problematic to combine a wide variety of actors and visions with productive processes of decision-making.

That dilemma was partially reflected in our EU benchmark study on foresight (Klüver, et al. 2006a). We found that foresight coordinators generally appreciate the idea of wide-scale participation in foresight; they rationalize this by using both principled and pragmatic arguments (as discussed in Section 2). With regard to the high level of appreciation, though, we recognized that the real level of participation was low and the circle of actors narrow. The group of key actors consisted of high-level civil servants, researchers and industrial partners. Because it was the duty of our task team in the EU-project to “enhance ‘science-society dialogues’ in foresight,” we ended up, quite philosophically, making recommendations to increase participation (Klüver, et al. 2006a).

During the analysis of the benchmark material, however, my attention was attracted to the pragmatic difficulty of organizing foresight exercises in a way that allows for extensive involvement and widespread social debates. There were many lessons garnered from the foresight coordinators we studied, which illuminates the pragmatic aspects of expanding expertise in foresight. While many of those lessons were reports of failures and difficulties, there were also examples of successes. Since wide empirical material was available—an effort to build a database that allows a comparative case study between 15 countries!—and our task team had analyzed it only from a rather general and policy-oriented standpoint, I decided carry on with the analysis of the same material. I focused on the issues of “requisite variety”. The findings are reported in *Paper III*.

Paper III studies the dilemma that emerges in foresight when combining high requisite variety with productive convergence. The concept of “requisite variety” refers to the degree to which the heterogeneity of the outside world is captured in the setup of a “hybrid forum,” such as foresight (see Rip, et al. 2004, and *Paper III*). Requisite variety provides cognitive representation and variation. Requisite variety can be increased by increasing the number and heterogeneity of participating actors and through the open and exploratory design of the foresight process. Productive convergence transforms requisite variety into different products, such as well-articulated and robust decisions and innovations. Productive convergence can take place either through the formal design of the foresight process (e.g., by assigning a pre-defined role to foresight in a public policy process, such as defining the priority research areas in a national research policy strategy), or more likely, through various informal channels (e.g., participants spread the foresight visions in their home organizations).

Paper III indicates that there are two kinds of difficulties in combining a high requisite variety with productive convergence. One relates to increasing complexity and managerial difficulty as the structure of actors in foresight becomes more heterogeneous. Several examples, such as the Czech, Maltese, Norwegian and UK national foresights, provide lessons about the rising costs, strategizing and cognitive distance that can damage the organizing of a foresight process in an effective and efficient way (see *Paper III*). This type of difficulty for foresight is called the “involvement—instrumentality trade-off,” according to Renn’s (2006) similar hypothesis. Another kind of difficulty relates to the creational and motivational aspect of foresight. The participation of (politically) influential persons can be required for transforming the foresight outputs into practical outcomes (see e.g., the examples of the Czech, Danish, Norwegian and UK cases in *Paper III*). When such persons are being involved, however, they often influence the foresight process through their *a priori* strong visions and commitments and thus reduce the open, exploratory and surprise-seeking focus of foresight. This type of difficulty is called the creativity-stakeholding trade-off, according to Georghiou and Keenan’s (2006) similar hypothesis.

Paper III argues that a trade-off between increasing requisite variety and productive convergence is to some extent inevitable. The experiences of foresight coordinators, however, provide lessons in how the two desirable but incompatible aspects of foresight can to a certain extent be reconciled. Several methodological solutions and examples are listed in the paper. The contextually contingent nature of the solutions is discussed. For example, the success of a Dutch “Ocean Farming” foresight in combining high requisite variety with productive outcomes is explained by considering both its methodological and contextual aspects. Examples of the successful methodological aspects are that the politically-complex issue (of an increased but sustainable use of the North Sea) allowed a “natural” inclusion of a broad range of dimensions, such as governance, market development and consumer preferences; and that the provision of a high level of independence and responsibility to a large number of participating stakeholders in the field of ocean farming instilled them with a high level of motivation. Equally important, however, is that the dialogue was deeply integrated with the Dutch corporatist approach to policy, which is even enforced in Dutch law (*Paper III*).

Paper III also raises the issue that the trade-off between variety and convergence is not limited only to organized formal exercises in the way that foresight is. There is evidence that a similar dilemma pertains to various kinds of group learning processes (Rip, et al. 2004; Rip 2003; Nair 2001; Nootboom 1999; see, e.g., March 1991). We can even expect it to become a systemic issue. In Finland, for example, more than 300 foresight exercises were carried out between 1998 and 2003 by organisations belonging to the “National System of Innovation” (see Klüver, et al. 2006b). While this is a prom-

inent example of the process of expansion of expertise, it indicates that there also can be a saturation point at a systemic level. There is the risk that the numerous foresights will result in overlapping and unexploited visions.

To conclude, even in a participatory arena there are limitations to the expansion process. The trade-off between variety and convergence implies that involvement at some stage becomes costly and counterproductive. This indicates that what Collins and Evans (2002) called the “Problem of Extension” (i.e., the decreasing productivity and efficiency of technical decision-making due to the inclusion of public concerns) can become materialized in a participatory arena. The “Problem of Extension,” however, is not as monolithic as Collins and Evans’s notion of “technological paralysis” might suggest. There are at least two different types of variety-convergence trade-off with different reasons. By learning and evaluating past experience one can attempt to expand those limits.⁵³

4.5 Implications

This dissertation explores how and on what conditions the expansion of expertise takes place in different arenas of technical decision-making. For this purpose, the first research question (RQ 1) aims at identifying the arena characteristics that influence the expansion of expertise. The most concise answer to the question is given in the proposed distinction between four different arena characteristics: placid, polarized, hierarchic and participatory. As we have already seen, the different arena characteristics involve different issues for the strategy of expansion; those issues influence the way in which the expansion of expertise is framed as a strategic option (being either an issue of style, power, enmity, or familiarity); and finally, the mismatch between a traditional and expanded arena involves different policy challenges and balancing requirements. The empirical findings concerning the arena characteristics and their influence on the expansion of expertise are summarized in *Table 3*.

The second research question (RQ 2) explores how arena characteristics—causing the “arena effect”—influence the process of the expansion of expertise. In answering RQ 1 (what are such arena characteristics), we have already provided an initial answer to RQ 2 (how do they influence). The most concise answer to RQ 2 is that the different arena characteristics influence the direction, speed and impact—and finally the success—of the expansion of expertise. The answer will be elaborated on next by considering the “cross impacts” of the arena characteristics, i.e., what bearings the different *combinations* of the arena characteristics may have on the expansion of expertise. I take the liberty of providing the answer by exploring ideas and metaphors rather in a manner of a think-piece than in a manner of a summary or research note.

Table 3 Empirical findings: arena characteristics and related arena effects

Arena characteristics		ARENA EFFECTS (i.e., issues for the expansion of expertise)
ACTOR-INDUCED	<i>Placid arenas</i> - low intensity of debate and low level of mobilization by opposite social forces	Issue: “silence of the public” - Different signal functions - Early warning vs. tacit sign of content - De-motivating effects Framing: expansion of expertise as style Policy challenge: balancing between policy practice and thinking
	<i>Polarized arenas</i> - high intensity of debate and high level of mobilization by opposite social forces	Issue: polarization - Intensified public debate and criticism - Dissolution of the “core set” of experts - “Closure by polarization” Framing: expansion of expertise as power Policy challenge: balancing between “rational” and influential policy-making
INSTITUTIONAL	<i>Hierarchic arenas</i> - institutions of decision-making elitist, centralized and exclusive	Issue: hierarchic policy culture - Policy cultural resistance - Compromising and re-orienting effects - “Quasi-Expansion” Framing: expansion of expertise as an enemy Policy challenge: balancing between reactive and proactive policy renewal
	<i>Participatory arenas</i> - institution of decision-making based on the principles of inclusion	Issue: participatory policy culture - Policy cultural embedding - Involvement—instrumentality trade-off - Creativity—stakeholding trade-off Framing: expansion of expertise as the home territory Policy challenge: balancing between increasing variety and productive convergence

As *Table 3* indicates, arena characteristics can be categorized in two groups: actor-induced and institutional (see, *Table 3*). Since the two groups are independent dimensions (or axes) of a social arena, the “world” of possible types of arena can be framed as a four-field taxonomy. The model takes into account how different arena characteristics influence each other. Four main types of arenas resulting from the combinations of the actor-induced and institutional characteristics are presented in *Figure 1*.

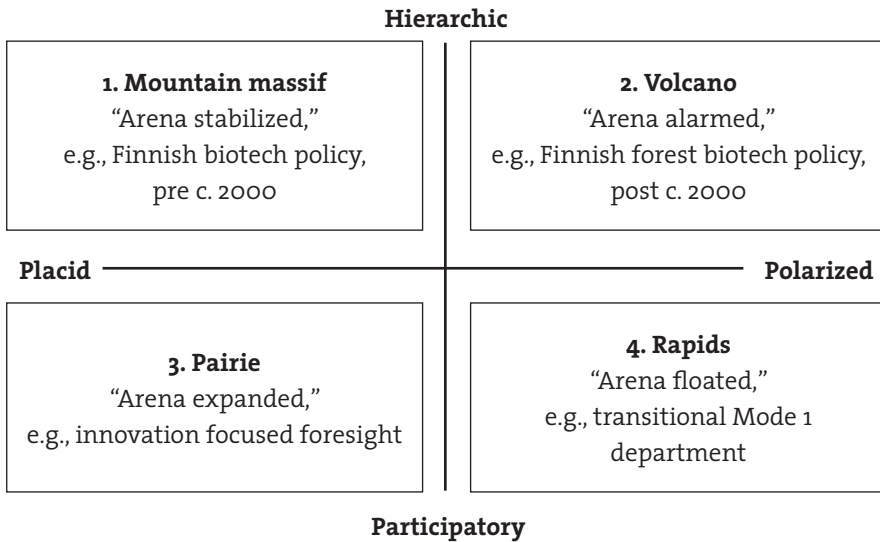


Figure 1 A typology of policy arenas

The four types of policy arena are named in *Figure 1* according to geographical metaphors. The metaphors “mountain massif,” “volcano,” “prairie” and “rapids” characterize the nature of each arena of debate and conflict. The subtitles (in quotation marks) and examples relate each arena type to the discussion and case studies of this dissertation. How each type of arena influences the expansion of expertise is discussed next. In preparation for answering RQ 3, I list issues, the acknowledgement of which helps design more workable strategies based on the expansion of expertise.

A placid and hierarchic arena (1) can be thought of as a “mountain massif,” because it is the most stable and monolithic of the arena types. It is an “arena stabilized,” because such contextual signals that would trigger policy-makers’ thinking about the need for restructuring the arena are absent. Expansion of expertise is conceived of as an exotic style as, for example, by Finnish biotechnology authorities in *Paper I*. In the mountain massif, policy-makers lack motivation for and commitment to the expansion of expertise. Due to the non-committal there is a tendency toward “Quasi Expansion.” The negative experience resulting from the latter further obstructs initiatives that aim at expanding expertise. The result is that the expansion of expertise becomes isolated from policy processes, in which it can nevertheless remain as an obligatory but poorly-understood element. The final outcome is that the expansion of expertise, in its distorted form, merely increases the cost and bureaucracy of governance and feeds dissatisfaction with initiatives for its renewal.

To climb the mountain, i.e., to build a more positive scenario for the expansion of expertise in this arena context, attention should be paid to the following issues:

- better reading of the status of public debate and mobilization is helpful. “Silence of the public” is not necessarily a signal of public content, but alternatively, it can be “silence before the storm,” or a signal of an inadequate level of social scrutiny of public policy;
- motivation through evidence is useful. An “ice ax” of pragmatic arguments (that articulate the social cost and benefit of the traditional vs. new policy approach) provides an effective tool for motivating policy-makers to expand their expertise. To gain such a tool, however, new policy approaches have to be tested and evaluated in real contexts of decision-making;
- stretching of policy paradigms occurs. Expansion of expertise involves both implicit and explicit conflicts between traditional and new ways of policy. Social scientist may help identify tensions and find ways of reconciling different strategic approaches and interests;
- anticipation through comparison and benchmarking is beneficial. Styles and debates of technical decision-making are becoming increasingly homogeneous as the world becomes more globalised. Comparison and benchmarking of international policy debates (e.g. on gene technology) and related governance styles help anticipate forthcoming shifts in national contexts.

A polarized and hierarchic arena (2) can be called a “volcano.” A hierarchic culture of policy-making is the common nominator between a mountain massif and volcano. A process of polarization, caused by an increasing intensity of public debate and a mobilization of opposite social forces, transforms the mountain massif into a volcano. A volcanic arena transmits signals of an approaching eruption of a social conflict. Policy-makers in this arena context, however, can be slow to react to the “alarm signals.” If the polarization continues for an extended period of time, the result can be a paralysis of the policy process (e.g., the case of Finnish forest biotechnology policy, in *Paper II*). It then becomes critical for policy-makers to find tools for more effective policy, for instance by adopting means of communicating and campaigning that are similar to those used by their forceful critics. Expansion of expertise in this context becomes framed as an issue of power and influence. If influence, however, is prioritized higher than negotiation and agreement, the risk is that the expansion of expertise just inflames polarities and intensifies the paralysis of the policy process.

To harness the volcano, i.e., to build a more positive scenario for the expansion of expertise in this arena context, particular attention should be paid to the following aspects:

- an early detection of the “alarm signals” is good. The sooner the social concerns related to technical decision-making are identified, the better the chances of reacting to them. It is both a policy cultural and methodological challenge to establish systematic procedures and structures for an early identification of technical debates and conflicts (the method of “pre-assessment,” elaborated in *Paper II* is an example of an effort to develop such approaches);
- conflicts can be learning processes. Conflicts open up different time scales for policy learning. Policy-makers are forced to react abruptly as issues arise, whereas policy scientists can adopt a temporarily expanded and theoretically informed perspective. If the arena has a short history of being volcanic, as in the context of Finnish biotechnology policy, this can imply a difficulty in seeing the value of treating conflicts openly through conflict study. The latter can, however, contribute to enhanced policy learning and conflict resolution;
- a review of policy goals helps. An adequate response to an “alarm effect” may require that not only new and more effective means are adopted by policy-makers,⁵⁴ but also that policy goals are openly reviewed. Adopting an expanded set of “non-technical” policy objectives, such as those related to the development of the governance approach, can help deal with “implicit risk issues” that may have a central role in a conflict (see, *Paper II*);
- experimentation with new policy approaches is useful. A process of polarization can involve strange configurations of actors and issues (e.g., the shared interest of forest industries and environmental NGOs in an anti-GM policy, see, *Paper II*). Even though methodological guidelines such as the RME can provide important rules of thumb, the particular configurations of issues and actors also calls for a contextually tailored approach. A conflict that relates to a very futuristic issue, for instance, can be a special reason for adopting an experimental mode in policy-making.

The metaphor for the placid and participatory arena (3) is “prairie.” There, in contrast to the hierarchic arena, motivation for the expansion of expertise is high. This results from a growing realization that the theoretical premises of the expansion of expertise hold practical value. For example, in the context of foresight, both practitioners’ and theoreticians’ conceptions of the value of foresight point to the following conclusions: foresight is effective in bringing new actors into the strategic debate; it helps in exploring future opportunities for investment in science and innovation; it is a workable method for building networks of actors, sectors, markets

and problems (see, e.g., *Paper III*; Georghiou & Keenan, 2006). On a “prairie,” a culture of participation prevails and the arena is placid (an example is foresight that is focused on brainstorming the innovation potential of some non-controversial technology). The prairie provides, in many ways, the most favorable context for the expansion of expertise. While the “prairie” provides a context in which expertise can be easily expanded, this type of arena also has some limitations. If there are no rules for stopping deliberations and if the mechanisms for transforming increasing requisite variety into decisions and innovations are lacking, a crisis of efficiency and effectiveness arises. There will be an overflow of unexploited visions, and the number of actors that are disappointed with the promise of participation will increase. These tendencies undermine the strategy of the expansion of expertise.

To effectively harvest the prairie, i.e., to build a positive and sustainable storyline for the expansion of expertise in this particular type of arena, attention should be paid to the following issues:

- the definition and anticipation of the limits of participation is helpful. It is not a straightforward exercise to identify the “reasonable” limits of the expansion of expertise—as we have seen in the pages of this introduction. However, an identification of such limits can contribute to more realistic planning. A starting point for such an identification process can be the clarification of the implicit and explicit assumptions of such limits by the actors who design the participatory processes. The assumptions should be reviewed along with the accumulation of experiences and insights;
- evaluation of participation pays off. The “prairie” blossoms with new policy exercises and experiments. An evaluation of participation is necessary in order to develop governance practices in the long run, and to direct experimentations in the short term. That a single framework could serve for the evaluation of any kind of participatory practice is not a plausible idea, not only because there is a great variety of them, but also because different arena contexts imply different challenges. Evaluation should meet the specific concerns of different types of arena;⁵⁵
- the building of linkages between different arenas (or stages within the arena) increases momentum. Sometimes prairie-type arenas can emerge in the foothills of the “mountain massif.” In order to open a route of communication between the mountain massif and the prairie, and to gain momentum for the expansion of expertise in the latter context, it is necessary to concert isolated activities. An example of this having happened in Finland is a recent project and report on participatory foresight and policy-making (Tarkka & Hintikka 2007). The project gathers together 11 distinct instances and examples of

- participatory policy applications—in the patchy “prairie” context of Finland—on the way to build momentum for the improvement of citizens’ hearing mechanisms in the national context;
- the scanning of “grassroots” practices is worthwhile. If prairie-type culture is the prevailing condition of a policy arena, there is a constant need for identifying new innovative approaches and deciding which of the past approaches have become obsolete. Scanning of “grassroots” practices, such as new communication and knowledge-sharing tools on the Internet, can help with these objectives. Emerging Internet-based approaches, such as wild political parties based on “Wiki” philosophy⁵⁶ both challenge and provide new means for the expansion of expertise in a public policy context.

Finally, a polarized and participatory arena (4) can be called the “rapids.” Participation in this type of an arena is a taken-for-granted issue that does not meet cultural resistance in the organization. The “Mode 1 department in transition” (*Paper IV*) is an instance of rapids-type of arena. Such a department has adopted a strategy that encourages increased participation and interaction by various actors across epistemic boundaries. Conflicts emerge, when the two modes of knowledge production encounter each other in the university setting. (An alternative example, with a more direct connection to the NTE and RME, is “professional risk management” that is based on a thoroughly participatory approach in the resolution of a polarized risk conflict.)

As in the context of the “prairie,” the approval of the participatory approach in the “rapids” can result from a growing realization by policy-makers (or conflict mediators) of its practical value for policy-making (or conflict resolution). The social turbulences or tensions in the broader institutional setting, however, generate special requirements for the expansion of expertise. They involve a sense of urgency and high social stakes; the polarized context also tends to politicise the *process* of planning and decision-making, unlike the placid context of the “prairie.” In the “rapids,” participating actors become concerned about who decides the rules of the game and on what grounds—issues that are not salient in the “prairie context.” There are two specific risks for the expansion of expertise in the “rapids” type of arena. One risk is that if the “design discourse” (see, Renn 2005) is opened up to all possible actors (in order to design an acceptable negotiation process) the process becomes slow, complicated and ineffective, and the “problem of expansion” becomes a reality. Another risk relates to a more exclusive strategy. If participation by politically influential actors is favoured (in order to effectively resolve the conflict), then biases emerge, reflections become more goal-oriented, and the policy (or negotiation) process can lose some of its creative potential.

To survive the rapids, i.e., to successfully expand expertise in a rapids-type arena, good balancing skills and timely actions are needed. Attention should be paid to the following critical issues:

- consideration of the design discourse is necessary. The politicization of a planning process makes it difficult to reach an agreement of an appropriate involvement procedure and negotiation strategy. Opening up the design discourse involves an arena that “floats” according to the needs of the stakeholders. This may help increase the social and political acceptance of the related procedures. Equally important, however, is that processes are kept running, e.g., by creating “forceful focuses” on the debates and by delivering specific roles to the participating actors.
- the combination of normative rules of thumb with contextual knowledge can help. An urgency in a conflict or polarized risk process requires that prompt actions are taken. Pragmatic and moral rules of thumb, such as, e.g., the NTE, can help design robust procedures; and even more so when the rules of thumb are completed with contextual information;
- the synchronization of the participatory processes with public debates and decision processes is useful. If in a “prairie” type of arena it may just be possible to gather “requisite variety” for different planning purposes, this seems unlikely within the rapids. In the latter context, there is an urgent need for handling the conflict. Synchronizing a participatory procedure with public debates and decision processes can increase its effectiveness and policy relevance. Since a goal-oriented policy process tends to compromise the creativity aspect of deliberation, special attention should be paid to how the two dimensions can be combined;
- attention to the different values of the expansions of expertise is needed. In a rapids-type arena there is a tendency to frame the expansion of expertise as a tool for power and effective action. Since some of the actors involved in a negotiation process can have different framings (e.g., they regard the expansion of expertise as a hostile form of decision-making, or oppositely, they attach high symbolic value to the efforts to deal with a technical conflict in a democratic manner), it is vital for a negotiation process that no single framing dominates.

As we have seen, there can be quite different challenges for the expansion of expertise in the four arena contexts. It is now time to consider whether the acknowledgement of the “arena effects” actually provides additional value for planning or decision-making. I will discuss this next and answer the last research question (RQ 3), “Can better knowledge of the ‘arena effect’ help design better strategies based on the expansion of expertise?”

Let us start by reminding that the criticism of the NTE and the RME links the rigidity and contextual insensitivity of those models to their limited value for policy design. Does the identification of the “arena effects” as proposed in this dissertation help deal with this problem? Drawing from the criticism of the referred theories (see, Section 2.6), four criteria for a “flexible and contextually sensitive” account of the limits of the expansion of expertise can be formulated. Such an account should: 1) take into consideration the contextual factors (at a meaningful level of generality), 2) without succumbing to a narrow or propositional framing of the issues of science and technology, 3) without leaning on concepts of expertise, science, or risks loaded with boundary problems, and 4) by offering perspectives and options for policy interventions. Are these criteria met by the identification of the “arena effects”?

Criteria 1-3 are about the quality of analysis. The first criterion (1) is met, since the study of the “arena effect,” by definition, takes into account contextual factors. My understanding is that the “arena approach” allows a fruitful way of structuring and abstracting empirical findings concerning the actors, issues and dynamics of the arenas. My intention is that the typology of different arenas and “arena effects” provides a framework of orientation to the contextual issues that are related to the expansion of expertise. I also believe that the second criterion (2) can be met. The arena focus opposes a propositional framing, because it does not analyse the issues in isolation but regards them as part of the “drama” of the actors and their resource mobilization efforts. The third criterion (3) is more challenging. This is due to the fact that any form of theorizing carries with it the risk of vague abstraction. I have defended my position (in Section 3 on methodology) by referring to the “grounded generalism” approach. The role of theorizing, according to this view, is in the naming and interpreting of empirical findings and in the building of heuristic models that allow learning from experience.

The fourth criterion (4) is about the policy relevance of analysis. Can the identification of the “arena effects” offer perspectives and options for policy design and thus have implications for the definition of relevant expertise in technical decision-making? A “no” answer to this question could be formulated by claiming that the study of the “arena effect” only provides *ex post* accounts or case specific information. This is not my answer, for two reasons. One aspect is that an increased sensitivity to different types of arena can indeed provide a starting point for designing customized rather than “Pavlovian” strategies⁵⁷ of expertise. To take an example, the Danish-type consensus conference has often been proposed as the way to support public deliberation and policy-making on ambiguous and challenging technologies, such as modern biotechnology. On the basis of past experience (see, *Paper I*), however, such an approach is more difficult to adopt in the Finnish than in the Danish context. This is understandable, because the Finn-

ish arena of (bio)technology policy is rooted in the mountain massif of national political history, which is coloured by a lack of tradition in critical debate, and a high degree of trust in experts, authorities and technologies. The Danish policy arena, in contrast, is rooted in a prairie-type tradition of grass-roots dialogue and citizens' participation, and there is also an institutionalized history of practice in participatory S&T policy (see, e.g., Klüver, et al. 2006b; Jamison & Lassen 2004; Jamison 1999a). Positive cultural resources for the expansion of expertise in Finland can be found in its recent orientation towards high tech and in its long history of futures studies. These resources were actually combined in a recent ICT-based project that collected "weak signals" for Tekes (the Finnish Funding Agency for Technology and Innovation) on the options and threats for Finland's future in the year 2020. The result was more than 3000 visions from a large collection of R&D experts, young activists, societal actors and business people.⁵⁸ The "weak signals" project represents quite a new approach with its wide scope of visioning in the arena of Finnish S&T policy.

The second aspect is that a better understanding of the arena-specific factors can help anticipate what specific challenges are related to the expansion of expertise, and, at best, in finding means for dealing with them. The "weak signals" exercise, for example, represents a new, "prairie" type of instrument for increasing the requisite variety in Finnish technology policy. Even though the evaluation of that exercise is yet to come, we can expect that some of the main challenges of the project will be related to a productive convergence of the collected visions. It is a challenge to which we can expect complicated managerial rather than straightforward political remedies.

To summarize the answer to RQ 3, lessons from the "arena effects" can provide means for the design of more realistic strategies of the expansion of expertise. These lessons cannot be the only basis for future action, however. Also needed are normative principles and guidelines, such as those suggested by the NTE and the RME. Without the latter elements, policies would be based merely on power, influence or narrow-minded practicality; not on principles of democracy and fairness. In this respect the two approaches are complementary rather than competing.

The next section (Section 5) closes the introduction of this dissertation with a discussion on future research needs for better understanding and management of the expansion of expertise.

5 Future research needs

Why should one be interested in the phenomenon of the expansion of expertise? Which of the issues that are related to it are still unclear or problematic and therefore deserve further attention? What further research questions does the study of the “arena effect” open? These are the final questions, the ones with which I conclude this introductory chapter.

The expansion of expertise is a longer term trend in the governance of science and technology. It has a history in the ideologically inspired participatory movement of the 1960s. Its parallel evolution can be followed through the development of several fields related to S&T policy, such as risk assessment, technology assessment and foresight. Currently the trend of the expansion of expertise is widely established; it has a rather more pragmatic than ideological motivation; it refers to multiple different practices and approaches, and there is an increasing interest in developing and evaluating those practices. The expansion of expertise is gaining terrain in the core work in S&T strategy-making. Since science and technology are, and will be, among the key drivers of societal change, it is of general (sociological) interest to try to understand whether the expansion of expertise will make a difference in the future conduct of S&T.

To my understanding, there are three problem areas related to the expansion of expertise that deserve more attention: first, the definition of its limits; second, the development and understanding of its methods and approaches; and third, an understanding of how policy cultures influence it. This dissertation sheds some new light on these problems. At the same time, I acknowledge that some aspects of these problem areas still remain unresolved.

First, the normative theories of expertise have opened the discussion on how to define appropriate levels of expertise on the basis of different qualities of science and risk. As a commentary and complementary perspective to these approaches, this dissertation has introduced the concept of the “arena effect”; proposed some contextual distinctions (e.g., the four types of policy arena), and discussed their relevance with regard to some of the key assumption of the NTEs (e.g., how the “problem of expansion” relates to the different types of arena). I have also recommended different arena types by pointing out issues that will most likely emerge in different types of arena, and how the issues can be responded to within them (e.g., in the context of a “mountain massif” it is crucial to anticipate and work with policy cultural tensions, whereas in the context of the “prairie” there is a need

to clarify participants' understanding of the limits of the expansion process.) Despite these steps, further research is needed to better bridge the gap between normative and descriptive-contextual theories of the expansion of expertise. That work could begin with a consideration of how the contextual models can better be integrated with the normative models of expertise. Such work might then result in a more contextually sensitive and integrated model of expertise.

Second, since a systematic research and development of the participatory method through testing, variation, comparison, evaluation and theory-building is still at an early stage, there is currently a demand for both methodological "basic research" and more practical development. The arena approach that is elaborated on the pages of this dissertation helps to identify contextual factors and conditions and to analyse issues of framing and resource mobilization, especially at the early stages of a policy process (i.e., in the framing and decision-making stages). I believe that in the future there is a particular need for developing contextually sensitive new methods that strengthen the participatory dimension both at the early and late stages of a policy process.

Since the development and application of participatory methods are costly, there is a constant pressure to do those things cost-effectively. This is a factor that supports co-operation in methodological work, both at the national and international level. Co-operation between more and less experienced organisations not only supports methodological knowledge transfer, but also helps build political legitimacy to projects aiming at introducing new approaches, especially in less participatory cultures of S&T policy. An encouraging example is the activity of the Danish Board of Technology to practice knowledge transfer and involve international partners in European and global participatory exercises.⁵⁹

Third, cultural and contextual impacts on organisations and decision processes have previously been studied in several disciplines including, e.g., institutional and organisational theory, political science, and cultural theory. Specific to the typology developed here is that it has been tailored to the study of the expansion of expertise; its starting point is in empirical case studies that focus on processes related to the expansion of expertise; and its outcomes are contextual implications for the expansion of expertise. The way the model of policy arenas is applied here contributes to an increased understanding of the cultural and contextual conditions of the expansion of expertise. I acknowledge there are issues that have only partially been treated in this dissertation but would deserve more systematic attention. A major issue is the dynamic relation among types of policy arena. We have seen that there can be various triggers for a shift from one type of arena to another. Examples of such triggers are an extended risk conflict (*Paper II*) and the dynamic role of expertise, as shown for instance in the case where foresight is intentionally applied as a tool for pol-

icy cultural renewal (*Paper III*). The study and theory of policy arenas can provide some insights to the question of how policy cultures change; further research could seek connections between this and other theories explaining policy cultural dynamics. One of the most interesting connections that would deserve more systematic study is between the arena theory and the “theory of organisational fields” (e.g., Greenwood, et al. 2002; Scott 1995; DiMaggio & Powell 1991; Abbott 1988). International studies and comparisons would enable a “natural” empirical framework for conducting studies of policy cultural dynamics.

Finally, the exploration of arena effects in this dissertation involves ideas that have to be further developed and scrutinized. The list of “arena effects” provided here is not in any sense exhaustive. While the scrutiny of the findings requires further empirical research and the identification of new kinds of arena effects is an open line for the study of policy arenas, I think it is important to link such a research agenda to broader issues. One of the main issues involved is the social control of technology (and most generally, the co-evolution of science, technology and society).

Already a quarter-of-a-century ago, Collingridge (1980, p. 19) summarized the dilemma of the social control of technology as follows:

... attempting to control a technology is difficult, and not rarely impossible, because during its early stages, when it can be controlled, not enough can be known about its harmful consequences to warrant controlling its development; but by the time these consequences are apparent, control has become costly and slow.

The essence of controlling a technology, according to Collingridge, is not in predicting its social impacts, but in retaining the ability to change it. His point is that it is of the greatest importance to learn what the obstacles to the maintenance of this freedom of control are. Since the expansion of expertise promises to increase the domain of social control by making technical decision-making more informed, socially acceptable and democratic while the arena effect risks compromising that process, Collingridge’s insight can be a valuable guideline for the orientation of future research. The dream of socially controlled technical decision-making comes true when new and expanded strategies of expertise are developed in relation to a rigorous study of arenas and their effects.

Notes

- 1 *Paper III* is related to the following reports, in which Rask is a co-author: Bedsted, et al. (2007); Klüver, et al. (2006a, 2006b).
- 2 The key argument of this introductory chapter was presented in a paper “On the rationales and limits of the expansion of expertise” at the *Negotiating the Future* seminar, 7 June 2007, at the University of Oslo.
- 3 Schwarz and Thompson (1990, p. 39) argue that the established thinking pattern is based on the separation of technical facts and social values. By referring to anthropologists and sociologists of knowledge, who, according to them, “. . . have shown us that what are considered facts depends ultimately on an accepted framework of social (and therefore evaluative) premises . . .” they reject this position. To make it clear, I share their “social constructivist” view of science as being a social activity, and of facts as being entwined with values.
- 4 For example, according to Statistics Finland, R&D expenditure in Finland was 3,5 per cent of GDP in 2003, which is the highest in the OECD after Sweden; the World Economic Forum (WEF) ranked Finland first in Growth Competitiveness in 2005, followed by the USA (for R&D statistics, see <www.research.fi>).
- 5 Kuitunen and Lähteenmäki-Smith (Manuscript) report that many of the representatives of the Finnish “technology elite” whom they surveyed call for the democratization and opening up of this policy area to new influences and actors. “Multi-vocal” policy was also a central theme of ProACT, the recent, biggest-ever Finnish research programme on technology policy (see, <<http://proact.ktm.fi/>>).
- 6 For example, Wynne 1989, has since a long time criticized and called for a change in the expert-focused culture of UK risk management: “Many such decisions are determined in the United Kingdom via expert advisory committees. These usually provide no record of meetings, of how issues are defined, how diverse evidence is examined and judged and different disciplinary inputs reconciled. Their membership is often narrow in disciplinary terms, and they are not held to account for their judgements (except in very indirect ways via Parliament or the media if the issue is sufficiently controversial). All these could be changed.” (Cf. Wynne 2005.)
- 7 I explain the main concepts applied in this dissertation in Section Two.
- 8 In the current debate on “upstream public engagement” (see, e.g., Irwin 2008; Wilsdon & Willis 2004) the “upstream” is understood as the early stages of the R&D (e.g., HM 2005) or S&T governance process (e.g., (e.g., Heiskanen 2006). Since the term “upstream” is thus loaded with meaning in this debate, in which research education is generally a lacking element, the latter could be called (quite ironically so) an “underground wellspring” of expanded expertise.
- 9 The terms “problematique” and “resolutique” have been used by the Club of Rome, the previous to denote the “interwoven mess of problems” (related to world sustainability), the latter to denote the coordinated set of efforts to deal with them (see, FICOR 1997).
- 10 The chief editor of *Social Studies of Science*, Michael Lynch, together with Simon Cole, claims that the field of Science and Technology Studies has undergone a *normative turn*, due to repeated calls for research that intervenes in public controversies about science and technology (Lynch & Cole 2005).
- 11 I am grateful to Les Levidow for the suggestion of adopting the term “expansion” to describe the broadening of expertise, and to cover new actors and knowledge perspectives.

- 12 The key concepts presented in this section are central to this introduction's synthetic discussion, and thus reflect my thinking after the papers included here were completed.
- 13 The *Oxford English Dictionary Online* defines it as: a) expert opinion or knowledge, often obtained through the action of submitting a matter to, and its consideration by, experts; an expert's appraisal, valuation, or report; b) the quality or state of being expert; skill or expertness in a particular branch of study or sport.
- 14 Certified experts, in this terminology, are academically or professionally accredited scientists and technologists, whereas non-experts such as ordinary citizens are devoid of such status; in the case of being called "experience-based experts," they may be considered as having special technical expertise, by virtue of their experience.
- 15 Collins & Evans (2002) repeatedly refer to the lesson from the sociology of scientific knowledge that all scientific and technical debates necessarily draw on "extra-scientific factors." This indicates a broad conception of the domain of S&T.
- 16 Renn (2005, p. 78) gives a distinct definition for "governance" at the global level, where it refers to "... the horizontally organized structure of functional self-regulation encompassing state and non-state actors bringing about collectively binding decisions without superior authority."
- 17 Heiskanen (2006) has called the second type of participatory activity "top-down 'engagement' exercises."
- 18 For a beautiful example of game theory, see Schelling 1980.
- 19 Karl Michelssen, the historian of technology, for example, describes the first stage of Western technology policy, from the era of nation-building to the first decades of the 20th Century, as an era of "passive" policy-making. It was focused on infrastructural projects such as canals, roads, bridges and fortifications, and on the building of universities and other institutions of higher education (Michelssen 1993).
- 20 We can see an evolution from the model of "ladders" to the one of an "escalator," described in Section 2.6.
- 21 According to Bruun, et al., transdisciplinarity (in the realm of sustainability) can be defined as "... collaborative research and problem solving that cross both disciplinary boundaries and sectors of society, engaging a shift from science on/about society towards science for/with society."
- 22 Rationale: "A reasoned exposition of principles; an explanation or statement of reasons; a set of reasoned rules or directions. The fundamental reason, the logical or rational basis (of anything)" (*Oxford English Dictionary Online*).
- 23 Trade-off: A balance achieved between two desirable but incompatible features; a sacrifice made in one area to obtain benefits in another; a bargain, a compromise (*Oxford English Dictionary Online*).
- 24 This kind of argument has also sparked criticism. According to Wynne, for example, the supposition that a "... certainty-craving public would shut down all innovation," if contingencies were to be displayed (through an open debate), is simply based on a false model of the public (Wynne 2005).
- 25 Lysenkoism: Belief in or advocacy of the views of the Russian agronomist T. D. Lysenko (1898-1976), who opposed modern genetics and advocated neo-Lamarckian views and who for a time achieved great influence in Soviet Russia (*Oxford English Dictionary Online*). Regarding "Lysenkoism and the like," Collins and Evans (2002) refer to "... cases where state power is used to over-rule scientific conclusions that are subject to broad consensus within the international scientific community."
- 26 Collins and Evans (2003) have defended their argument at a programmatic level, and also introduced some new analytical concepts, e.g., "iniquitously-" vs. "scientifically-" framed problems.
- 27 There are three main types of risk problems in this terminology—complex, uncertain and ambiguous—with the following definitions (Renn, 2005). *Complexity*: "Complexity refers to

the difficulty of identifying and quantifying causal links between a multitude of potential causal agents and specific observable effects." *Uncertainty*: "A state of knowledge in which, although the factors influencing the issues are identified, the likelihood of any adverse effect of the effects themselves cannot be precisely described." *Ambiguity*: "Giving rise to several meaningful and legitimate interpretations of accepted risk assessment results."

- 28 On closer inspection, there is some discussion on the contextual factors related to both models. Collins and Evans (2002), for example, refer to the particularities of different policy cultures, such as those in economic policy, where instead of the urge for participation, the tendency in most major economies has been toward independent central banks and an elite group of decision-makers (cf., Francis 2002). Renn (2004, 2005) discusses the connection between established ways of stakeholder involvement and (paradigmatic) styles of policy-making ("adversarial," "fiduciary," "consensual" and "corporatist").
- 29 Since the empirical materials, as well as the methods applied are reported in the articles, I do not review them in detail here. An overview of the research topics, approaches and methods is provided in *Table 1* (in Section 1).
- 30 This program is a tool broadly used by social scientists for the conduct of qualitative content analysis of various empirical material. The program does not involve any theoretical assumption about the analysis, but assists in managing the data and conducting the empirical analysis systematically.
- 31 I was responsible for conducting the analysis and reporting of a two-round monitoring exercise in the referred EU project. The results are reported in Bedsted et al. 2007.
- 32 Coherence: "Consistency in reasoning, or relating, so that one part of the discourse does not destroy or contradict the rest"; harmonious connexion of the several parts, so that the whole 'hangs together'" (*Oxford English Dictionary Online*).
- 33 There are, roughly speaking, two opposite approaches to the study of how policy context influence the process of the expansion of expertise. One way is to start from established theories and typologies of policy cultures, which are exploited as interpretative tools in the analysis of policy processes. One of the most famous cultural typologies is suggested by "Cultural Theory" (Grenstad 2003; Douglas & Wildawsky 1997; Rayner 1992; Schwarz & Thompson 1990). It is based on a distinction between four (sometimes 3-5) main types of organisational cultures with different rationalities: the hierarchist, the egalitarian, the individualist and the fatalist. The paradigms introduced in *Paper I* come close to the typology of cultural theory. The "enlightenment paradigm" resonates with the rationality of hierarchist culture, the "critical paradigm" with egalitarian culture, and the "economic paradigm" with individualistic culture. An alternative classification distinguishes between the fiduciary (i.e., patronage), the consensual, the corporatist and the adversarial policy cultures (Renn 2005; Renn 2004; Jamison 1999b). The cultural typologies provide explanations of why organisations behave as they do and why certain processes are slow to change due to the deeply rooted cultural patterns (see, e.g., Hänninen 2007). A problem, when starting from established typologies is that they take fundamental epistemic assumptions for granted, while at the same time, they fail to pay enough attention to more subtle distinctions and dynamics that bear upon the practical outcomes for the expansion of expertise. Therefore, in this introductory chapter, I have adopted a more exploratory approach. My starting point has been a synthetic analysis of the empirical findings of the papers (concerning the contextual and practical limitations of the expansion of expertise), and the result is thus a new heuristic model of the characteristics and types of arenas, which best helps explain the empirically observed phenomena.
- 34 "Foresight" refers to the policy-oriented "hybrid forums" in the S&T-related area, based on the interaction between industrial, academic, governmental and social actors. Participation is the starting point of current foresight activity. In reality, however, there is a great variation, in the nature and scope of participation, between specific foresight exercises (see, Klüver, et al. 2006a).

- 35 In some earlier presentations of this material at conferences, I was asked about how studying citizens' participation in the context of Finnish biotechnology policy could be relevant if such related activities were scarce, and more severely, if the public outrage that would have necessitated those activities was absent.
- 36 Hukkinen, et al. (1990) make a similar, "dialectic" argument, that is, that the way toward resolving the agricultural drainage dilemma in California is to polarize the conflict through the organizational division of labor. Their conclusion relates to the dysfunctional effects of the status quo, and to the lack of polarization.
- 37 This is also the problem with the argument: one cannot equate stringent regulation with sound public policy. However, what is interesting with Graham's argument is that it makes an empirical case, where "silence of the public" presumably implies negative effects on public policy.
- 38 The surprise caused by the contradictory interpretations of this issue was one of the reasons why I continued, in *Paper II*, to study the influence of actors on the process of policy-making.
- 39 See, <<http://www.joensuu.fi/biologia/sopanen/index.htm>>.
- 40 In the following summer, a new act of sabotage led to the destruction of the GM potato field test site in Jokioinen, see <http://www.bioteknologia.info/uutiset/maatalous__ruoka/fi_FI/boreal_koe_tuhottu/>.
- 41 To be more exact, the European controversy over biotechnology was entered for the first time in Finland during the "watershed years," 1996-1997, as in most other European countries. During that time, media peaks were also reported in Finland, as reactions to the importation of Monsanto's genetically modified soya strain, called "Roundup Ready," and to the birth of Dolly, the first animal proclaimed to be cloned from an adult cell. The tone of the debate and action, at that time, however, remained modest, especially compared to that in many other European countries (see, e.g., Bauer & Gaskell 2002; Rusanen, et al. 2001; Levidow 1999a; Durant, et al. 1998).
- 42 This suggestion can be called more generally the "genomically informed but non-transgenic" alternative (see Wynne 2005).
- 43 This may sound premature. On the other hand, in Sweden, for example, there has been an innovation company, SweTree Technologies, operating in the field of forest biotechnology since 1999, see <<http://www.swetreetechnologies.se>>. New regulatory institutes or agencies, more generally, can provide means to overcome some of the ethical and social dilemmas of modern biotechnology. For a recent proposition, see Fukuyama & Furger 2006.
- 44 One could argue that "participatory processes per se make procedures more fair and socially acceptable, regardless of any practical influence" (a counter-argument raised by one of the pre-examiners of this dissertation). The problem with that argument, however, is that it treats the "participatory process" as a black box that automatically transforms procedures into being more democratic. If the box is opened, however, it contains a great variety of tools and practices, which can be used for different purposes, by various actors, with different rates of success. It would be unrealistic to assume that all these processes are conducive to more democratic processes (e.g., see the next note on "performance participation"). In the Finnish case discussed here, one of the main problems was a limited, or, at best, ambiguous connectivity between the participatory and the regulatory process.
- 45 Kothari (2002, p. 149) writes of a similar phenomenon, which he calls "performance participation." He describes it as follows: "The tools provided can limit the performance so that the performers are unable to convey what they want to; the stage has been set by others and the form of the performance similarly guided by them. The resulting communication or dialogue is then fraught with confusion and ambiguity."
- 46 This can be done by ensuring that the newly-introduced actors can participate effectively. This often calls for the mobilization of new kinds of resources, including an access to scientific evidence, money for the compensation of the efforts of the participants, and an explicit delivery of responsibilities in the participatory policy processes, and so on.

- 47 Guidelines on Scientific Analysis in Policy Making, Office of Science and Technology, 2005 <<http://www.dti.gov.uk/files/file9767.pdf>>.
- 48 Science and Innovation Investment Framework, 2004-2014, HM Treasury, 2004 <http://www.hm-treasury.gov.uk/spending_review/spend_sro4/associated_documents/spending_sro4_science.cfm>.
- 49 See, <<http://www.sciencewise.org.uk/>>.
- 50 An analogous problem that we discuss in *Paper IV* is that an intense and far-reaching transformation of research education in the direction of “Mode 2” puts a discipline’s identity under strain.
- 51 The High Level Expert Group appointed by the European Commission, for example, defines foresight as, “(a) systematic, participatory, future intelligence gathering . . .” (EC 2002b).
- 52 In some cases, however, foresight has a more direct role in public policy. The Czech national foresight exercise (2001-2004), for example, was directly applied in the ranking of the priority research areas defined in the national research programme (see, also for other examples, Klüver et al, 2006).
- 53 I hope that by discussing the limits of the expansion of expertise I have not played “devil’s advocate,” since it is nevertheless a policy strategy that I find in most cases well justified.
- 54 There are two problematic ways in which policy agencies can react to the “alarm effect.” One approach defends the domain of activities of an agency by relying on its narrowest formal and legal role, with the resulting risk for its credibility and efficiency (see, e.g., the case of the BGT, in *Paper II*). Another approach adopts more effective means for the advancement of hierarchically defined goals, with a subsequent risk of inflaming social polarities.
- 55 As my own contribution to the evaluation of participation in technology assessment, in the Finnish context of S&T policy, I have proposed a framework that builds on the premises of futures studies (Rask 2007).
- 56 See, e.g., <<http://www.wikipuolue.fi/>>.
- 57 Black, *et al.* 2005 use the notion of “Pavlovian regulation” to describe how governments and administrations are conditioned by the experience of negative mass-media attention to create low-intelligence regulatory innovation in a very short space of time (in a manner similar to the way Pavlov’s dogs were conditioned to salivate at the sound of a bell). The strength of such regulation is that it is economic; the weakness is that it can be based on an inadequate problem- and need-analysis.
- 58 The project referred to was organised by Tekes, together with eight national-level R&D agencies. The project applies an internet-based tool for the collection, structuring and evaluation of the weak signals (see, <<http://www.tekes.fi/TilastotJaVaikutukset/ennakointi.html>>).
- 59 I am personally being involved in two of this kind of projects, the one called “World Wide Views on Global Warming,” in which citizens all over the world are consulted by a “citizen summit” method, on their positions on the issues and questions central to the negotiations at the United Nations Climate Change Conference (COP15) in Copenhagen 2009 (see, <http://www.worldviews.net/>). The other project is an EU-funded project called “Citizen Visions on Science, Technology and Innovation,” in which a new long-range participatory method for scanning emerging issues for European S&T will be developed. The point is that this kind of international co-operation is crucial for the introduction of the new approach, e.g., in the Finnish “mountain massif” type of S&T policy arena.

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Appendix 1

Summary of the research questions, key literatures and main findings of the papers in this dissertation

Paper I analyses the introduction and development of citizens' participation in Finnish biotechnology policy. The research frame is problem-centred and analogous to that often used in the study of the social construction of technological artefacts (Pinch & Bijker 1999). The focus is on the competing and contradictory conceptions concerning the applicability of citizens' participation in policy-making, a phenomenon that the paper calls the "problem of citizens' participation." *Paper I* has a theoretical background in the sociology of public understanding of science (see, e.g., Michael 2001; Miller 2001; Dierkes & Grote 2000; Locke 1999; Miettinen & Väliverronen 1999; Michael 1998; Sjøberg & Kallerud 1997; Irwin & Wynne 1996; Irwin 1995; Wynne 1995). Drawing from that literature and its ideas about the state, S&T and citizenship, the paper distinguishes between three paradigms of participation in policy-making: the enlightenment, the economic and the critical paradigms.

Paper I combines paradigm-based sociological reflection with the evaluation of policy practices. This takes place through an operational evaluation framework that is applied to the analysis and comparison of participatory activities engaged in by Finnish biotechnology policy agencies. *Paper I* concludes that the enlightenment and economic paradigms are the dominant frames, while the critical paradigm receives only marginal support from the civil servants interviewed. Through the analysis of the organising of a "Hanasaari Conference," in the year 2002, in which the public authorities aimed at a new opening for a structured public discussion on biotechnology, but where the outcome became more like public education of science, *Paper I* claims that new policy practices cannot be effectively developed if the practices introduced are incompatible with the existing policy style and thinking pattern, as is currently the case.

Paper II is a case study of Finnish forest biotechnology. It explores the dynamics of a risk process, and its implications for policy-making. The empirical analysis is based on the application of the social arena theory and method (Jaeger, et al. 2001; Renn 1992).

Paper II also has the objective of developing a new approach for risk "pre-assessment" (see, Renn, 2005). Pre-assessment is defined as the first step in the risk handling chain that helps estimate appropriate risk governance strategies, such as the need for public participation, options for stakeholder involvement and the demand for new kinds of organizational capac-

ities—questions crucially related to the expansion of expertise. The paper argues that despite many insights into pre-assessment within the field of risk studies (e.g., Böhm, et al. 2001; Flynn, et al. 2001; Jaeger, et al. 2001; Lash, et al. 2000; Lupton 1999; Bauer 1997; Krinsky & Golding 1992), it suffers from a lack of robust methodological tools and approaches. The paper elaborates the new approach based on the social arena method and the identification of “closure mechanisms” (Pinch & Bijker 1999; Misa 1997).

Particular to the Finnish forest biotechnology arena is that the number of driving forces is small, forest industries are committed to a policy that is negative to forest biotechnology R&D, and a small environmental NGO has effectively “filled the vacuum” of public debate and criticism. *Paper II* explains the difficulty of defining an acceptable agenda for forest biotechnology R&D through a process of polarization in which the key actors have increasingly invested in opposite value commitments and social prestige. *Paper II* identifies options for policy interventions, for example, in better distinguishing between the different lines of R&D, in the increasing of the number of the driving forces, and in the organizing of risk exercises such as risk scenario workshops among interdisciplinary expert teams. The study also indicates that a risk process is a test case, for public authorities, of the transparency of information and of the ability to maintain open and proactive policy-making.

Paper III is a study of the dynamics and scope of participation in European Foresight. “Foresight” refers to the policy-oriented “hybrid forums” in the S&T-related area, based on the interaction between industrial, academic, governmental and social actors (see, e.g., Barré 2001; Brown, et al. 2001; Georghiou 1996; Martin 1996).

The main participants in European foresight exercises, according to *Paper III*, are civil servants, high-level researchers and industrial actors. By analysing the experiences of foresight coordinators in the introduction of a higher “requisite variety” (i.e., an increase in the number and heterogeneity of actors or knowledge perspectives) the study finds support for the existence of two kinds of trade-offs between increasing requisite variety and productive convergence (Rip, et al. 2004; Rip 2003; Callon, et al. 2001; Rip, et al. 2000). One is called the “Involvement-Instrumentality” trade-off, with reference to Renn’s (2006) notion that an early involvement of the public in deliberative processes may compromise the objective of efficient and effective policy implementation. The other is called the “Creativity-Stakeholding” trade-off, with reference to the hypothesis of Georghiou and Keenan (2005), that consensus and stakeholding can be a trade-off between creativity and insight. The paper collects lessons on how to counterbalance the mutually exclusive inclinations. Examples of such measures, developed in detail in the paper, include: an access to influence, definition of the communities of interests, decision-oriented and multi-layered foresight meth-

odologies, mediation, efficient task definition and management, the nomination through personal qualifications, the evaluation of participation aspects of foresight, the building of implementation functions in foresight, the selection of “champions” and a high level of publicity.

Paper IV discusses the “Mode 2 effect,” i.e., the implications for research education of the transition from a Mode 1 to a Mode 2 context of knowledge production. The paper reconstructs the hypothesis of Gibbons, et al., (2000) on the transition from the “traditional” discipline-oriented Mode 1, to Mode 2, where knowledge production is institutionally distributed, produced in a context of application, problem-driven and transdisciplinary (the “Mode 2 hypothesis”). *Paper IV* reviews the debate on the Mode 2 hypothesis (see, e.g., Neumann 2002; Grey 2001; Hatchuel 2001; Huff & Huff 2001; Muller & Subutzky 2001; Nieminen & Kaukonen 2001; Weingart 1997), and concludes that there is ample evidence for many of the claims of Gibbons, et al., (2000). In order to analyze the challenges for research education ensuing from the assumed shift, the paper proposes a distinction between Mode 1 and Mode 2 Departments.

Building on the analysis of the experiences of research students and senior researchers at a transitional university laboratory, *Paper IV* innovates means of developing research education in “Mode 1 departments in transition.” *Paper IV* recommends an expanded set of activities—writing applications, external and internal lecturing, teaching, organising courses and conferences, editing and reviewing books, working in multidisciplinary teams, writing doctoral dissertations as article compilations, popularising or debating research in the popular press, carrying out duties in academic societies, and so on—that could be incorporated in research education and formally credited to the research students. *Paper IV* argues that a trade-off between Mode 1 and Mode 2 types of skills and curricula is needed in research education.

