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Preface

This working group report has been a mixture of privilege and pain: privilege to work with such a committed, engaged and high-quality group of colleagues from diverse arenas, not all of whom I knew beforehand,. I want to thank them all for their collegial commitment, well beyond their formal contractual obligations. However I reserve my most especial thanks for our rapporteur, Ulrike Felt, who has not only borne her full share of the writing and rewriting of several drafts, starting in summer 2006, but has also managed always to compensate for my rather indulgent academic chairing of our group's intense, mostly constructive but often difficult meetings, when I should have given pragmatism more influence. She always pulled us back on track, from the beginning right to the very end, and I am forever grateful to her for that.

We convened for the first time in July 2005, and altogether met five times for about two days each at roughly four-monthly intervals. Initially we were assisted by Nicole Dewandre, who encouraged us very much to address the issue in a rather broad manner. She was replaced in September 2006 by Rene von Schomberg. On behalf of the group I thank both for helping us at the different stages of this work. Another Commission staff-member, Silvio Funtowicz, took part as an academically recognized expert in the field of our report, and we are also grateful to him not only for his own research and policy insights, but for sharing with us his long-standing experience of Commission preoccupations. I would also like to thank Michael Rogers giving us his response to an earlier draft in the light of his experiences as a senior European policy maker. None of these colleagues should be held responsible for any of the report's contents even if their advice was often influential.

Our working process involved detailed debate over the nature of the problems in this domain, then production of working papers on topics identified. A further round of discussion and writing produced 'building blocks' which were almost provisional outlines of chapters. Summer 2006 saw a first full draft produced by Ulrike Felt and me, using these materials. Close to the production deadline, smaller 'specialist' informal sub-groups who had already produced topic working papers took on the task of redrafting specific chapters, sometimes radically, with each chapter going through at least three revisions. In this process there was a lot of interaction across the whole working group, during which we also agreed to restructure the overall draft in significant ways. Thus the final report is a group product to which everyone involved is able to sign up except Isabelle Stengers. I would nevertheless like to thank her for her contributions. Of course, in such a complex, highly-pressured, and unevenly collective enterprise this does not mean that everyone agrees with or is responsible for every word or argumentative form.

Never before having presided over the collective production of what is a quite original and intellectually (not to mention politically) challenging document, but in a charged and multifarious policy context, and against a fixed deadline, I have learnt a lot. I deeply hope it was worth it.

We were all convinced of the importance of the issues we were asked to address, and we spent many animated hours confronting each-other as to what we believe these issues to be. The pragmatic requirement to address policy audiences with what are complex and not always convergent ideas, itself leaves a delicate judgment as to how strongly to make our thoughts 'digestible' and 'accessible' to our anyway differentiated and not clearly-defined audiences.

This also resonates with another strategic question about whether we look for immediate or longer-term impact. Although our group differed on these strategic questions, my own personal view is that if the sheer complexity of the issues and perspectives we introduce means that they are indirect, difficult and slow to gain any influence, better this than to enjoy immediate recognition and influence, but in ways which may risk obscuring some of the key difficulties which exist. I therefore want to apologize, but only up to a point, for the sometimes undoubtedly gratuitous inaccessibility of our writing. Much more will be difficult for some to digest only because it reflects unfamiliar ways of seeing what are decidedly difficult issues.

Finally, the contents of this report are the sole responsibility of the working group, whose views do not necessarily reflect those of the European Commission nor of any organisation with which members of the working group are affiliated.

Brian Wynne

January 2007

Table of contents

Executive Summary

Introduction

This report is the product of an expert working group acting under mandate from the European Commission Directorate General for Research (DG RTD), on the topic of European science and governance. We interpreted our mandate to have three main concerns:

i. How to respond to the widely-recognised problem of European public unease with science, especially in relation to new science-based technologies;

ii. How to further the stated EU commitment to improve the involvement of diverse elements of democratic civil society in European science and governance;

iii. How at the same time to address urgent European policy challenges that are often taken as strongly scientific in nature – including climate change, sustainability, environment and development.

Inevitably we have dealt with these policy concerns unevenly, and each deserves more extensive treatment, perhaps especially where we have suggested usually unremarked intersections between them. The overall logic of the report is outlined below.

The working group was composed of scholars from the academic field of science and technology studies (STS) and related areas of philosophy, sociology, policy analysis and law, as well as participants from public interest and labour organisations. We were asked to provide insights which might improve the treatment of these governance challenges, both in Europe and more broadly, as well as to make specific practical recommendations where appropriate.

The ‘Problem’: Public Unease with Science?

Perhaps the most widely recognised indicator of public unease concerns reactions to issues at the intersection of ‘science’ (including science-based technologies) and ‘risk’. The public is thought to fear science because scientific innovations entail risk. Both science and risk, however, are ambiguous objects. It is frequently assumed in policy circles that the meanings of both for citizens must be the same as for experts, but that assumption is, in our view, itself a key element in generating ‘public unease’. The widespread sense of unease – sometimes expressed as ‘mistrust of’ or ‘alienation from’ science – must be seen in broader perspective. We conclude indeed that there is no general, indiscriminate public disaffection with nor fear of ‘science’. Instead, there is *selective* disaffection in particular fields of science, amidst wider areas of acceptance – even enthusiasm.

In seeking to understand these complex processes, we recognise that institutional practices in science and technology are tacitly shaped and framed by deeper social values and interests. These include:

- changing expectations concerning science and governance as Europe moves from a single economic market to a more political union;
- important political-economic and other changes taking place in relation to science over the last two decades – moving from science as 'Independent Republic' to science as servant of innovation and 'the knowledge-economy';
- impacts of the increasing commercialisation of science in particular areas affecting public trust, credibility and senses of 'unease';
- shifting, ambiguous and often unexamined ways in which science and expert judgment feed into governance, innovation, and policy.

In order to fulfil our mandate properly, it was necessary to engage with these institutional and social dimensions of European science and governance. This called for two levels of analysis and, eventually, conclusions: (1) to pose a series of quite general and far-reaching questions about the deeply ingrained assumptions and meanings that have come to shape the proliferating field of science and governance; and (2) to review issues in specific policy domains, such as risk and precaution, ethics, and public participation. We believe that the resulting discussion addresses fundamental aspects of social experience that lie at the centre of public unease with science in Europe, and which policy making relating to science, innovation, and technology cannot ignore.

From Risk-Governance to Innovation-Governance

European policy encompasses two principal roles for science: informing innovation-oriented research; and protection-oriented analysis. This duality reflects the familiar distinction between 'governance of science' (R&D policy, increasingly defined to be for innovation) and 'science for governance' (e.g., risk and regulation). STS research has found, however, that this distinction is no longer tenable in simple terms: what are typically defined as public concerns over 'risk', for example, are also animated by public concerns over innovation.

In Chapter 2, therefore, we take innovation as the starting point for our review. This emphasis parallels high-level policy interest under the EU's 2000 Lisbon Agenda, which includes the commitment to use scientific research to build the most competitive global knowledge-economy by 2010. As science-based innovations are generated at an ever-greater pace, so areas of conflict and controversy attract anxious attention in policy making. On this stage the EU public has become an especially prominent actor, with what are thought to be innate and indiscriminate aversions to innovation, science and technology. Sidelined in this script, however, are manifold ways in everyday European life where science and technology are implicitly trusted, taken-for-granted, depended-on, and enthusiastically embraced by European publics . Ignored, too, are the active, and intensifying roles of European non-governmental actors in producing S&T, both for enhanced productivity and welfare and for use in governance. An intrinsically 'mistrusting', 'risk-averse' European public for science is a serious mischaracterization.

An important conclusion of this report highlighted in Chapter 2, but reiterated throughout, is that steps should be taken away from the present narrow and exclusive understanding of innovation towards recognising more socially distributed, autonomous and diverse collective forms of enterprise. This promotion of diverse civic 'knowledge-abilities' would perhaps be the most effective single commitment in helping address legitimate public concerns about Europe as a democratic knowledge-society, able to hold its own distinctive place in a properly-grounded global knowledge-economy.

In Chapter 3, our analysis shows how public misgivings over the purposes and interests behind innovations are often misunderstood as if they are concerns about safety as defined by regulatory science and expertise. Thus, public hesitation over the directions or contexts for innovation are typically interpreted as misperceptions of probabilities of harm that experts have concluded are acceptably small. Yet public concerns tend to focus not only on the narrow prediction of probabilities, but also on neglected or unknown (thus unpredicted) effects on society, and the institutional incapacity to deal with such effects. Indeed, the tendency to collapse these normative dimensions into technical assessments of 'risk perception', and to dismiss public concerns as irrational, is itself a major source of concern. Only when these problems are recognised does it become possible to address more effectively the sources of public concerns, namely inadequacies in the governance of innovation itself.

Following this logic, a promising response lies in treating risk and uncertainty with greater scientific rigour and credibility. Consequently, in Chapter 3, we also outline a series of concrete measures by means of which aspects of uncertainty and ambiguity might be dealt with more systematically.

Learning Normative Deliberation

Both Chapter 3 (on risk) and Chapter 4 (on ethics) describe how European policy making on science and technology often inadvertently suppresses full-fledged expression of normative questions, political values and democratic aspirations. In both areas, this occurs most centrally through the assumption that expert discovery can reveal objective truths, which then determine proper policy, and that democratic input is valid only after factual truths have been revealed. This institutional focus on post-innovation, 'downstream' or output questions as the only ones of interest to publics marginalises legitimate democratic concerns about the inputs (such as imagined social purposes, needs, benefits and priorities) that drive innovation research in the first place. An important change in the governance of innovation would be strategic development of improved European institutional capacity to deliberate and resolve normative questions concerning the prior shaping of science and innovation: over their directions as well as their scale and speed. Put simply, we recommend the introduction of structured ways of appraising the projected benefits of innovation. This means, as discussed in Chapters 4 and 5, a shift from expert-dominated to more open deliberative science-informed institutions on ethics, risk and innovation.

Science, Citizens and Sustainability: Promoting Civic Engagement

Intensified EU commitments in areas of environmental sustainability, such as climate change, food safety and the precautionary principle, bring with them the understandable concern that publics should be able to respond to compelling scientific insights and urgent associated policy prescriptions. Radical reductions in greenhouse gas emissions, for instance, will not be effected by centralised state policies or new technologies alone, but will also require a multitide of diverse and distributed public actions.

Our documentation of the nature of public unease over science, holds important implications for policy making in this area. By directly addressing the sources of public apathy and alienation, we also point toward ways of reviving the sense of public agency that is required to overcome present inertia. Here a major conclusion of our report is that responsibility to deliver public authority is too-heavily invested in science by politics, as if science could ever reveal the unambiguous 'natural' limits of 'safe' societal behaviours for complex processes in which we are now aware of our cumulative interventions.

Master-Narratives and Imaginaries of Science and Society

Our analysis raises recurrent questions about the imagined futures or 'imaginaries' shaping, and shaped by, European science and technology. As this report shows, all of the key reference points in science and governance are variously the objects of collective imagination: social priorities, purposes and outcomes in steering research (Chapter 2); misgivings concerning the directions, governance, and consequences of innovation (Chapter 3); ethical issues in research and application (Chapter 4); publics and their concerns and capacities (Chapter 5); and expectations concerning social learning and adaptation to innovation (Chapter 6).

We therefore devote Chapter 7 to imaginaries relating to science and governance and the master-narratives of policy that reflect and sustain these projected collective futures. We conclude that master-narratives are the cultural vehicles through which ideas of progress are linked to S&T in particular ways. These are not 'merely' stories or fictions. They are an important part of the cultural and institutional fabric, of taken-for-granted aspects of social order. We emphasise the interwoven, mutually-ordering character of such master-narratives with the materialities of social and institutional relations and of technosocial commitments and trajectories. We observe that, in the science and governance domain, these narratives and the imaginaries they support urgently need to be subjected to more critical, open reflection, especially in the light of the global economic, scientific and political changes besetting early 21st century Europe.

Conclusions

Our conclusions reflect the two-tiered nature of our analysis. In Chapter 8, we first outline a number of important conceptual observations, which we hope will help foster sustained debate and deliberation on matters of science and governance. We then offer a series of more practical recommendations, not only for policy but more broadly for relations between science and society.

In the end, there are no simple answers to the pressing and apparently contradictory demands placed on European science and governance. Global economic imperatives to pursue science-led innovation as quickly and efficiently as possible conflict with the inevitable frictions and demands of democratic governance. In response, we suggest that the main guide lies in trusting Europe's rich democratic and scientific traditions. It is in the realisation of diversity and multiplicity, and in the robust and distributed character of publics, their capacities and imaginations, that we may justly conceive robust and sustainable pathways of technoscientific development.

In the perceived pressing need to encourage innovation, democratic governance has become dislocated in ways that cannot be remedied by technical methods and tools alone. Policy making should not stop at simple or mechanical solutions; it should address the complex issues of science and governance honestly, thoroughly, patiently and with humility. Only then will European policy take 'knowledge society' seriously – and fulfill its abundant promise.

Chapter 1: Introduction

Recent years have seen a strong wave of concern amongst policy, scientific and industrial elites in Europe about what has been called widespread public uneasiness with science. The unease as well as the concerns it provokes have proven to be resistant to remedial efforts. Indeed fear is expressed that this may be just the beginnings of a more paralysing reaction against techno-scientific innovations essential for Europe's survival in the face of accelerating global competition. The place of science, or better, technoscience, as a key agent of governance and government, able both to enlighten, and to generate public legitimacy for democratic policy commitments, is seen as seriously weakened by this public unease. So too is science's crucial perceived role as the motor of European economic welfare. Much effort has therefore been invested in the aim of 'restoring public trust in science', so far with at best modest success.

These doubts and uncertainties resonate with the risk society narrative that spotlights the adverse consequences of technology (Beck 1992). Such doubts have swept across the developed world during the 1990s, after decades of profound collective emotional investment in science, as expected infallible producer of endless technical fixes to societal problems produced by human fallibility. This ambivalent mood has provoked explicit fears from EU political leaders, scientists and industrialists about being left behind by such countries as India and China, as well as the US, in the global 'race' for economic survival.

Scholarly analysis of science and technology as social institutions has joined with the thoughtful insight and public reflection of many scientists themselves to put these concerns into perspective. Not only analysis and reflection, but the societal experience of some of the problems linked to scientific interventions during the latter half of the 20th century, along with the emergence of new risks whose complexity escapes calculation and control, have contributed to the more ambivalent cultural mood towards science on entering the new millennium. Especially as new nations emerge in the scientific area with a historical experience different from ours, European science, policy and publics are all still struggling to come to terms with the ramifications of that deep positive aspirational identification with science in the post-war period. The EU's 2005 Science and Society Action Portfolio reflects this shift:

> *"Following the Enlightenment, progress in science and technology was considered to be a goal in its own right. But today, science is no longer viewed unquestioningly as the harbinger of better times. Society's view of scientific inquiry has become more sophisticated and nuanced … The gap between the scientific community and society at large has widened … People are not willing just to sit by and let the scientific community and the politicians set the agenda". (EC 2005b)*

Europe has been one of the most active and committed global regions in responding to these new challenges. Member States and the EC have for a decade or more supported various initiatives in structured public participation in issues with strong scientific dimensions. 'Public engagement with science' has become an almost obligatory passage point for science policy in some countries, even if its substantive forms and meanings still need development.

Coinciding with those currents of public concern and controversy to which participatory moves have been a response, another defining European commitment was struck in 2000, with the agreement of the Lisbon Agenda by the EU Council of Ministers. This committed Member States to the ambitious goal of becoming "the world's leading knowledge-based economy" by 2010. It was officially reaffirmed in 2004, and has been a continual preoccupation of EC and member-state policy actors.

The term, "knowledge-based economy" prioritises the instrumental use of scientific knowledge for competitive economic advantage. Science is seen as both the key factor of new production and as traded commodity-product in itself. UK Prime Minister Tony Blair explained in November 2006 that a knowledge-economy is "an economy where we do not compete on wages – how can we when China's wage costs are 5 per cent of ours? – but on intelligence, on innovation, on creativity".

This instrumental vision of science's meaning and rationale goes back to its origins in 17th century Europe. Yet a profound ambiguity in the Lisbon Agenda is that, while it marked the growing pressures to translate fresh research insights rapidly into globally-marketable commodities, and to reorganise science accordingly, this has been accompanied by the explicit EU policy commitment to public engagement[1] and respect for public doubts or scepticism. It remains to be explained how these two apparently contradictory commitments, in the same important policy domain, can be reconciled. This report attempts to address these challenges and contradictions, and provide resources for rethinking them. This report follows a long line of previous EC and other work on science and governance. A distinctive feature of our report is that we have drawn heavily upon the scholarly field of *Science and Technology Studies* (STS). To bring the concepts and insights from an academic field into close encounter with policy concerns and pressures is an ambitious and difficult task. However we believe that this interaction offers fresh insight into issues for science and governance which have to be tackled.

We decided to step back and attempt to clarify the complex issues flagged in our mandate beyond the range of immediate instrumental analysis. That there may not be immediate answers does not mean that policy should be denying the questions. Indeed, this points to a certain cultural shift we would like to promote: to allow broader exploratory and experimental approaches to gain ascendancy over more dogmatic, closure-oriented ones. Our conclusion that questions have to be kept in mind as an on-going element of policy itself, while we nevertheless have to act, suggests that science and governance institutions need to learn to make a shift in policy and practices towards more inclusive, reflective and open forms of learning.

1.1. The Mandate for this Report

Our mandate from the EC's Directorate-General for Research asked us "to analyse the growing uneasiness which affects the relations between science and society and to explore ways to develop constructive interactions between techno-scientific expertise and public concerns with a view to more effective European governance". To "assess the current challenges and discuss future strategy" was seen as timely, particularly with preparation of the 7th Research Framework Programme in mind. It was expected that our analysis should be based "on research done by science and society academics, and experience gathered by policy-makers and representatives of civil society".

Several important issues arise from this brief.

The first is that we follow normal academic and policy practice in encompassing both governance of science and science for governance (or 'policy') under the term 'science and governance'. We do not prescribe any singular prior definition of governance (nor of 'science') except to note that this includes but extends beyond formal 'policy' performed by 'policy institutions', to encompass agents, collectives and networks of civil

1. E.g., in the European Life Sciences (2001) and Nanosciences (2004) programmes, in its Science and Society Action Plan, EC (2005b), and all related works in the EU science and governance field.

society such as labour organizations, patients' groups, and environmental NGOs. We note how relevant knowledge-agents extend into diverse and distributed social sectors well beyond the recognized institutional expert and stakeholder bodies established as the formal policy infrastructure. For EU policy this translates into the following challenges:

- first, to acknowledge the significance of socially dispersed knowledge-actors and knowledge-capacities involved;
- second, to develop more fully the practical means of giving agency to civil society capacities in EU innovation, policy and governance processes[2] .

This does not mean that inclusiveness always has to be practised at a central level, but could – for composing a resilient European Union – be more decentralized, with appropriately distributed powers and resources. Thus as the report explains at appropriate points across the wide spectrum we have addressed, institutional change has to be within our remit, and not only new methods or procedures.

A second point, as the mandate emphasizes, is the overriding concern in current EU policy thinking about the uneasiness in relations between science and society at large. This has been most dramatically manifested in the still unresolved EU GM crops and foods controversy, which began in the mid-1990s. Based on two decades of scholarly research, our analysis of these tensions leads us to query the causes of controversy typically identified by powerful European policy actors – scientific bodies and advisory scientists, industry, and policy-makers. We suggest that institutional behaviour and related expert understandings are also part of the problem. To improve the state of 'public unease with science', these also have to be questioned, and reconsidered.

The anxieties and aspirations which fed the imagination of a European Community since the second world war and eventually led to the European Union have subterraneous linkages to the science and governance issues which we have to address today. A key linkage, not unique to but in play in Europe, is the way we have turned to science as a means of keeping potential social conflict at bay, by projections of collective benefit into the future and promising more for all – if only a certain order is maintained.

Throughout the report we therefore attempt to bear in mind the concerns about social order which in key respects define Europe and the EU, and in which science is centrally implicated. These unstated but powerful imaginations and insecurities are expressed through public policy discourse-practices. These are not only representations, but also play an inadvertently performative role, shaping behaviours and relations, and frames of reasoning. As explained in Chapter 7, what we refer to as master-narratives have become in effect constitutional, and taken-for-granted. Yet with deeply and rapidly changing conditions for Europe in global society, and for science and its social relations, these established frames may no longer be functional. It is therefore necessary to ask whether the established sorts of narrative shaping governance and science, and the assumptions, values and aspirations they express, remain adequate to these changing conditions. We are convinced that they are not, and suggest ways in which we might attempt the longer-term aim of changing these, beyond the remit of current 'policy' alone.

1.2. Taking European Knowledge Society Seriously

Acknowledging these complexities led us to approach the issue of science and governance from five different perspectives, starting with the central issue of innovation, moving to risk and normative discourses, then addressing the role of publics and rounding off with modes of learning and collective experimentation.

2. When we refer to 'the EU' as a governance entity in this report, we do not exclude decentralised local, regional, member-state and cross-cutting networks and institutions, unless we specifically refer to a centralised EU process or output.

Drawing on these analyses we find commonly shared master-narratives about technoscience and society which frame ways of governing. We explore these in the seventh chapter and then offer our conclusions and recommendations.

Innovation: Questions, of Direction and Distribution

A key issue for knowledge is that of innovation. The European Union has expressly tied its vision of scientific research to that of economic competitiveness through continual technological innovation. Independent of the Lisbon-agenda targets by 2010 or later, the dominant question is how to achieve as much innovation as possible, as fast as possible. This vision is linked to a diagnosis of an innovation-averse European public, which is said to encourage potential global investment in knowledge to desert Europe for India, China and Korea, with their supposedly less-averse publics.

Innovation is indeed a vital policy issue for Europe. However, it should not just be about the more and the faster the better. Directions of innovation also matter. Normative questions about directions of innovation should be on today's democratic and innovation policy agendas. In Chapter 2, we show that innovation dynamics do not follow the so-called linear model underpinning avowed European Union policy views. Innovation is distributed, many actors are involved, and there is no simple route to success. But there are patterns, and we identify two main ones: the producer-led pattern (or regime) of pushing techno-scientific promises, and competing on that basis; and the user-led pattern visible in open-source software development and innovation. In other words, innovation is being reinvented already, and policy makers can do better by systematically taking this into account.

Risk Science as Silently Normative: broadening the agenda

The 'science and society' domain is dominated by debates on risk. We conclude in Chapter 3 that what is now called risk-governance should be renamed innovation-governance, since the concerns which citizens express can be seen to be about innovation and its social purposes and priorities. Of course this rightly includes risk, but it is a mistake to reduce a more multivalent set of concerns, including about institutional behaviour in science and policy, to risk alone. Neither are these further concerns adequately addressed by the more recent and growing domain of ethics (Chapter 4) at least as currently conducted and envisaged. In Chapter 3 on risk and uncertainties as governance issues, we argue that the emphasis put on risk in science and governance, and the ways in which more serious forms of uncertainty are defined only as *controllable* uncertainties, both obscure the more 'upstream' normative issues of R&D and innovation-governance, and neglect corresponding public concerns. In turn this focus on risk as the essential meaning of public issues, combined with the under-appreciation of the diverse knowledge-abilities distributed amongst the rich variety of concerned social groups noted in Chapter 2, allows over-centralised models of innovation to dominate.

One might think that questions of normative directions would have been covered already by the often-criticised excess of regulatory appraisal of innovation. However regulatory processes for S&T are almost exclusively limited to the instrumental question – is it safe? Thus risk assessment alone defines the boundaries of societal selection of innovation, with ethics added more recently. In Chapters 3 and 4 respectively, we analyse these expert modes of resolution of risk and ethical questions, as they stand for the wider normative democratic questions and concerns which should shape and direct innovation.

Thus we note in Chapter 3 how risk assessment has been increasingly institutionalized as regulatory tool since the 1970s, but with absolutely no complementary questions about social benefits. We thus examine the ramifying problems this brings, including widespread – and legitimate – public unease, and thus propose a deliberate EU and member-states policy commitment to broadening the frameworks of regulatory appraisal of innovation to recognize and address broader public concerns about the trajectories of innovation.

We show that 'risk science' is already inevitably imbued with unrecognised politically-weighted commitments, intended or not. Moreover, we also show how the shift of emphasis from risk to precaution is a result of taking the scientific risk knowledge seriously, not of rejecting it. An intellectually rigorous treatment of the various kinds of uncertainty in scientific risk knowledge leads inexorably to the exposure of foundational contingencies, and to open deliberative questions of human ends, purposes and priorities, which underwrite the precautionary approach.

Normative Politics of Europe as Ethical Expert Discovery?

The inclusion of ethics in EU regulatory processes in science and technology governance has been a laudable move in principle. However in Chapter 4 we place our analysis of such ethical decisions in the wider context of Europe's more general difficulty of accommodating full political deliberation of legislative proposals for building the Union, and the pressures, including pressures for speed from commercial interests, to translate questions of public value into expert questions. In EU practice, ethics – basically similar to risk – is defined as a matter of expert analytical derivation and discovery rather than of collective, principled, reasoned reflection. Thus ethics as a regulatory innovation has become at least in part a concealed normative process of imposing obligations on EU citizens to behave in prescribed ways towards science and technology. While one might gain the impression of a democratic normative deliberation on the ethics of different innovation trajectories, the political, techno-social and commercial interests, interactions and commitments behind these remain or have become opaque.

Strikingly, in the midst of the EU commitments to the Lisbon agenda and faster innovation on one hand, and to the greater engagement of citizens with science of all kinds on the other, the then-European Commissioner for Research, Philippe Busquin, acknowledged in 2004 that "part of forging a knowledge-based society is knowing ourselves – our aspirations, our needs and our concerns". (EC 2004) Busquin's aspiration, a reflexive one, resonates strongly with the conclusions we draw from examination of existing initiatives in the EU science and governance field. However European policy and innovation actors need to grasp this nettle seriously if we are to address the fundamental factors encouraging public unease with science, and generate a robust knowledge-society.

Practical Policy Concerns Involving Science and Citizens

A further part of our mandate stated that

> *"recent history shows that a growing uneasiness is affecting relations between science and civil society which impacts on the relations between science and industry and is echoed in policy-making. European societies manifest more and more difficulties to tackle the nature, the size and the complexity of societal dilemmas such as global warming, pollution, energy supply, food supply and safety, health threats and poverty."*

This implies that the recognized unease of EU publics towards science might be damaging not only Europe's innovation and economic ambitions, but also its ability to tackle complex and pressing issues such as health, climate or energy. One way of reading this logic is to say that if there is too much public mistrust, science's ability to help resolve such issues is compromised *ab initio*, because people will disbelieve the science, and hence also the policies which follow.

Yet there is no evidence of any general public mistrust of science. Thus there is no reason to think that public apathy over changing lifestyles to address such major problems as climate change, is a function of the same kind of public mistrust of science which has afflicted many – not by any means all - areas of innovation and technology.

In Chapter 5 we draw upon insights from STS about the less obvious reasons for public alienation from 'science'. We reflect on how models and practices of public participation and governance contain visions about relevant actors, their possibilities of participation as well as desired outcomes. To continue to try to generate broad civic commitment by simply intensifying the science does not seem to work, and a more constructive way out might be to admit that the 'scientific' object – sustainable development, 'safe limits' to human interference with climate, or 'risk', for example - is itself ambiguous, and in need of continual collective work to negotiate and at least temporarily stabilise its collective meaning. A corollary is to work from the potential of citizens to be in-principle capable, independently knowledgeable agents, with their own frames of meaning in constructing collective rationalities, knowledges and responsibilities. Then we might begin to develop the cultural and political conditions under which genuine widespread civic ownership of societal problems like sustainability, and climate change (amongst others), and real engagement with the salient science, might be achieved. This is not a simple point, but we believe it to have far-reaching positive implications, if it were to be taken up. Europe's traditions, including its scientific ones, provide perhaps the most promising global grounds for this collective learning process.

Learning: Relational, and Reflective

A knowledge-centred society has to give collective learning a central place. In Chapter 6 we focus on those dimensions of established modes of science, innovation and governance where ideas of learning may be most salient. Existing modes of learning and evidence-generation seem unduly channelled such that experimental, deliberate, reflective learning in the face of acknowledged complexity and contingency seems not to inform most practical societal forms of knowledge-generation and use, when it could.

In this chapter we focus on three distinct aspects of learning – instrumental, reflective, and relational. In the light of our analysis of the unrecognised importance of contingency, we develop the potential connections between these forms of learning, and collective experimentation. We suggest that these potentials have been neglected because of the deeply-entrenched habitual tendency in science and governance to imagine possible learning as instrumental only.

For science and governance, learning capacity is, and has to be collective and socially distributed. Policy may have underestimated the independent experimental learning capacities of ordinary (European) citizens, as a resource which can be combined with others to build a serious European knowledge-society. In order to develop these connections it would be essential for institutionalised science and policy to develop reflective and relational forms of learning, in ways which amplified and extended established instrumental learning modes.

Master-Narratives, Imaginaries and Culture in Science and Governance

There are no simple nor immediate answers to the difficult questions posed by our mandate; nor does our analysis result in simple prescriptions, even if there are steps forward, some of which we identify. But the shortfall of immediate answers gives no reason to deny the questions - and science should not be involved inadvertently in supporting this role of public denial. We suggest that European policy-leaders will only discredit and undermine science – and democracy – if they do not grasp the nettles of uncertainty and public scepticism, and acknowledge the very tensions and contradictions which we identify – including those less directly tractable, more cultural ones . These are innocently accumulated contradictions, and now damaging habits, for which we must take shared responsibility, without being forced to lay blame nor claim full control.

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We therefore deliberately combine direct prescriptions on the issues of our mandate with a longer-term, indirect and less immediate strategic perspective which can over time spawn productive new methods, policies, arrangements, and actions. Our approach also attempts to realize the insight that the human subjects whom we refer to as 'the public' of European democratic knowledge-society are not actual but potential, and always in-the-making. They exist in relation to a technoscientific culture which was not given, but historically made. It can also be re-made.

Taking the European Knowledge Society Seriously requires us to take seriously these deeper issues, even if they are not directly amenable to conventional processes of policy, planning, and management.

Chapter 2: Reinventing Innovation

2.1. The Challenges

Innovation is not limited to technological innovation. In fact, most so-called technological innovations are really socio-technical innovations, because organisational competencies, business-to-business linkages, and value chains and industry structures more broadly have to be renewed as well. This is widely recognized, but not always taken into account when innovation policy goals are reduced to politically manageable objectives like the Lisbon goal of 3% (of GDP) expenditure on R&D in Europe by the year 2010.

A similar reduction occurs in the linear (and science-push) model where science invents, industry applies and society conforms (to quote the motto of the 1933 Chicago World Exhibition). Such a sequence might occur occasionally. The development of atomic bombs and nuclear energy depended strongly on science, but even there the role of the military (and the historical occasion of the Second World War) should be factored into the equation. And then, society, eventually, did not conform.

The important point is that the linear model ¬– ‘science’ to ‘technology’ to ‘social progress’ ¬– is only one possible innovation model. Science, technology and innovation policies in the post-World War II era have been predicated on this linear model, and this is still visible when the goal of becoming a knowledge society is to be achieved by increasing expenditure on R&D. Actual patterns of innovation are more complex, however, with feedback loops, user-induced innovation, and societal developments rather than technological developments leading the way. (Caracostas & Muldur 1998; OECD 1992)

Two observations are in order at this point. One is how policy often has recourse to master narratives about innovation, e.g. as the motor of economic growth. To mobilise political support, such master narratives need not reflect what is happening “on the ground”. This was true for the Lisbon Agenda and many earlier government policies for innovation. Such political power need not, however, translate into actual implementation of the goals that were stipulated. The Aho Report (2006) has analyzed this for the Lisbon agenda. Here, we are not saying that there is no relation between innovation and economic growth, only that innovation is not automatically motor of such growth. It is indicative how this particular master narrative needs another narrative, that of competitors surging ahead if “we” do not invest in innovation, to bolster its force.

The other observation is that innovation patterns themselves, up to broad background regimes of innovation, are not static. Reinventing innovation is occurring already, and in various ways. One striking feature is the recent shift from the idea of centralized organization of innovation to explicit recognition of the importance of distributed and more diverse innovation, even if that means some loss of control for central actors. An example would be the present interest, with a number of big companies, in open innovation (explained below). Another example is the possibility of open source software developed further by user-communities.

The key message of this chapter is that some forms of distributed innovation must receive more attention. This is both a matter of democratic principle in its own right, but also a need for making Europe a vibrant knowledge society. To show this, we have to add more complexity to the picture, and to discuss regimes of innovation as these enable and constrain ways of innovating and are closely linked to *de facto* governance of innovation.

2.2. Regimes of Innovation

While every innovation has its own "journey" (Van de Ven et al. 1999), these journeys depend also on the nature of the techno-economic and institutional "landscape" in which they take place. One element of such a landscape are the intellectual property right rules and practices, which shape actions and assessments of the profitability of an envisaged innovation. These rules and practices can change, partly in response to new technological options as happened for biotechnology. In general, one can speak of a regime with its various infrastructures and institutions, "dispositions et dispositifs" as one can say in French. With the emphasis on institutions in the sociologists' and economists' sense of socialised rules, a regime can be seen as a configuration of rules, or a grammar. Rules of the grammar of a regime evolve slowly, reflecting what is happening in ongoing practices, just as the grammar of a living language community evolves.

Now that innovation is recognized as a challenge by itself, and has become institutionalized in various practices, one can speak of regimes of innovation. This is now common usage in the economics and sociology of innovation and technological change, even if there is some variation in actual definitions and terminology (Pavitt 1984, Nelson 1994, Dosi 1982, Rip & Kemp 1998, Malerba 2006).

A regime, here a regime of innovation, contains a model, or paradigm, i.e. a notion of how things must be done. The implications of models of innovation are not only in terms of economic impact or competitiveness, but also in terms of distribution of power and agency, collective learning, social relations, etc. Indeed, models of innovation are also models of society. Promotion of innovation is a powerful way to shape society. STS scholars have highlighted social choices incorporated in ongoing innovation choices or commitments (Winner 1986, Latour 1987, Bijker 1995). In other words, the politics of innovation are much broader than the question how much support will be given to which innovation actors.

In policy and political discourse, models of innovation are used to reduce complexity, for example when simple versions of the linear model are used to define policy measures. The linear model also defines roles of various actors including a division of labour, and implies a diagnosis of what is happening and should be improved. This is how universities, and academic institutions generally, in Europe are being exhorted to interact with industry, and to work towards valorisation of the knowledge they produce. If the model is too simple (as we have argued), the diagnosis and policy measures linked to it will not be productive – but will still shape society. This includes pushing universities towards activities that had better be done by other types of actor. This is not to say that universities should just continue their traditional roles; when we discuss two newly visible regimes of innovation in the next sections, it will be clear that there are challenges to be addressed. Our point here is about how models of innovation also shape universities. The shaping of society is further visible in the idea of the knowledge economy as articulated in the Lisbon Agenda, and underpinned by the linear model. This then leads to implicit or explicit assertions that "*Science is the solution, society the problem*". Society has to become more entrepreneurial, become more accepting of, or even keen on, new technology. The 21st century version of the Chicago World Exhibition: "society has to conform".

There are other specific representations of innovation processes which influence problem definitions and actions, even when they capture only part of the complexities of innovation. We mention three influential representations.

First, innovation is considered as codified and replicable information. Thus, provided that users have the capacity to pay for it, innovation may be diffused globally, without having to take local contexts into account. Diffusion processes are reinforced by increasing returns to adoption which may lead to lock-in situations (Arthur 1989). In the struggle for a "dominant design", such lock-in is actively sought by actors, if they offer them a privileged position.

Second, and continuing the idea of a competition where the "winner takes all", is the conviction that the only good position is to be the first (Frank & Cook 1995). Examples of such innovations are Microsoft's Windows Office, and Monsanto's RR GM soybean. Innovation becomes a collection of "premiers", and science and technology are supposed thus to promote the originating country to be most successful competitively. While the examples indicate that this innovation model occurs in practice, it is not, and should not be taken as, the only viable model. One important reason is that externalities (network externalities as well as unintended effects) are neglected.

Third, innovation is linked to entrepreneurship and to popular ideas (pressed by innovators themselves) about the heroism of innovators fighting against odds. The representation of innovation as produced by heroes with outstanding qualities (star scientists, world industry champions, etc.) and who fight to be the first, goes back to the early views of Schumpeter about entrepreneurs creating "new combinations", and to stories commonly told about the "lone innovator". To be sure, there is some truth to these stories. Our point is that there is far more to innovation than heroism.

The heroic "lone innovator" narrative should be adapted to include all the actors relevant to innovation, and to societally successful innovation. And the informational, simple-diffusion representation should be replaced by recognition of the transformations, recontextualisations and new alignments that occur when innovations emerge and are taken up in value-chains and in society more generally.

One alternative storyline, already visible in the later views of Schumpeter about hierarchically organized innovation as exemplified by the big industrial R&D labs since the late 19th century, is centralized innovation: innovation produced and/or orchestrated by a central (focal) agent. Many big public research institutes have been following the model of centralized innovation as well, and big mission-oriented R&D programmes like the US Apollo Program and the "war on cancer" have central orchestration as a characteristic feature.

Distributed Innovation

The centralized innovation narrative (while never adequate to understand everything that happens) is now undermined in practice and countered by alternatives, e.g. the notion of 'open innovation' and more generally, 'distributed innovation'. Distributed innovation is observed in situations where heterogeneous actors who hold complementary pieces of knowledge interact, form networks or creative communities; they cooperate in quite informal ways and co-construct the technology and its use.

The notion of open innovation, as promoted by Chesbrough (2003), has been taken up eagerly by firms like Dell, HP and Philips. It is seen to take into account the distributed nature of knowledge and to adapt to complex environments resulting from market and user differentiation and globalization. In "open innovation" models actors create hybrid organisations which mix public and private research platforms, market and research, etc. It requires adequate intellectual property right arrangements to be sustainable, and various arrangements based on differential access and exchange (rather than rights per se) are tried out. While not called 'open innovation', new interactions between pharmaceutical firms, public research institutions and patient organizations add up to similar new kinds of research collective.

The case of OSS (Open Source Software) – and more widely, development of open-access tools in information technologies – shows that the distributed model of innovation can be more user centred and that one of the motives of its promoters is to redistribute agency, knowledge and power. In other words, there is a normative model of society being performed as well. One of the key features is the invention of *collective property rights*, through the creation of General Public Licence (GPL or copyleft): the right to use it at no costs, the right to modify it, and the right to distribute modified or unmodified versions at no cost. Even when incorporated in commercial tools, software protected by a GPL is not proprietary. A useful discussion is given in NESTA 2006.

The overall movement towards distributed innovation models and practices, and the reluctant recognition of distributed innovation at the policy level, opens up to wider influences the earlier-described regime of centralized innovation with its reliance on versions of the linear model. There are other dynamics as well, which can be captured with the help of the notion of regime of innovation.

We have identified two specific ways to organise and promote innovation and technological change in contemporary societies, which we have labelled as the *regime of economics of technoscientific promises*, and the *regime of economics and socio-politics of collective experimentation*. These labels are our creations; they do synthesize recent studies and discussions in economics and sociology of innovation, science & technology studies, as well as evolving practices.

We will describe these two regimes as they occur, but also introduce some evaluation. Specifically, we will indicate the promise-push elements in the regime of economics of technoscientific promise, and how this (re-)introduces the linear model. And indicate our concern about how the emerging regime of collective experimentation is overshadowed by the economics of technoscientific promises. So there will be some asymmetry in the presentation in the two next sections. We can justify this because we think a vibrant European knowledge society must be built on collective experimentation. Technological promises can, and should be, incorporated, but they should help, not lead.

2.3. The Regime of Economics of Technoscientific Promises

Promising new technological options emerge again and again, and they need to be nurtured to develop their potential, rather than be subjected to short-term return-on-investment requirements beloved by venture capitalists. In other words, the economics of technoscientific promise (ETP) must include more than financial and short-term commercial considerations. Studies of earlier innovations show the proponents of the "new" have to fight the "old", and may not always win. On the other hand, the "new" is not, by definition, better than the "old". Technological promises have to be tested (dynamically), not just pushed as such. These last observations capture the essential ambiguity of the regime of "economics of technoscientific promises": promises are by their very nature uncertain, requiring support by believing in them *before* they exist; but they should not be accepted at face value either.

The specific way in which this basic ambiguity is addressed can now be seen as a regime of innovation. While dynamics of technoscientific promises are a general feature of technological change and innovation, ETP is particularly visible in the mode of governance of so called new and emerging technosciences: biotechnologies and genomics, nanotechnologies, neurosciences, ambient intelligence. We identify a number of distinguishing features:

1. The creation of a fiction in order to attract resources – financial, human, political, etc. –, viz. that the emerging technology (biotechnology in the 80s, nanotechnology now) "will solve human problems" (health, sustainability, etc.) through a wide range of applications. The credibility of this promethean conception of technoscience is linked to "naturalisation" of technological advance, which is seen as almost a self-fulfilling prophecy (if enough resources are provided and effort is made). An extreme version (where requirements are derived from the promise of a next generation of the technology) are developments subsumed under law-like patterns like Moore's Law, Gabor's Law, etc. The reference to a "law", even if it is actually man-made, suggests there is no means to escape from the future.

2. It draws on an uncertain future, and derives its force from the uncertainties. Upstream solutions are thus promised for downstream problems, without having to take the details and socio-political dynamics of the downstream problems into account.
3. The economics of technoscientific promise is associated with a diagnosis that we are in a world competition and that Europe will not be able to afford its social model if it is not in the race. Given the cumulative effects of technological development, there is a strong sense of urgency: those who are late won't have any place; there is only place for winners. There is no role for civil society other than as a collection of prospective customers. This view is not specifically European; as the USA National Science Foundation report on Converging Technologies (June 2002, Rocco & Bainbridge 2004) phrases it: "we must move forward if we are not to fall behind".
4. For scientists and technologists, the economics of technoscientific promise is associated with cycles of credit (and credibility) and requires intellectual property rights to be safeguarded at an early stage. This fosters new relationships between research, higher education and industry and emphasizes patenting of basic knowledge.

The regime of ETP works with a specific governance assumption: a division of labour between technology promoters and enactors, and civil society. Let us (= promoters) work on the promises without too much interference from civil society, so that you can be happy customers as well as citizens profiting from the European social model. The Aho Report (2006) is explicit about this assumption when it discusses, in its recommendations:

> The need for Europe to provide an innovation-friendly market for its business (…). This needs actions on regulation, standards, public procurement, IPR and fostering a culture which celebrates innovation.

And:

> Europe and its citizens should realize that their way of life is under threat but also that the path to prosperity through research and innovation is open if large scale action is taken now by their leaders before it is too late.

In addition to the need to foster "a culture which celebrates innovation" so that the promises (if and when realized) will land well, the regime of ETP now also recognizes the need to consider societal embedding and public reactions, and at an early stage. Lessons from biotechnology, and in another vein, from pharmaceuticals, have been important here. One could argue that big promises, inevitably, run the risk of attracting big concerns. Indicative for how the lessons are taken up is how the promotion of nanotechnology in the USA and Europe is accompanied by consideration of current and future ethical, legal and social aspects.

This mode of governance has its drawbacks, starting with the recurrent failure to realize the promises – unavoidably so since technology by itself does not save the world –, and becoming victim of self-induced hype-disappointment cycles. The Lisbon Agenda, which is a second order use of ETP ("invest 3% of the GDP in research and you will save the European model") experiences the same drawback.

The ETP regime recognizes the important role of industrial or scientific "entrepreneurs" which create conditions of change through raising expectations. When government agencies and political representatives become the advocates of the promises, a mix-up of roles and accountabilities may result. The ambivalent role of policy makers, promoting the specific interests around the technoscientific promises and taking the public interest into account, is unavoidable under the regime of ETP. This can become problematic when concerns are raised about the new developments: space for public deliberation quickly becomes reduced to polarised interactions for or against the technoscientific promise. As we show throughout this report, policy makers can fall in the trap of seeing civil society, under the rubric of "the public", as outsiders, to be taken into account, for sure, but as “irrational”, prone to be scared without reason, and always to be monitored by opinion polls. The continued public interest in new science and technology, and the overall trust in the institutions of science ‘in general’ that is found in such polls, including the Eurobarometer, is a source of surprise for policy makers and other promoters of technoscientific promises who encounter concerns and criticism about specific developments. Alternatively, this combination (of overall acceptance with specific concerns) could be taken as an indication that the public is rational.

Clearly, different narratives can be drawn upon. One further, and striking, example is the dual narrative about new technology. The technology is brand new (and will create a new society through genetic modification or offer nano-implants for human enhancement) when technological elites speak to investors, policy makers or patent offices, and to publics to be enrolled in the new venture. But the same technology is nothing unusual (we have been modifying genetic make-up of organisms all the time, nanotechnology is just about making things smaller and faster) when actual or anticipated concerns have to be assuaged.

2.4. The Regime of Collective Experimentation

There are innovation approaches and models which do not fit the ETP regime. We already discussed how Open-Source Software is seen as a model for other innovation approaches. We want to explore whether such approaches might add up to an alternative regime: as such, and because of contradictions of the ETP regime. This is particularly important because the latter regime appears to become hegemonic – which would undermine what is actually valuable in the regime. This happens because technoscientific promises start to function as a political order, with a tyranny of urgency and naturalisation of technological progress. Civil society is then taken into account only as the final and undifferentiated passive recipient of innovation, and when resisting, labelled the enemy of innovation.

If an alternative regime is emerging, it will be distributed, but with another division of labour than in the ETP regime. Von Hippel (2005) has written about ‘democratizing innovation’, but not in the sense of political democratization where citizens would have more voice, and be listened to. However important democratization might be, Von Hippel is drawing attention to something else: phenomena like user-induced innovation and community-based innovation. His concrete examples are drawn from the information and communication sector (where the distinction between developers and users is not sharp), and from sports (like mountain biking and kitesurfing). Malerba (2006), recognizing the same phenomena, adds participatory design (in information technology), and introduces the notion of co-invention.

There are other examples, ranging from the involvement of patient associations in health research (Rabeharisoa & Callon 2004), participatory plant breeding research experiments and exchange of experiences in ‘peasants’ networks’ in France (Bonneuil et al. 2006), and bottom-up innovations in low-input agriculture (Wiskerke & Van der Ploeg 2004). Mort (2002) and Wainwright and Elliot (1982) also describe worker-initiatives in high-technology industries like defence and marine engineering to define new R&D strategies reflecting different visions of social needs, intended outputs and research-for-innovation priorities. Electric vehicles are surrounded by promises (as an alternative to the dominant regime of internal combustion engines), but are an occasion for collective experimentation. Hoogma et al. (2002) have analysed social experiments with electric vehicles over the last few decades, and identified limitations, particularly missed opportunities for learning.

Taken together, these examples show the emergence of a new regime, the regime of collective experimentation. This recalls John Dewey’s conception of policy as collective experimentation. But the experimentation is now at the technological level as well. Situations emerge or are created which allow to try out things and to learn from them, i.e. experimentation. Society becomes a laboratory, one could say (Krohn & Weyer 1994). Here, however, the experimentation does not derive from promoting a particular technological promise, but from goals constructed around matters of concerns and that may be achieved at the collective level. Such goals will often be further articulated in the course of the experimentation.

The regime of collective experimentation, with its own division of labour in terms of participation of a variety of actors, is recognized as being productive. It depends on investment of effort from these actors who are willing to engage in innovation processes because they are concerned about a specific issue. However, there is also some room for opportunistic behaviour. This is very clear in Open Source Software: on the one hand, people contribute because they share the concerns, and perhaps the ideology behind it, but on the other hand, many users wait for others to develop new software so that they can profit from it. There are ambivalences in other areas as well, as when patient associations would function as testing grounds, and in that sense as subsidiaries of pharmaceutical companies, rather than be innovative actors in their own right. Indeed, the space for collective experimentation has to be structured so that the innovation processes are sustainable.

Therefore, a key feature of the regime of collective experimentation is that new approaches to intellectual property rights have to be created to ensure viability of the regime. In Open Source Software, General Public Licence (GPL or copyleft) specifies such rights. In the “peasants’ networks”, there are attempt to reinvent the commons (Boyle 2003). The social experiments with electric vehicles were driven by public authorities, but further investments from the private sector will require tax incentives as well as some protection of innovative approaches.

In the regime of collective experimentation new forms of interaction between scientists and other actors have to be “invented”, because the traditional authority of laboratory-based science is not sufficient. Also, what is at stake is not the direct involvement of “the public” (or worse of “the society”), but the selective engagement of concerned groups. “Collective” means that many independent disconnected and variable collaborative investigations between “established” professionals and concerned people could take place simultaneously, and may make spontaneous interconnections as they develop. They become collective issues only under certain political conditions.

The regime of collective experimentation faces challenges because such embedded innovation is laborious, typically loosely-coordinated and slow; as it should be, because users and other stakeholders have their own contexts and logics to consider. Inspired by the ‘slow food’ movement, one can now proclaim a ‘slow innovation’ program.

There is also the problem whether actors will invest in collective experimentation rather than wait for others to take the risks of such experiments. And if such investments are made, such a distributed regime makes it uncertain whether learning and its exploitation for the next steps will occur. A further problem is that collective experimentation is often associated with, and reduced to, participation of civil society, e.g. upstream public engagement. This may be in line with democratic values, but would lead to productive experimentation.

2.5. Conclusions

The two regimes, of technological promises and of collective experimentation, were characterized as alternatives. There are struggles between innovations and innovation patterns located in the two regimes; but it is not a complete dichotomy. Both regimes are part of the overall trend to recognize and emphasize distributed innovation. The two regimes highlight and incorporate different features. Ideally, they are complementary rather than mutually exclusive. When pushed as hegemonic however, they become opposed.

We think a vibrant European knowledge society must in the long-term be built on collective experimentation. Technological promises can – and should – be incorporated, but they should help, not lead.

One way to further articulate this combination has been proposed by the Expert Group on Converging Technologies (Nordmann 2004). Since nanotechnology and converging technologies more generally are enabling technologies, allowing a wide range of applications, a separate effort is necessary to identify and pursue goals linked to social needs and priorities. They indicate the need for policy experimentation:

> *Since enabling technologies are not dedicated to a specific goal or limited to a particular set of applications, they tend to be judged by the visions that go into them rather than the results they produce. Since these visions reach far beyond disciplinary perspectives, scientists and engineers, policy makers and philosophers, business and citizens are called upon to develop social imagination for CTEKS [Converging Technologies for the European Knowledge Society] applications. (Nordmann 2004, 42)*

The track record is not hopeful, however. In agrobiotech, technological promises were pushed, but met with resistance. The net effect was an impasse, and there are only a few pockets of collective experimentation. For fuel cells and the hydrogen economy (Avadikyan et al. 2003) a similar situation might arise. For nanotechnology, promises dominate, but there is also widespread concern about avoiding the impasse of agribiotech. So there is willingness to open up and learn – in principle. Since actual nanotechnology applications are still limited, the envisaged learning is in the future, itself a promise. In other words, collective experimentation might happen, but at this moment, can be no more than good intentions.

There are other considerations, however. In particular, there are institutional structures and cultures that allow for productive combinations of the two regimes. From the late 1980s onwards, Centres of Excellence and Relevance have emerged and/or been created, connected to universities or standing alone, where the gap between promises made for excellent science and the down-to-earth work on relevant innovation is bridged. The role of public sector research organisations can be reconsidered: they are not just the owner of public interest (as is the tradition in France), nor just a publicly funded support for innovation, but can also become a nursery, opening up for collective experimentation. For example, access for (emergent and orphan) groups to public research activities are now encouraged through new funding schemes for partnership between public labs and civic society organisations. Taking into account the increasing role of "third sector" knowledge production as well, one can see a productive range of combinations.

Distributed Innovation Generally

There are two general issues. First, distributed innovation includes diversity, not just of actors, but also of new options that are opened up for exploration. That is one recurrent element of innovation policies, whether focused on technological promises or on collective experimentation. It should be combined, however, with selection and preparing for exploitation of some of the new options. When and how to go for reducing flexibility is a difficult question, for the management of technology in and across organisations, as well as for EU or member-state innovation policies. When a techno-scientific promise is pushed, the opportunity costs of pursuing the selected option to the exclusion of others should be considered. Continuing to pursue all options is not viable either, however. There are techniques of technology assessment and option assessment, but these have difficulty to take into account how future performance might evolve, especially when the innovation is eventually taken up in society. Socio-technical scenario approaches may do better here, but the dilemma between going for exploration or selective exploitation remains.

Second, reinventing innovation requires reinventing the commons. This is visible already in the arrangements for open innovation that are tried out. Patents are but one means, and are more important for strategic positioning than for enabling distributed innovation. They can actually create problems when they impede circulation of knowledge and collective experimentation. On the other hand, absence of protection of intellectual property may lead to parasitic appropriation. The ideology of a commons, as visible in open source (software) movements, can then turn into a tragedy of the commons. Thus, the commons must be structured, there must be specific arrangements. We outlined some of the issues already when we discussed distributed innovation. Intellectual property rights should be subsumed under the general issues of access and exploitation. Science, Technology and Society Studies should contribute, because they have much insight about actual practices in knowledge production and circulation, and their dynamics. One important observation is that there is no fully public science, there are always thresholds, circles of limited exchange. The question therefore becomes which structures are more productive than others. Existent and new rules and practices of intellectual property rights are but one element. Trust is another element, and it is linked to the build-up and the maintenance of a commons.

To return to the Lisbon Agenda

Innovation models are not unique and they are constantly reinvented by actors. There is not one single best way to innovate. Hence, any policy based on such premises would miss an essential point. Conversely, policy makers might want to promote diversity of innovation models. Our brief discussions of opening up public sector research would be examples.

The Aho Report (2006) calls for a "new pact for research and innovation", and correctly observes that "the 3% target [for R&D expenditure should be seen] as an indicator of an innovative Europe, not as an end in itself." We have gone a step further. It is an irrelevant and misleading indicator. The real challenge is what Europe is going to do with such money.

Chapter 3: Normalising Europe through Science: Risk, Uncertainty and Precaution

3.1. Introduction

The field of scientific and technological 'risk' first emerged as a governance issue in its own right in the 1960s (Starr 1969)[3]. Proliferating almost exponentially since then, it has grown to assume truly global ramifications – appearing almost as emblematic of governance itself (Giddens 1990; Beck 1992).The European Commission in particular has been identified as an incipient risk 'regulatory state' (Majone 1994). Trade negotiations on 'risk' are increasingly prominent features of international relations (Joerges & Petersmann 2006; Winickoff et al, 2005). As a result, the European Union has emerged as a major global arena – perhaps laboratory – for these developments, which have been at the heart of the concerns over public unease with science. Consequently, any appraisal of science and governance in Europe would be incomplete without serious analysis of these risk dimensions in governance.

An almost diagnostic feature of risk as a topic has been the presumption that it is a fundamentally 'scientific' object (Jasanoff 1990; Wynne, 1989), whose nature can be revealed without at the same time being 'constructed'. In what is called 'risk-governance', complex, ambiguous, uncertain, hotly-contested differences over knowledges, values, meanings, and interests are routinely defined instead as apparently neat, technical (often quantitative and apparently more consensual) matters of 'probability' and 'safety' (Wynne 1996). Yet the underlying social, ethical and political dimensions typically remain close-beneath the surface of what are called 'risk-issues'; and all the more intractable for being partially obscured. Indeed the assumption that the 'real' public issues are solely about risk (as defined by regulatory science), and that reactions and attitudes are therefore also solely risk-focused, only begs questions about other possible public meanings that may be neglected. Nowhere is this more salient than on matters of social need, prioritisation, shaping and choice among the many possible future directions for scientific research and technological innovation that form the subject of this report (Stirling 2005). In this sense, 'risk' as a governance discourse tends to conceal bigger normative issues about the underlying choices, imaginations, and commitments shaping innovation processes.

In this chapter we do not attempt to review the whole field of risk, its governance and management. Instead we place our analysis and discussion in the framework of the present report. First, we briefly examine the historical forces that have shaped the emergence and conditioned the institutionalisation in Europe of 'science-based' notions of risk. We then explore the extent to which these apparently narrow scientific risk considerations also embody under-acknowledged wider normative issues of politically-weighted assumptions, interests and public values. We then explain this historic institutionalisation of ostensibly objective, purely factual scientific risk discourses as a process under which otherwise unruly and inconvenient political deliberations over the purposes and directions of technological innovation and their associated unknowns can be shaped, framed and managed in reasoned and democratic ways.

3. *To pre-empt misunderstanding, we underline at the outset how the conventional terms, 'risk-issue', 'risk governance' and 'risk-attitudes' or 'risk perceptions' as routinely used to describe the public issues whose governance this chapter addresses, are themselves a problem. We thus reject them for reasons which we hope this report, especially this chapter, will explain. However, since these terms have assumed such common usage, we will refrain from indulging in unwieldy and unfamiliar alternatives. Instead, we use the 'risk' terms in inverted commas.*

In particular, this requires close scrutiny of some especially complex and occasionally confused discussions around a controversial and distinctively European innovation in this field: the *Precautionary Principle*. We believe that this offers a valuable lens, through which to bring into focus some currently pressing – but neglected – aspects of the relationships between science, technology and governance in Europe. We close this discussion by pointing to some more constructive ways forward – arguing that it is only through more balanced and explicit articulations of technical 'facts' and 'uncertainties' with wider social values, interests and imaginations around science and technology, that we can build more robust decisions and commitments relating to 'risk' and what this encompasses.

3.2. The Institutionalisation of Risk in Europe

'Risk issues' extend across many disparate contexts. Europe is a diverse cultural, political and institutional environment, with many varied historic trajectories. As a result, there exists in this broad field a multitude of specific cases, frameworks and practices across which it is difficult to generalise. Nonetheless, given the present focus on the overarching governance of science and technology, it is possible to resolve a broad historical picture. In short, the development of risk governance procedures in Europe holds much in common with that in other areas of the world. Indeed, throughout much of its history – and in most respects – developments in Europe have tended to follow a general pattern and rhythm set primarily by the evolution of policy in the US.

Over recent decades, the basic trend can best be described by reference to the seminal 'Red Book' published by the US National Research Council in 1983. Despite subsequent shifts of nuance and emphasis (e.g. NRC 1996, EPA 1997), the architecture set out in this study remains the principal point of reference in much high level discussion of risk governance – in Europe as elsewhere. This centres on the assertion of a clear-cut separation between the realms of science and politics, or between 'risk facts' and 'values'. Intended partly as a means to inhibit manipulation of scientific representations by political interests, this distinction is formalised as a categorical separation between 'risk assessment' and 'risk management'. The former was – and continues to be – envisaged as an exclusively scientific process of objective factual discovery, always conducted prior to risk management. The latter then introduces more normative questions for the first time - about economic costs, ethical issues, and subjective social values and interests as well as the practical exigencies of implementation.

The interaction between these two stages is conventionally seen as one in which risk assessment science sets its own agenda, presenting factual conclusions which once viewed in the light of established normative regulatory policy rules allow the derivation of prescriptive recommendations to risk management. Put simply, all that remains to be clarified as grounds for a 'decision' (once risk assessment has established the scientific facts) is an evaluation of what constitute the acceptable 'levels of protection'. This in turn is typically based on a rigidly pre-set model of the relationships between 'costs' and 'benefits', generally framed in exclusively economic ways. In this fashion, determinations of applicable safety standards, regulatory instruments, financial incentives and technological choices have all come to be seen as essentially 'based on' the 'sound science' of risk assessment.

Accordingly, the particular questions posed of (and in) risk assessment have tended to remain somewhat under-examined – effectively regarded as self-evident to science and unworthy of wider deliberation. Any residual ambiguities are resolved in an apparently straightforward way, by the application of the relevant law and science. In this way, the notionally clean, rigorous and independent (thus incontestable) practices and outcomes of risk assessment have come to be regarded as indispensable justification of otherwise delicate or exposed decisions. In public disputes over innovations, the propositional scientific issues of 'what are the risks?' have thereby been allowed to define and discipline the issue, its conduct and outcome.

Across a variety of sectors, developments in 'risk governance' in Europe over the past two decades have taken the form of a progressive reinforcement in this basic architecture. For instance, the institutional regimes and procedures established in fields of nuclear (CEC 1996), chemical safety (CEC 2001a), control of medicines (EMEA 2006), planning (CEC 1997) waste (CEC 2002a) and water management (CEC 2000a), as well as the regulation of food safety (CEC 2002b), and biotechnology (CEC 2001b) all follow this basic epistemic and institutional pattern. Where the European Commission has articulated a more general framework spanning these different fields, the same basic normative relationship between risk assessment and risk management also prevails. This is true of the 2000 Communication on Precaution (CEC 2000b) – discussed in more detail in section 3.4, the formal 2002 European Commission guidance on risk assessment (CEC 2002c) and the EC-supported European Policy Centre report on "Enhancing the Role of Science in the Decision-making of the EU" (Ballantine 2005).

For all their value, we find in all these documents varied refractions of the analysis presented here. In other words, they reflect a consistent and persistent under-emphasis of the ways in which risk assessment inevitably rests on normative commitments. These commitments variously take the form of subjective judgements, influential social values, contestable assumptions and administrative procedures that are open to contingent framings and the tacit or deliberate exercise of power. Even the scientific units used to define risk embody value-choices (Shrader-Frechette 1990). These issues are treated in the next section. For the moment, the important point is that the resulting discouraging of debate on these normative social dimensions of risk assessment science contributes to the high levels of public mistrust in 'risk-governance' that are now rightly seen as problematic by Europe's policy agencies. Similar issues often underlie the exacerbated tensions between EU and member state risk and regulatory competent authorities which have erupted around the new European Food Safety Authority (EFSA), especially over GMO risk assessment and decision-making under the revised and amplified GMO release Directive EC/2001/18.

It is against this background that a new and distinctively European turn in risk governance has emerged. This centres on the burgeoning of new policy debates around the 'precautionary principle', 'public- and stakeholder-engagement' and 'participatory deliberation'. For all its flaws, the 2000 EC Precaution Communication mentioned above (and discussed below) displays some encouraging signs of this kind. But the general governance implications of this new wave of thinking is probably best expressed in the 2001 EC White Paper on governance (CEC 2001c) and associated literature on the implications for risk and science. More concrete institutionalisations of these new themes have emerged in a number of EU member states, like the Teknologiradet in Denmark, the Rathenau Institute in the Netherlands, new 'Strategic Commissions' and 'dialogue' processes in the UK and some of the activities of the Council for Global Change in Germany. Although not yet reaching the same tangible or even statutory status at a European level, some resonances are beginning to develop. These may be seen in interventions by bodies like the European Science and Technology Observatory (ESTO 1999) and European Environment Agency (EEA 2002) as well as numerous initiatives under the auspices of the EC Science and Society Programme and Sixth Framework RTD Programme (EC 2006). Some of the work of the European Parliament's Science and Technology Options Assessment unit (STOA) also addresses these new imperatives, and new legal responsibilities are also being introduced, as under the Aarhus Convention (UNECE 1998) and in the EC Water Framework Directive (CEC 2000a). Most recently, the International Risk Governance Council has sought to develop an overarching framework in which more robustly and democratically to address this complex and intrinsically contestable character of risk science (IRGC 2005).

This broad and uneven European front has begun to expose a disjuncture with the still-continuing, rigidly 'science-based' distinction between risk assessment and risk management, and with continuing practices elsewhere in the world reflecting this traditional structure. Indeed, this has been a principal factor in the emergence of new international trade conflicts between the US and EU in the regulation of risky innovations like beef hormones and GMOs (Winickoff *et al*, 2005). We will next examine some of these tensions and open issues, focusing especially on this central disjuncture at the heart of contemporary European 'risk-governance'. In short, it remains the case that despite increasingly sophisticated language around 'precaution' and 'participation', current statutory risk-governance institutions and practices at European and national level alike continue to operate under structures, assumptions, habits and routines, sustained by problematic underpinning imaginations, as discussed in Chapter 7. These trace right back to the original risk assessment / risk management distinction first inscribed in policy imagination and practice by the 1983 'Red Book'.

3.3. Why Scientific Risk is a Normative Issue

What is wrong with prevailing processes under which 'risk' issues have historically become institutionalised – and are now currently addressed – in European policy, primarily as a matter for expert declaration and exclusively 'science-based' judgements? There are a number of reasons why apparently 'sound scientific' questions of risk can be recognised intrinsically to be shaped and framed by social values, sometimes embodied in routinised habitual ways of institutional thinking, and political interests. Indeed, that this is so constitutes a large part of the reason for all the efforts and difficulties documented in the last section in the development of those risk institutions themselves. Though sometimes neglected in public policy discussions, many of these questions are entirely familiar (and uncontroversial) under even the narrowest of specialist perspectives.

We can begin with the most straightforward of technical questions. What are the relevant forms of risk (human health, environmental burdens, ecological integrity, monetary values, social disruption, ethical offence)? How should we measure these (for instance, health can be measured alternatively as frequency or mode of death or injury, disease morbidity, or quality of life)? What degrees of aggregation or differentiation across varied populations is appropriate? What should be the appropriate baselines and thresholds of 'safety' under each? How do we compare impacts on different groups in society (workers, the public, children, elderly)? What weight is placed on wellbeing of humans compared with non-humans, or future generations compared to the present? Do we look only at the 'acceptability' of a single proposed course of action, or do we compare alternatives in order to find the 'best', or 'best' combination? When framing the object of risk-scientific attention at high level of scientific detail, how do conflicting scientific criteria of valid knowledge (for example, precision, or comprehensiveness, or realism), influence those practical scientific definitions, and how are they traded off when they conflict? When as often happens, technical parameters like the mechanical reliability of a human-fabricated, – maintained, and –operated technology embody social-behavioural factors which are contingent, how does risk assessment represent these? Do we simply assume the promised benefits and attend only to the risks, or do we weigh the realism and magnitude of both up together? If so how – and what balance should we strike?

How do we make comparisons between different measures? How do we handle those aspects that cannot easily be measured? Which aspects are included in analysis and with what priority? How do we deal with disagreements among experts or between disciplines? What do we do about uncertainties, unknowns and ever-present possibilities of surprise in risk-producing processes? How do we take account of different answers to all these questions from different groups in society? Even the most ardent proponent of 'sound scientific' approaches, would acknowledge that there neither exist nor can be any definitively 'scientific' ways to resolve – or even frame – these crucial questions that underlie any ostensibly objective or scientific definition and assessment of 'risk'.

Cumulatively, these relatively obvious questions alone amount to a pretty robust challenge to prevailing simplistic deterministic ideas of 'sound scientific' or 'risk based' decisions of the kind established in the 1983 'Red Book' and exemplified above. They are invoked even under the most apparently straightforward preoccupations of European risk regulation, in asking: "What are the risks?" "Is this safe enough?" "Do the risks outweigh the benefits?" "What would be safest?"

Yet this is only the beginning of the difficulties. Behind these relatively simple manifestations of the role of public values within the domain of 'scientific' risk, there lie further questions over the treatment of the broader social and political issues that are intrinsically bound up in narrowly-framed institutionalised science-based notions. Typically speaking, 'safety' is far from being the *only* issue at hand; and safety or risk *from precisely what*, is also an ambiguous issue[4]. Other pressing questions raised by new scientific knowledge or innovative technologies include those over the distribution of the possible benefits and burdens. Who stands to gain and who to lose? Under what assumptions and conditions might either of these be true? Which areas are prioritised for scientific enquiry and under what incentives and constraints? What values and meanings are embodied in our science and technology concerning relationships among people and between humans and the natural world? To what extent and to whom should we assign property rights in knowledge and technique? Which technological pathways would we pursue most vigorously and which should we neglect? Whose visions of the future should drive the direction of progress? What kinds of political process or institutional procedure do we employ to resolve these matters or establish legitimacy? To what extent do groups in wider society 'trust' those actors and processes on whom they know they are dependent for producing and interpreting the salient knowledges and making the associated decisions? How 'trustworthy' as representatives or custodians of public values, have these incumbent groups and institutions proven in the past? It is these further kinds of fundamentally political question that are part of the scientific definitions and frames, but which are essentially denied by artificially narrow, simplistic and deterministic preoccupations with 'risk' alone.

Since the institutionalisation of narrowly scientific 'framings' of risk issues in the 1980s documented above, a particular dilemma confronting risk assessment and management was the challenge of 'uncertainty'. Indeed, it is here that many of these intractable questions come to a head. In response, this inadequate singular catch-all term has been usefully differentiated by analysts. A series of important but conventionally neglected issues have been exposed. For example the following quite distinct problems – risk, uncertainty, ambiguity, ignorance, indeterminacy (Box 3.1.) – have been recognised both in theoretical and practical terms. Each implies quite different strategic and methodological treatment, extending well beyond conventional 'risk assessment'. Indeed they require institutional re-thinking if taken seriously.

Of course these different aspects of 'incertitude' are not mutually exclusive. Each depends to some extent on the others. In different degrees and permutations, all may typically be expected to occur together. The conditions apply even to their own application as categories. The point is, that these are not simply different 'degrees' of uncertainty, each with different methodological implications. The perception or interpretation of any of these different states of knowledge itself presupposes a set of analytic assumptions and 'enacts' a range of normative commitments. For instance, each holds radically different connotations for the attribution of responsibilities, and for what can or cannot be taken as stable and externalised (if only for 'the time-being'…).

For example, if we 'base' a decision on the scientific understanding that the risks from a nuclear power station are, say, one human death from an accident for every million people exposed per year of operation, then the normative commitment is enacted *inter alia*, that only human life is valued. The further normative social commitment that any consequences of radioactive waste or plutonium production do not matter, is also implicit in this scientific-technical representation. So too, if it happens (as it often does), is the normative commitment to neglect alternative possible ways of achieving the same societal ends – in this case the production of comparable quantities of electricity. In the past, these sorts of question were not mobilised in

4. *For example, the infamous 1994 controversy over Shell's environmental disposal of the Brent Spar oil-rig from the North Sea into the Atlantic Ocean floor, was not about the risks from dumping the Brent Spar alone, but was about the risks that would be created if not only this first such rig to be decommissioned was dumped there, but also the other 400 or more rigs, plus other wastes like radioactive wastes which had been designated for such dumping but which had been suspended by seamens' union and environmental NGO action. The values ('framing') issue in scientific risk assessment is not only a question of what do we define as 'at risk' (i.e., what do we value?), but also, 'from what?'*

high level policy debates in Europe. Nowadays they most certainly are; and persistent exclusive recourse to narrowly scientific treatments of risk and wider aspects of 'incertitude' are disrespectful of this new reality.

BOX 3.1. - DIFFERENT QUALITIES OF UNCERTAINTY

- **Risk:** under which we know both the probabilities of possible harmful events, and their associated kinds and levels of damage (Knight 1921; von Neumann & Morgenstern 1944; Starr 1969; Winterfeldt & Edwards 1986). This is where the various techniques of risk assessment are most usefully applicable.
- **Uncertainty:** where we know the types and scales of possible harms, but not their probabilities (Knight 1921; Funtowicz & Ravetz 1990). This is the best established 'strict' definition of the term 'uncertainty', under which 'risk assessment' is strictly not applicable.
- **Ambiguity:** where the problem at hand is not one of the likelihood of different forms of harm, but where the measurement, characterisation aggregation or meanings of the different issues are themselves unclear, disagreed among specialists or contested in wider society (Arrow 1963; Jasanoff 1990; Wynne 1992b, 2001; Stirling 1999; Renn et al. 2006). For example: how exactly do we define 'harm' or 'risk'?
- **Ignorance:** where we don't have complete knowledge over all the possible forms of harm themselves. Where we 'don't know what we don't know' – facing the possibility of surprise. This renders problematic even the questions that we ask at the outset in risk assessment (Keynes 1921; Loasby 1976; Ravetz 1986; Wynne 1992a,b; Faber & Proops 1994; Stirling 2003)
- **Indeterminacy:** where the possibilities for different social 'framings' depend 'reflexively' on complex interactions and path dependencies in the co-evolution of social, technological and natural systems. In other words, not only do our commitments and choices depend on what we know, but what we know is conditioned by our preferred or expected commitments and choices (Jasanoff 1990; Wynne 1992a,b; Stirling 2003).

3.4. The 2000 EC Communication on the Precautionary Principle

Notwithstanding the persistent difficulties and shortcomings discussed above, it should be clearly recognised, that many 'risk institutions' in Europe have in some ways adopted more sophisticated and progressive approaches to these issues than those adopted elsewhere in the world. Such are the countervailing instrumental pressures, that this represents a significant achievement in governance for which due credit should be given. Indeed in a number of high profile areas, the EU has over recent years taken a clear lead on the international stage in seeking more seriously to address the varied and complex dimensions of uncertainty, the associated limits of scientific knowledge and the resulting substantive reasons for more effective public engagement. Nowhere is this more obviously the case, than in distinctively European interpretations and institutional developments around the Precautionary Principle.

Coming to a head in a series of recent high-stakes confrontations with the US and others under the World Trade Organisation disputes process, the European Commission has in some ways shown a staunch resolve in defending aspects of these more nuanced and fundamentally different understandings discussed above. Unfortunately, this position has been somewhat compromised and thus sometimes undermined by the parallel adherence of these same European institutions to the longer-entrenched narrow reductionist notions of scientific risk with which these understandings are incompatible. The resulting inconsistencies have been exploited in strategic misrepresentations of the EC position (not least by the US State Department) as expressing an allegedly anti-science culture. This was explicit, for example, in the US and allied nations' prosecution of the WTO Disputes Panel case on GMOs against the EU (Winickoff *et al*, 2005).

These incoherences in the evolving EU position on risk and precaution are exemplified, *inter alia*, in the seminal policy documents themselves. Like the original 1983 US risk 'red book' a decade or so before precaution became a headline issue, the EC's formal Communication on the Precautionary Principle (CEC 2000b) actually in some ways compounds problematic framings of social appraisal of science and technology as a matter of narrow scientific 'risk assessment'. Indeed, 'risk' is highlighted here not just as an *important* element, but as *definitive* of all the issues raised in the governance of science and technology. Accordingly, the precautionary principle is restricted in scope to address only those "risks that science is not yet able fully to evaluate". Although the existence of uncertainty is sporadically acknowledged (in the strict sense defined in the last section), the methodological implications remain largely unaddressed. Moreover – though citing without discussion a detailed analytical review – the more difficult states of incertitude described in Box 3.1. (which have been recognised in the published research literature on risk and precaution since the early 1990s) are entirely unacknowledged in the text of the Communication itself. Risk assessment is thus firmly upheld as the gate-keeping scientific tool for policy decisions on precaution as if it addressed all aspects of incertitude.

In this way, invoking the precautionary principle is restricted in the Communication as grounds for possible legal intervention to situations:

> *"where preliminary objective scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen for the [European] Community".*

Furthermore, again echoing the Red Book philosophy,

> *"The precautionary principle should be considered within a structured approach to the analysis of risk which comprises three elements: risk assessment, risk management, risk communication. The precautionary principle is particularly relevant to the management of risk."*

Thus even as this positive and novel institutional innovation is introduced, so is the problematic conventional linear sequential hierarchy of categories maintained and reinforced – running from risk assessment, through risk management, and then to risk communication. Perhaps most problematically, the precautionary principle is – despite important pioneering work elsewhere (ESTO 1999; EEA 2002; Stirling et al. 2006) – repeatedly held by other EC bodies to apply only to risk management. It is described as a science-guided policy measure, and not a scientific, risk assessment measure. Thus scientific risk assessment knowledge itself is effectively exempted from scrutiny with respect to its own detailed framings, practical epistemic criteria, and interpretive judgements. In this way, risk assessment science is supposedly 'protected' from any imagined policy or other *normative* influence. Note however that this is a normative declaration of (a desired) 'reality', not an empirically-observed account of it.

> *"The precautionary principle, which is essentially used by decision-makers in the management of risk, should not be confused with the element of caution that scientists apply in their assessment of scientific data."*

'Policy', therefore, does apply to risk assessment also, but only in the restricted terms originally laid out for the 1983 Red Book, when it was realised that some scientific judgements in risk assessment were unresolved and open, but had important influences on scientifically-decided risk assessment outcomes[5]. The EC explains this distinction thus:

> *"There is a controversy as to the role of scientific uncertainty in risk analysis, and notably as to whether it belongs under risk assessment or risk management. This controversy springs from a confusion between a*

5. *An example was whether to use a linear-through-zero, quadratic, or linear-with-threshold dose-response model to extrapolate to low doses typical of real-life exposure situations, from experimental data which only existed for high doses and short exposures.*

prudential approach and application of the precautionary principle. These two aspects are complementary but should not be confounded. The prudential approach is part of risk assessment policy which is determined before any risk assessment takes place and which is based on the elements described in 5.1.3; it is therefore an integral part of the scientific opinion delivered by the risk evaluators.
On the other hand, application of the precautionary principle is part of risk management, when scientific uncertainty precludes a full assessment of the risk and when decision-makers consider that the chosen level of environmental protection or of human, animal and plant health may be in jeopardy." (CEC 2000b)

The risk assessment policy factors admitted in the passage referred to here (section 5.1.3), are the familiar ones of:

- "relying on animal models to establish potential effects in man;
- using body weight ranges to make inter-species comparisons;
- adopting a safety factor in evaluating an acceptable daily intake to account for intra- and inter-species variability; the magnitude of this factor depends on the degree of uncertainty of the available data;
- not adopting an acceptable daily intake for substances recognised as genotoxic or carcinogenic;

adopting the "ALARA" (as low as reasonably achievable) level as a basis for certain toxic contaminants." (CEC 200b))

In this way, an attempt is made to preserve a privileged and transcendent role for the 'sound science' of risk assessment, treated as isolated from contamination by social values or interests. The distinction between precaution (in risk *management*) and the new notion of naturally prudential science (in risk *assessment*), serves to reassert the policy authority of controlled scientific expertise, and entirely marginalises the important implications of precaution for risk assessment itself. Crucially, these implications concern not just the practice of risk assessment, but the authority which it can logically carry in the larger process of regulation and policy for innovation. It is this latter aspect which is rigidly – and we suggest, incorrectly - protected from question and revision by many of the most influential ways in which precaution has been defined and institutionalised thus far. Drawing in part on work by the European Environment Agency mentioned earlier, Box 3.2. summarises some of the concrete insights that this leaves unanswered and the potentially positive and constructive new practices that are suggested in response.

In short, what is being missed is that the advent of the Precautionary Principle should command serious and scientifically rigorous attention to uncertainty, ambiguity, ignorance and indeterminacy as well as risk (as defined in the previous section). This logically includes indirect as well as direct responses. It means that precaution should remain an overarching policy principle, applicable as a point of reference in all eventualities and with particular concrete implications for assessment in instances of interlinked scientific uncertainty, ambiguity, ignorance or indeterminacy.

EC-funded research is developing more concrete ways to take this forward, as part of wider processes of risk governance (Stirling et al. 2006; Renn et al. 2006). The framework under development by the International Risk Governance Council may also offer positive elements that are consistent with this (IRGC 2005; Renn & Roco 2006).

Yet these more sophisticated proposals for experimental processes, introducing more systematic frameworks for public-deliberative interactions, have much to offer. But any consequent policy innovations will fall foul of the same problems documented here, if they continue to treat broader questions over the directions taken by scientific and technological innovation, merely as 'risk' alone.

BOX 3.2. - SOME KEY IMPLICATIONS OF PRECAUTION FOR ASSESSMENT
(ESTO 1999; EEA 2001; Stirling forthcoming)

Precaution 'broadens out' the inputs to appraisal beyond the scope typical of conventional regulatory risk assessment, in order to provide for (*with examples in italics*):

1. independence from vested institutional, disciplinary, economic and political interests; *as long-constrained attention to asbestos health-problems*
2. examination of a greater range of uncertainties, sensitivities and possible scenarios; *addressed early with antimicrobials but later neglected*
3. deliberate search for 'blind spots', unknowns, and divergent scientific views; *as with assumptions over dispersal in the story of acid rain*
4. attention to proxies for possible harm (eg: mobility, bioaccumulation, persistence); *as encountered in managing chemicals like MTBE*
5. contemplation of full life-cycles and resource-chains as they occur in the real world; *like failures in PCB containment during decommissioning*
6. consideration of indirect effects, like additivity, synergy and accumulation; *of a kind neglected in occupational exposures to ionizing radiation*
7. inclusion of industrial trends, institutional behaviour and issues of non-compliance; *such as the large scale misuse of antimicrobials*
8. explicit discussion of appropriate burdens of proof, persuasion, evidence, analysis; *presently implicated in systematic neglect of Type II errors*
9. comparison of a series of alternative technology and policy options and potential substitutes; *neglected in the case of the over-use of diagnostic X-rays*
10. deliberation over justifications and possible wider benefits as well as risks and costs; *insufficiently considered in the licensing of the drug DE, and usually neglected in other risk domains.*
11. drawing on relevant knowledge and experience arising beyond specialist disciplines; *like knowledge of birdwatchers relating to fisheries management and sheep-farmers on environmental radioactive contamination of sheep*
12. engagement with the values, knowledge and interests of all stakeholders possibly affected; *as experience of local communities in pollution of the Great Lakes*
13. general citizen participation in order to provide independent validation of framing; *significantly neglected in the management of BSE, and more generally ignored*
14. a shift from theoretical modelling towards systematic monitoring and surveillance; *systematically neglected in many cases, including that of PCBs*
15. a greater priority on targeted scientific research, to address unresolved questions; *as omitted during the BSE experience, for example on the infective agent*
16. initiation at the earliest stages 'upstream' in an innovation, strategy or policy process; *fostering cleaner innovation pathways and preventive intelligence before lock-in occurs*
17. emphasis on strategic policy practices like reversibility, flexibility, diversity, resilience; *these offer ways to hedge even the most intractable forms of ignorance*

3.5. Conclusions: Re-imagining Fact-Value Relationships

This chapter has noted some deep problems – as well as opportunities – in European processes of risk governance. The primary location of these is less in calculated positions which we identify as mistaken, but in the underlying philosophical premises and taken-for-granted categories which shape the institutional culture. These problems thus have wider ramifications, including for the central preoccupation which stimulated the commissioning of this report; namely, public unease with 'science' (as institutionalised in governance processes). Risk science also represents (and performs) 'the public' whose concerns it both represents, but also, in playing its public policy science roles, which it imagines and projects onto 'the public'.

There is a tendency simultaneously to simplify and exaggerate the role of science in risk assessment, and in the issues which risk assessment is deemed to address. Policy discussions tend to ignore the ways in which framing of risk issues is typically allowed to extend far beyond the narrow domains of safety, and obscures the ways in which risk science itself is actively but tacitly shaped by social values, assumptions and interests. Although presently interpreted in unhelpful and contradictory ways, increasing attention to the 'precautionary principle' and 'public engagement' point to a number of practical governance responses which could be pursued more thoroughly and consistently, with major benefits for European public support for and interest in science, as well as for the quality, effectiveness and dynamism of the science itself.

In wrestling in good faith with these conflictual historical and political forces – and in many ways leading global debates in this regard – European risk governance is presently undergoing important processes of change. These have significant implications not only for regulatory policy, but also for much wider issues concerning the roles of science and democracy in innovation, and the future of Europe in a globalised world. These wider issues have yet to be clearly recognised, let alone addressed in public debate and policy. In its global commercial, technological and policy entanglements, then, European science is itself an agent of these processes of change, as well as being deeply affected by them. Together these constitute an important dimension of an issue already widely recognised by the Commission to be crucially important for European society in future – *what kind* of Europe do we want? And what kind of knowledge does this require? One partial answer might be for policy to address itself more to directly represented public concerns, rather than to imperatives mediated exclusively by increasingly market-driven innovations systems. One simple way to illustrate this, would be a move from preoccupations with 'downstream' risk-governance, to a broader interest in more 'upstream' *innovation*-governance.

Risk and ethics, as well as precaution, are inevitably ambiguous; and all intertwined. The example of xenotransplantation and risk management is an outstanding example for this. (see Box 3.3.) A set of options with radically different qualities is 'articulated', which involve either undermining individual human rights of freedom of movement and association on risk-control grounds, or introducing a moratorium on clinical trials of the technology because to proceed either safety or human rights would have to be transgressed. It appears as if the idea that a control may have to be introduced on the technology, as with the moratorium in the public's interest, is rapidly annulled, and this annulment is thereafter rigidly enforced while bending between civil rights or safety as alternative sacrifices. There is no explanation or debate about whether the third option (moratorium) should be considered. Instead in advancing the technology, two problematic alternatives are left to compete with each-other – curtail freedoms, or increase risks – leaving the technology to enjoy a positive passage.

The centre point for debate on science and normative public issues, is the existing expressed ambition on the part of European governance institutions for Europe to become a leading global knowledge society and a beacon for enlightened, and sustainable innovation, including social innovation. The implications of our analysis are that, to take these aspirations seriously, we should properly acknowledge the intrinsically normative aspects of science and technology, including risk. This in turn demands an alternative approach to that which treats risk-science as being outside normative or political debate and thereby allows normative issues to be unaccountably prosecuted because they have not been seen for what they are. Instead we could strive through deliberation to establish explicit normative principles under which to structure and interpret our science and innovation in this area. This has to include the commitment and global witness to a longer-term practical collective ethic of sustainability, and of creative experimental capacity whose imagined outcomes and purposes are democratically-negotiated. Sustainability, precaution and intellectually rigorous treatment of incertitude in science all logically demand that acclaims and aspirations to prediction and control are more rigorously interrogated, complemented by parallel processes and – where still appropriate and useful – conducted with greater humility.

The European Commission is well-placed to develop these new more explicit and legitimate kinds of normative framework for science, innovation and governance. On the global stage, the European Commission is distinguished by its unapologetic commitments to new concepts of precaution and public deliberation on science. So far however, much of this engagement remains quite rhetorical. The emphasis is more on the communication than the informing, and conceivable *transforming*, of decisions and commitments. Interest seems focused on new procedures more to justify established imaginations and commitments, and to procure 'trust' for what remain essentially unchanged imaginations, habits-of-thought and decision-making processes. This is the disjuncture observed at the outset between the language of precaution and participation, and the persistently technocratic, reductionist and exclusive functioning of the underlying governance culture itself. To resolve this, all that is required is to take the new language seriously, and follow it through in practice.

Of course, responsibility for successful transitions of this kind – like that for the problems to which they are a response – do not only lie with high level governance institutions in the EC and members states. Multiple industry 'stakeholders', civil society organisations and diverse public constituencies also carry much responsibility – and must bear much of the load. Communities of practitioners such as the present authorship also hold responsibilities constructively to engage with all these diverse voices, in order to help facilitate progress. In particular, it would be foolish to romanticise the capabilities or motivations that can be articulated in engagement. Nor should it be supposed that typical members of the public-at-large are out there 'straining at the leash' in their enthusiasm to perform as model 'participatory citizen scientists'. This is as much a false projection onto 'the public' as the view that public resistance to nuclear energy or biotechnology is due to ignorance of the science.

In seeking to establish these new more vibrant discourses on the role and directions of science and technology in the knowledge society, the obstacles lie not only in resistance from incumbent institutions, but also from various forms of fatalism, indifference or alienation, and inertia on the part of publics themselves. Although these are in part a consequence of the mismatch in existing discourses observed, they nonetheless present very real challenges. As the next chapter emphasises, again deriving from long-established scholarly insights, 'the public' of risk, science and innovation, is a construct in whose substantive shaping we have a collective stake, and responsibility. Contrary to the defining commitments of western social science, this construct is forever in-the-making. Public engagement processes in 'risk-governance' must avoid imposing identities on them as concerned only about risk, and listen to what those publics are really concerned about.

Rather than simply relying on the active design of ever more elaborate and expensive procedures for engagement under the committed assumption that it is all framed within risk meanings only, a key to establishing these new normative frameworks as constructive for democratic knowledge-society may also lie in apparently more modest innovations. One such possibility concerns the norms for shaping and communicating 'science advice'. Instead of 'closing down' policy deliberation by focusing on single prescriptive recommendations, science advice in all current areas of risk assessment undertaken by Commission bodies, might instead be required to be framed and communicated as a modest number of alternative interpretations and proposals. By 'opening up' the ways in which the 'answers' depend on the 'questions' and the framing of analysis, this would in itself facilitate the nurturing and maturing of more open and diversely creative discursive spaces on the roles and purposes of science in governance. In this way, it might help reinforce accountability and so catalyse development of more effective and measured public discourse on science generally, as well as on 'risk' and innovation-governance.

BOX 3.2. - WAIVING HUMAN RIGHTS IN THE NAME OF PRECAUTION: THE EUROPEAN CASE FOR XENOTRANSPLANTS

Xenotransplantation, namely procedures involving the use of living cells, tissues and organs from a non-human animal into a human being, is seen as a potential solution to the shortage of human organs. Several biological and technical barriers exist for xenografts to become a real alternative in transplantation, mainly due to the rejection of the animal tissue/organ, but the major problem is the safety of this medical technology -- the potential threat of spreading unknown transmissible infections (xenogenetic infections) from pigs to human patients and the general public. Thus, xenotransplants are problematic at both individual and collective levels. While it is still unclear whether this technology will provide real benefits, the risks are actual and present. Patients are informed about mostly unspecified, unknown risks and asked to accept behavioral restrictions due to potential infections. The general population, although not involved in the consent process, is at risk of exposure to new epidemics.

The European regulation of xenotransplants has wavered in its goals and principles. It started by endorsing the precautionary principle and ended up asking patients to waive their fundamental rights. This also illustrates how the precautionary principle is ambiguous itself, when required to adjudicate between public health and individual rights.

In 1999, after a previous Council of Europe (CoE) Recommendation (Rec 15/1997) raised questions about xenotransplantation, the Parliamentary Assembly of the Council of Europe invoked the precautionary principle in unanimously adopting a Recommendation (Rec 1399/1999) calling for a legally binding moratorium on all clinical trials.

Several countries adhered to the moratorium and the CoE set up a Working Party on Xenotransplantation (WPx) to explore further its scientific and normative aspects.

Initially the European analysis was inspired by a cautious approach and by a willingness to merge the technical and ethical aspects. However, after the US guideline allowing clinical trials was published in 2001, the WPx shifted its position. In 2003, a new Recommendation (Rec 10/2003) was approved proposing an unexpected solution. Recalling how health emergencies in Europe "have created an atmosphere of distrust of science and scientists in the public mind" and that "there is a fear that no one is really 'in control' or 'knows what will happen,'" the WPx nevertheless suggested that xenotransplants may proceed. But how?

The precautionary principle, previously invoked to account for the unknown unknowns of xenotransplants, was no longer needed because unpredictable risks were to be controlled instead by adopting very restrictive rules for patients (and their relatives).

The European Commission Scientific Committee on Medical Products and Medical Devices, apparently without hesitation, had already accepted that, in order to go ahead with xenotransplants, some fundamental human rights (for the patient and "others" !) may be "suspended."

"Some of the measures that may need to be taken in a surveillance system may have legal implications as they could be in violation of the Declaration of Helsinki and other guidelines for research on human subjects. In the recent EC Directive for conduct of clinical trials, the right of a subject to withdraw from a clinical trial is explicitly stated (EC 2001), and this could be a problem for prolonged surveillance in xenotransplantation clinical trials. As xenotransplantation has implications for public health, it may be that certain rights may have to be modified in such a way that surveillance can be continued. Patients (and others?) could therefore have to agree to waive some of their human rights."

One may (naïvely) argue that this outcome is incompatible with the general statements of the European Convention on Human Rights. But the representatives of the European Court of Human Rights (ECHR), requested to give their opinion, reassured the CoE of the legitimacy of measures aimed at preventing the spread of infectious diseases. In order to clarify the legitimacy of proposed restrictions, if necessary, the ECHR explained that "the Convention in Article 5(1)(d) permitted the lawful detention of persons to limit the spreading of infectious diseases" and that "in certain circumstances it might be considered that an individual, by giving consent to a particular interference, had waived his or her rights."

The ECHR omitted justification for the strong assumption implicit in its comment: whether illiberal measures permitted under the circumstances of an accidental epidemic represent a valid analogy for the implementation of a new, planned technology.

Chapter 4: New Normative Discourses in European Science and Governance: Law and Ethics

4.1. Introduction

Rapidly proliferating issues of science and governance in the EU are shaping the Union's formal and informal constitutional practices. The EU may remain an 'unidentified political object', but it still has distinctive material and substantial attributes. One of its most pervasive features is the shifting relationship between the tacit normative dimensions of policy issues and their more explicit factual and descriptive dimensions. These dimensions do not automatically evolve in coherent relationship with one another. In particular, fact-finding does not always occur independently of and prior to making normative judgments. Important aspects of science and governance, the topic of this report, are worked out in the context of interconnected processes that are (a) beyond what is normally recognised as science, and (b) beyond what is thought of explicitly as governance.

In this chapter we call attention to the new 'normative discourses' being articulated in the European Union, partly through discourses that are seen as expressly scientific (for example of risk. Chapter 3), and partly through discourses about the forms, functions and proper regulation of science through ethics. To this end, we first address some previously unnoticed dimensions of the role of law in European governance. Whereas in the last chapter science was expressly involved as a regulatory actor (e.g., in 'risk governance'), in this chapter it features more as object of governance (e.g., through bioethics or nanoethics),

We use the term, 'normative discourses', in place of 'legal discourse', to capture normative developments that have a legal or quasi-legal function, but that are easily missed if we look for them under the conventional heading of the 'legal'. We use the term 'discourse' in order to include the ways in which important but implicit shifts in normative orientations are shaped not just by deliberate regulatory initiatives, but also by language and practices which appear to have no regulatory dimension. This less formal and less obvious normative domain has been extended in Europe by a broad shift away from direct and explicit modes of regulation towards 'soft', non-legally binding instruments, such as codes of practice, fiscal incentives, audit and reporting measures—in short, by the shift from legislatively authorised *government* to administratively implemented *governance*.

4.2. Legal Discourse and Order in Europe

In early 2000, at the outset of the new millennium, the EC identified the reform of European governance as one of its four strategic priorities. This was seen as vitally important even before the envisaged overall reform of the EU Constitution was stalled by negative reactions in some European countries. The constitutional impasse may have slowed overt developments towards this end, but it has not in the least slowed the less overt normative developments which shape European political, social and economic life. Indeed it may have added momentum to them.

Legal rules have operated as the primary instrument for harmonizing markets in Member States. As an EC input to the 2001 EU Governance White Paper put it, “compared to national political systems, the European political system focuses more on enacting rules than intervening financially in the economy”. (CEC 2000, 8) This privileged position of legal rule-making was reinforced in the shift from the European Economic Community based mainly on the free movement of goods, labour, capital and services in a common market, to the European Union as a political entity framed by a Constitution and a corpus of fundamental human rights. But, in the passage from economic to political Europe, the role of the law has been strengthened and widened; law has become the preferred instrument for building Europe as a polity and Europeans as citizens.

The law is conventionally seen as the institution that regulates an existing order of things in accordance with the expressed will of democratically elected legislatures. It is also recognised as an active participant in the creation and maintenance of order, for example through case-law and interpretation of legislation that is irreducibly ambiguous. Yet legal discourses strive not to admit their constructive political role so as not to impair the legitimacy of judicial institutions. One common strategy is for legal institutions to acknowledge only their positive fact-finding function, and to apply the facts so found to democratically decided legislative norms. The intensifying relationship between law and science (Jasanoff 1995) has accentuated this tendency. The objectivity of the law increasingly seeks to ground itself in the objectivity of science. Accordingly, as scientific discourses and imaginations become increasingly influential across European policy domains, the understanding of the law as apolitical is also reinforced.

The rule of law is widely seen as not flexible enough for the governance of fast-moving science, as well as too slow for the ‘rapid response’ which modern policy demands. The long history of EU patent policy offers a clear example of this attempt to find a rapid response in a morally contested field. (see Box 4.1.) Thus a wide range of more flexible, less formal, less mandatory measures has been introduced to cope with member-state/EC/EU demands relating to innovation and commerce in science and technology (S&T). Curiously, this administrative expansion has opened some new spaces for democratic inputs. While European legislative processes have remained relatively unresponsive to much-expanded demands for public participation and civil society involvement, administrative institutions, including especially the EC, have engaged in “opening up the policy-making process to get more people and organisations involved in shaping and delivering EU policy… [with] greater openness, accountability and responsibility for all those involved.” Put differently, renewal of the EU and its governance is to be achieved by “following a *less top-down* approach”; but “when legislating the Union needs to find ways of *speeding up* the legislative process”. (CEC 2001c)

BOX 4.1. - ETHICAL CONSTRUCTS: THE UNSALEABLE BUT MARKETABLE BODY

Even though ethics should not be influenced by economic concerns in the field of biotechnology, through subtle institutional boundary drawing and selective invocation of ethical principles, a framework has been created not only to protect the human body but also to permit its uses in commerce.

Two major documents—one from the European Union and one from the Council of Europe (CoE)—on the legal status of the human body have agreed on a vision in which the human body is at one and the same time unsaleable (for individuals) and marketable (for industry). In the former guise. it is ethically relevant; in the latter, it is ethically irrelevant.

6. *GAEIB, Opinion No 8 of 25 September 1996: The patenting of inventions involving elements of human origin: “The affirmation of the citizen’s rights in the European Union implies that the economic advantages derived from biotechnological developments should in no way affect the respect of ethical requirements”.*

When the Council of Europe (CoE) adopted the Oviedo Convention on Human Rights and Biomedicine in 1997, the European Parliament and Council Directive on the legal protection of biotechnological inventions (98/44/EC) was still undergoing approval. Despite the fact that ethical concerns about patenting life were a major obstacle to the approval of the European Directive, the CoE decided to ignore the connection between patents and bioethics. Commenting on the relation between the Oviedo Convention and the proposed Directive 98/44/EC about the prohibition of receiving financial gain from the human body, the Explanatory Report on the Convention stated the following:

"The question of patents was not considered in connection with this provision (marketability of body materials); accordingly the latter was not intended to apply to the question of the patentability of biotechnological inventions".

Avoiding dealing with patents on living matter, while affirming the non-marketable status of the human body, is a way not to see the elephant in the room. If patenting of bodily materials is allowed, this amounts to giving legal sanction to the marketability of the body.

The CoE and EU determined not to challenge each other's legal status and competence, but to draw the boundaries of their relationship in a way that preserves separate spaces for ethics and economics. CoE is seen as the authority for values; EU governs the market. Reciprocally acknowledging each other's position, the CoE Convention takes it for granted that biological entities may be patentable, whereas the EU Directive calls for respect for the fundamental human rights to dignity and integrity.

This division of labour has played an important role in the subsequent history of patents and the separation of what is natural and what is artificial. Directive 98/44/EC, Article 5.2 provides that an element isolated from the human body or otherwise produced by means of a technical process may be patented even if this element is identical to a natural one. The distinction between non-commercial, natural elements of the human body and the commercial, technically produced elements maps precisely onto the distinction between what is ethically relevant and irrelevant.

Through the formal demarcation of their different institutional tasks, the EU and CoE have contributed to neutralising the political space between what is freely given and what is commodified.

The narrative of greater public openness and involvement often collides with those of 'rapid response' and institutional efficiency. The European Commission is forced to operate as if it can reconcile them, and cannot admit to the impossibility of doing so. The attempted reconciliation often takes the form of greater conciseness and economy, but therefore also open-endedness, in legislation, namely through a "'primary' legislation limited to essential elements (basic rights and obligations, conditions to implement them)". (CEC 2000, 20) This economy can be understood as a felt need to circumvent the time-consuming and unpredictable 'inefficiencies' of democratic deliberation in favour of delegating complexity to different

7. *Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Convention on Human Rights and Biomedicine), adopted by the Ministers Committee the 19th of November 1996 and open to signature in Oviedo the 4th of April 1997.*
8. *Explanatory Report to the Convention on Human Rights and Biomedicine (Strasbourg, May 1997, DIR/JUR (97) 5), Art.21, P.134.*
9. *Only the Explanatory Report to the Convention refers to the Proposal for a European Parliament and Council Directive on the legal protection of biotechnological inventions, COM (95)0661 - C4-0063/96 - 95/0350(COD)). The preliminary version of the Directive makes reference to the Convention, while the final text quotes only Art.1 of TRIP's Agreement (Trade-Related Aspects of Intellectual Property Rights, GATT 1994, WTO 1995) and the Convention on Biological Diversity (Rio de Janeiro, 5.6.1992).*

modes of expert judgment - economic, scientific, ethical, or legal. Thus, instead of the classical model in which law is made by democratic politics, then implemented in consultation with the polity, EU legal discourse has created the political fiction of democratically-deliberated policies through laws that outline a series of technical needs that require no further public involvement. Technical delegation occurs through reference to supposedly overriding but ambiguous principles such as 'global free trade', 'competitiveness of the European knowledge-economy', and, increasingly, 'ethics'. These principles have received no substantive democratic legitimation, but have enjoyed EC sponsorship in the *name* of European democracy. The manifest problems of public mistrust and disaffection which Europe is encountering with respect to science and governance may be a reaction to this deeper structural weakness.

Science and technology (S&T) do not simply represent one among many tasks for policy and law, but are a founding political principle of the European knowledge-based society that provides the means and frames the ends of policy. The cognitive/normative landscape generated by, and generating, risks and uncertainties and their management reflects this normative action of S&T in relation to the law. In particular:

1. There is considerable deference in the law to a the idea of well-defined and deterministic facts, especially in those cases where scientific expertise masks significant uncertainties
2. Deference to science and expertise in making policy leaves hidden, and therefore unaccountable, the significant ordering dimensions of alleged facts, and their reinscription of undebated, thus undemocratic, normative commitments;
3. Law is used in this way to transfer such hidden norms between political contexts such as EU Member States;
4. The ambiguous relation between law and ethics, and the institutional treatment of ethics as a mode of expert discovery akin to scientific expertise, effectively extends these problems into new arenas of S&T governance.

We look next at the domains of ethics, and also of risk, uncertainty and precaution, as key European arenas in which scientific and ethical expertise, normative issues, and questions of public deliberation, are intersecting in new ways. Through the examples provided in the following sections, we clarify where and how new normative discourses invoked in the name of efficiency or expert judgment have foreclosed or black-boxed the potential for legitimate and democratic law-or rule-making.

4.3. The Unpolitics of European Ethics of the Life-Sciences

4.3.1. From Bioethics to Political Ethics

The late 1960s brought renewed interest in applied ethics and the official birth of bioethics. According to historians of ethics the main reason was the rise of biotechnical medicine and associated problems of human subjects research (Jonsen 2000; Tina Stevens 2000). But this explanation is too narrow.

The genealogies of the growth and institutionalization of bioethical discourse indicate rather that the need to establish a more intense and open dialogue between science and society lies at the core of the bioethical/ethical movement (Jecker et al. 1997). Its purpose was to ground the normally self-referential ethics of science in a democratically legitimated framework of values and sociotechnical choices.[10]

Some ethical issues have become the object of court decisions, mostly in the US legal system (Jasanoff 1995). In the European context (EU and Council of Europe), numerous directives, conventions and recommendations include legally binding provisions in fields ranging from good clinical practice to cloning,

10. *In the US the growing interest in the social implications of science at the end of World War II was associated with the discussion of science policy concerning the role that social sciences might play as a form of public accountability of science for the natural sciences community (OTA 1986).*

from genetically modified animals to the use of human biological tissues. But even though several fields related to life sciences (such as reproductive technologies and GMOs) have been subjected to the legislative process, the role of bioethics in the normative landscape of Europe remains strangely ambiguous.

The attempt to introduce bioethics at an institutional level has led, at least in the European context, to a backgrounding of the basic challenges posed by this field. This backgrounding has taken place through the creation of ethics committees and commissions as a seemingly innovative method of decision-making, both for single cases and for general guidance on scientific programs.

As a result, the emergent pluralist, inclusive and interdisciplinary dialogue that was at the core of a potentially new way of shaping public policy in Europe has instead been largely reduced to the bureaucratic mechanism of expert ethical advice, deriving from procedures which are identical to those for scientific advisory committees.

This section describes how bioethics and ethics have become important political resources in the EEC/EC/EU normative discourse for purposes other than bringing relevant societal moral values to bear on decision-making about science, technology and innovation. These further uses of ethics serve the grander European aim to overcome the constraints of the original economic foundation, the EEC, and to shape, indeed create, the EU's political and epistemic identity.

We introduce the expression "politics of ethics" to refer to the political role that ethics plays in the EU's continuing development. An apparent politics of values has indeed been widely advertised as a distinctive element around which the political European community can and should be built. Science shares this political role with ethics, since the ethical discourse has been introduced in Europe as a warrant for, and a putative regulatory control over, scientific and technological power ¬- and as a means to establish a closer link between science and society.

However, ethics has played other political roles in a much less explicit way, as an instrument which effectively de-politicises some highly sensitive issues involving science and technology. Thus ethics has become a self-legitimating way to serve the same functions as politics and law, but with neither the democratic deliberative mechanisms nor the warrants required by legal systems to protect citizens against state power.

Ethics has been used at times by EU institutions to neutralise political issues, to introduce norms outside the traditional process of law-making, to evoke society without involving it, to pay lip service to democratic concerns while only expert processes were taking place, to control citizens' behaviour and even to allow direct intervention into their bodies, and to exempt the market from ethical criticism and debate. In resorting to ethics as a supposedly participatory discourse, EU institutions have de facto engaged in unaccountable forms of biopolitics. Ethics is represented as if it is naturally a matter of expert judgment only, though this very framing has markedly shaped, and continues to shape, which ethics and whose values count in European politics.

4.3.2. Slippery Slopes in Normative Language: "European Legislation on Ethics" and "Ethical Legislation"

In recent years EU institutions have represented the main role of ethics as a vehicle for open and shared deliberation and choice. EU institutions (and primarily the Commission) seem to be willing to talk about themselves in a self-reflexive way, offering this narrative about the function of ethics. In order to create a recognisable public space for ethics, numerous websites[11] describe its rise, representing it as a factor in the shift from the ECSC Treaty in 1953 to the Single Market in 1991, to the Treaty of Maastricht in 1993, when "a new phase of the European integration began: to build an ever closer European Union".

11. After our work began, the DG Research website dealing with ethics has been remodeled. In this deep revision several expressions were modified. This makes the European politics of ethics even more intriguing, since an apparent politics of words is restlessly taking place. The references to the previous sites are shown here to document the history of the online European ethical language. The original sites can be still found in the Internet Archive at ***http://www.archive.org***

Ethics entered the European arena primarily through bioethics and research ethics, but since has extended to all fields of science and technology. The politics of ethics officially began in 1991 with the decision to "incorporate ethics in the decision-making process",[12] at first in relation to biotechnology, and later, in all areas of application of science and technology.

As the document appointing the Group of Advisers on the Ethical Implications of Biotechnology (GAEIB) in 1991 states:

> *"In setting it up the European Commission has highlighted its desire to integrate Europe's science and technology in a manner that serves the interests of European society and respects the fundamental rights of every European citizen. (...) European integration must mean more than establishing a single market; progress in science and technology must be given a human, social and ethical dimension, otherwise European citizenship cannot be established".*[13]

Ethics, according to this narrative, is essential to establish the very idea of "European citizenship", imagined as being at the intersection of and as integration among the single market, scientific and technological progress, and human, social and ethical concerns. But European citizenship appears as an abstract normative concept whose definition and establishment are authoritatively vested in European institutions through the legal fiction that they represent the "ethical values of all Europeans" (see, for example, box 4.2). This would have been an extremely ambitious claim even for institutions of single Member States, let alone for Europe as a whole.

Ethics, then, has entered the European arena as a basic element in regulating both citizens' lives and researchers' behaviours in relation to biotechnology, but it has also become an important legitimizing factor in the construction of a political European Community.

> *"In the spirit of this economic approach most legislative powers were allocated in the core fields of necessary market regulations. Ethics and cultural values, by nature, are predominantly regulated on the national level. They follow the principle of subsidiarity. However, while seeking for harmonised market conditions, European directives necessarily touch on the issue of ethics".*[14]

In this formulation, ethics implicitly is playing a catch-up role with the market and political institutional commitments. But this articulation raises many questions. Why did ethics suddenly emerge in the context of market regulations? What is the relation of autonomous ethical expert communities, prescribing a professionalized ethics, to the idea of an ethically responsible political union among European countries?

The overall impression is that moral values have become an element of concern in the European context because of the shift from a primarily economic to a political organization. (Jasanoff 2005) This impression is strengthened by the seemingly reluctant way of introducing ethics as a European concern at all. It seems that "ethics and cultural values" should not ordinarily be subject to European legislation. This is not because they are in principle a questionable field for legally binding norms. Instead, the main reason is the priority held by national legislation in ethical matters. But that priority has to yield when the superior interest of harmonising the single European market gives precedence to European regulation. Ethics in the EU then is disadvantaged from the start, as it is implicitly subordinated to narratives of market harmonisation, such as increasing European competitiveness and efficiency.

12. *CEC (2005): "(1) In November 1991, the European Commission decided to incorporate ethics into the decision-making process for Community research and technological development policies by setting up the Group of Advisers on the Ethical Implications of Biotechnology (GAEIB). (2) The Commission decided on 16 December 1997 to replace the GAEIB by the European Group on Ethics in Science and New Technologies (EGE) extending the Group's mandate to cover all areas of the application of science and technology".*
13. ***http://ec.europa.eu/european_group_ethics/archive/1991_1997/bilan_en.htm***
14. *Cf. CEC, Research, Science and Society,* ***http://europa.eu.int/comm/research/science-society/ethics/research-e-legislation_en.html*** *(accessed October 2005).*

The EU GAEIB 'manifesto' makes the reader aware that ethics has to be a matter of legislative competence; that this competence may be national or supranational; that European directives "necessarily" must deal with ethics; and that ethics is directly related to the economic field.

It is worth noting that no definition of ethics is given in justifying these claims: Which ethics; applied to which fields? Whose ethics? How is ethics framed and how does it frame the issues it addresses? Moreover, ethics is paired with cultural values, another undefined concept. The latter expression suggests that *everything* in peoples' lives, in their history and behaviour, may become part of an enlarged "ethical" perspective. By talking of ethics and allowing ethical values to be taken into account through public decision-making processes, European institutions suggest they can represent European society as a whole and present themselves, in effect, as a comprehensive political community.[15]

The willingness to invoke ethics looks on its face like an endorsement of indirect public involvement in the decision-making process, and as a symbolic move toward a qualitatively different vision of the European Community – one that emphasises the role of civil society in building a broader political community. But inspection shows that ethics is drawing only on the symbols and not the actuality of democratic involvement. Even though it is declared that "(t)he Commission aims to promote responsible research in Europe and to keep the rapidly advancing progress in science in harmony with the ethical values of all Europeans",[16] the identification or articulation of these values is not linked to any sort of public consultation. Instead, the terms of reference of the GAEIB established as the Committee's main tasks

> *"to identify and define the ethical issues raised by biotechnology; to assess, from*the ethical viewpoint *[italics added], the impact of the Community's activities in the field of biotechnology; to advise the Commission, in the exercise of its powers, on the ethical aspects of biotechnology and to ensure that the general public is kept properly informed"*.[17]

The identification and definition of ethical issues are the tasks of ethics experts, and indeed the activity of the scientific/ethical committee is recognised as expert advice. The public's role is just to be "properly informed."

Ethics, politics and the law have become so intertwined that some substantive and procedural principles have shifted from one domain to the other without open acknowledgment. For instance, this is the case for the principle of subsidiarity that informs the political and legal relationship between the EU and the Member States. Ethics, as is mentioned in the document appointing the GAEIB, "should follow the principle of subsidiarity". However, the application of subsidiarity to ethics has gone beyond mere respect for different national sovereignties and has become an ethical principle *per se*. In fact, it affects not only political organisation but has become part of ethical reasoning.

BOX 4.2. - THE "ETHICAL-AND-SAFE" EUROPEAN CITIZEN-DONOR

The ethical gaze on scientific issues has become a recognisable element of European epistemology (Tallachini 2002), but is also being used to shape the identity of European citizens. Ethics is applied to science not only to assess the behaviour of scientists and researchers but also to assess, shape and normalize citizens' behaviour. The legislation on the procurement of human biological materials provides an example of the construction through ethics of a normative citizen identity: the "ethical-and safe" citizen-donor.

15. Ib., p.89.
16. CEC, Science & Society, http://europa.eu.int/comm/research/science-society/ethics/legislation_en.html (accessed October 2005).
17. Ib.

The regulatory framework for human cells and tissues has been shaped for many years by institutions inside both the EU and the Council of Europe (CoE), which established the two principles of free donation and prohibition of financial gain from the human body.
In 2004, the EU published Directive 2004/23/EC on setting standards of quality and safety for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells. The Directive applies to almost all human cells and tissues, as well as to reproductive cells (eggs, sperm), fœtal tissues and cells, and adult and embryonic stem cells. (CEC 2004)
Though the title refers solely to scientific-technical requirements, and the EU here seems to stick to its well established identity of market harmoniser, the Directive contains one of the most remarkable ethical statements that can be found in EU legislation. Without any reference to a shared public vision of the topic, a well-defined philosophy of the human body is normatively declared at Whereas (18). After stating that awareness that "we are all potential donors" has to be promoted at both national and Community levels (in order to help "European citizens decide to become donors during their lifetime"), the text so follows:

"As a matter of principle, tissue and cell application programmes should be founded on the philosophy of voluntary and unpaid donation, anonymity of both donor and recipient, altruism of the donor and solidarity between donor and recipient. Member States are urged to take steps to encourage a strong public and non-profit sector involvement in the provision of tissue and cell application services and the related research and development". (Whereas 3)

A sharp contrast may be seen between the philosophical approach (which seems to stress donor autonomy) and the urgency presented to States to implement this philosophy. Further, in the following lines it quickly becomes clear that the principle of (compulsory) "altruism and solidarity" is mandatory only for citizens and that it does not apply to "(t)issues and cells intended to be used for industrially manufactured products" (Whereas 6).
The ethical vision of European citizens is not only strongly encouraged and enforced, but, in the context of standards of biological materials, appears as an issue of safety concerning both tissues and tissue donors. "Voluntary and unpaid" donations are presented not just as prerequisite for a more equitable society but also as a promoter of safety:

"Voluntary and unpaid tissue and cell donations are a factor which may contribute to high safety standards for tissues and cells and therefore to the protection of human health". (Whereas 19)

It is hard to say whether these provisions show concern about the possibility of European citizens selling their biological materials as occurs in several developing countries (as well as in some parts of Europe for blood, *inter alia*), or if they are aimed at granting industry free access to human tissues as 'raw materials' for research or production. Notably, however, the imperative of free donation becomes also a measure for public health and safety protection. Anyone willing to sell his/her tissues – the Directive presumes – is a threat to society. Thus good citizens will be those who behave at the same time "ethically and safely". But this "science-based ethics" – the ethics of behaving safely (where safe is a synonym for moral) – is introduced through a seemingly neutral, descriptive language: the implied correlation between "freely chosen" solidarity and anonymous collective safety.

The assumption that ethics is a form of citizen representation and the weak awareness that ethics and law cannot easily be reduced to each other, neither in content nor in process, have become so entrenched that some interesting linguistic slips can be found in EU policy documents. Expressions such as "legislation on ethics"[18] and also "ethical legislation"[19] are a sign that the distinction between law and ethics is becoming a matter of semantic, if not institutional, confusion.

Expressions were used for more than two years, between April 2003 and November 2005, when the new websites switched to: "Ethics: Democratic fundamentals."[20] With a sudden change that demonstrates European identity in flux – even though this flux is not made transparent –, so-called European values are now more opportunely connected to the Charter of Fundamental Rights.[21]

4.3.3. Commissioning Ethics: Rule-Making Beyond the Rule of Law?

The problem of EU comitology has been widely explored at both the theoretical (Wynne 2001) and the institutional level.[22] But the issue is not resolved and it bears heavily on the representative nature of ethical committees.

From the point of view of States under the rule of law – as Europe is – the problematic character of all expert committees is made even worse for ethics committees because of the flexibility of their procedures as compared to legislative ones. It is interesting that this flexibility was seen as one of the GAEIB's main virtues:

> *"Its openness and dynamism are the best response to the accelerating pace of development in the relationship between science, technology and the key values of society".*[23]

The recent Commission Decision on the renewal of the European Group on Ethics (EGE, successor to GAIEB) mandate in 2005 seems further to emphasize dynamism at the expense of openness. After asserting that the EU rules on expert knowledge[24] apply to their committee, EGE members, the document explains how the EGE functions. Article 4.3 affirms the non-public character of EGE work; its sessions are private. The participation of a limited public is allowed only during roundtables (one for each opinion delivered), aimed at promoting dialogue and improving transparency.[25]

Other elements reveal the bureaucratized nature of this ethical discourse. Article 4.5 suggests that when "not unanimously" taken, decisions shall also contain dissenting opinions, but it leaves to internal regulation the adoption of relevant decision rules.

18. *Cf. CEC, Science & Society in Europe,* ***http://europa.eu.int/comm/research/science-society/ethics/research-e-legislation_en.html (accessed October 2005). Now on: http://web.archive.org/web/20030418165425/http://europa.eu.int/comm/research/science-society/ethics/research-e-legislation_en.html***
19. *CEC, Science & Society in Europe,* ***http://europa.eu.int/comm/research/science-society/ethics/legislation_en.html (accessed October 2005); now on http://web.archive.org/web/20030402063432/http://europa.eu.int/comm/research/science-society/ethics/legislation_en.html****: "Ethics - Ethical Legislation and Conventions - The Commission aims to promote responsible research in Europe and to keep the rapidly advancing progress in science in harmony with the ethical values of all Europeans".*
20. *http://ec.europa.eu/research/science-society/page_en.cfm?id=2995*
21. *Ib.: "Europe's democratic societies should offer the necessary safeguards and channels of dialogue to ensure that the development and application of science and technology respects certain fundamental values. The EU's 450 million or so citizens have just such a common ethical framework that binds them together as Europeans: the Charter of Fundamental Rights."*
22. *Through the reform of the system of committees serving the European Commission: see Council Decision 1999/468/EC of 28 June 1999 (a new 'comitology decision' repealing Decision 87/373/EEC) laid down the procedures for the exercise of the implementing powers conferred on the Commission.*
23. ***http://europa.eu.int/comm/european_group_ethics/gaeib/en/biotec02.htm***
24. *Commission Decision on the renewal (2005/383/EC), Whereas (5): "The Communication from the Commission on the collection and use of expert advice by the Commission".*
25. *Commission Decision on the renewal (2005/383/EC), Art. 4.5 "will organize a public round table in order to promote dialogue and improve transparency for each opinion that it produces".*

Accordingly, Whereas (4) reinforces the idea that ethics is a lighter and faster version of law, and that it requires "new working methods in order to respond to more rapid science and technology developments in a timely manner".[26]

In the ongoing discussion about the so-called law lag, frequently invoked by European Directives dealing with science and technology, the informal features of ethics, conducted according to the logic of expert knowledge and decision, represent an easy way to introduce legal rules beyond the rule of law.

4.4. Conclusions

In this chapter we have examined how law and ethics operate as often unseen factors which may be contributing to the widespread public disaffection with science. We first addressed the general question of legal norms and their political foundations and forms, and examined how these may have been tacitly found to be 'too slow' for the flexibility and responsiveness, not to mention anticipatory dynamism, 'required' by modern science, technology, innovation and global competitiveness. In this situation, we have seen, how many normative commitments are created under the name of 'law' which are not accountable to democratic control, yet which appear authoritative, almost *faute de mieux*, under prevailing political conditions. Any loss of potential economic competitiveness is invoked as almost a 'state of emergency', such that efficiency overrides the slower and more cumbersome application of democratic principles.

We then examined the rise of institutional ethics as a mode of EU governance, and showed how an expressed need for full-blown civic deliberation about the good society, and about the forms of knowledge needed to uphold this, are translated into an expert discourse: "ethics". Despite its ambitious claim to bridging between European science, policy and innovation on one hand, and Europe's sceptical, questioning citizens on the other, ethics has in practice been institutionalised as 'soft law' which imposes, without collective debate, as if 'discovered truths' about citizens and their responsibilities towards science and innovation on European society.

EU science and governance initiatives have done little thus far to prepare institutionally for this sort of potentially enlightening, reflective inquiry into its own categories and framing assumptions. Nor can any expert body, certainly not ours, pretend to take the place of such ongoing collective review, which will itself be slow, need preparation, and be of uncertain outcome. When such rule-making in the guise of rule-following is being conducted, there are ill-defined and ambiguously-bounded intersections between expert presumptions of political authority and legitimate civic expectations of democratic deliberation and accountability. In particular, the huge acceleration, proliferation and intensification of the commercial exploitation and conduct of what, only a generation ago, was taken as "The Independent Republic of Science", has not yet impinged adequately on our public sense of what 'science' is, or can be, nor how it relates or can relate to human aspirations, needs, and values. Put simply, European ethics has yet to come to grips with the normative implications of industrialised science.

Ethics is not supposed to be subject to the same decision-making processes as law-making. However, EU institutions have not made it clear how ethical opinion is related to the law. In this ambiguous situation, expressions such as "ethical legislation" are likely to produce a slippery slope towards an undeliberated State production and imposition of collective values; all this coloured, moreover, by the *de facto* primacy given to material growth as a governing principle for science and democracy.

Ethics has been institutionalised in Europe through the creation of expert committees. Some important questions thus remain unanswered: whether ethical decisions may take place beyond the rule of law; if ethics may appropriately be seen as just a matter of expertise; and how, as is claimed by the EC, such expert committees may convincingly represent "the values of all Europeans".

In the next chapter we extend the theme of how normative issues about the social and political order of a democratic Europe are being shaped through expert discourses on risk, uncertainties and precaution

26. *Ibid., at Whereas (4): "The EGE requires new working methods in order to respond to more rapid science and technology developments in a timely manner and requires new competences in order to address a greater range of science and technology applications".*

Chapter 5: European Publics: Formations, Performances, Encounters

5. 1. Introduction – the challenges

A central starting point for this report was our mandate's diagnosis of "a growing uneasiness which affects the relations between science and society". Indeed the idea that rethinking and practical reshaping are needed in ways of governing science in order to regain public trust appears as a central preoccupation in European Union and many member-state science policy discourses. This is seen as imperative, rather than as an option. "Science is not just about knowledge but also about politics, ethics and quality of life" acknowledged the report on *Governance of the European Research Area* in 2004, under the metaphorically interesting heading of "Giving society a key to the laboratory". (EC 2004) Public "concerns over the implications of modern science", are declared to be legitimately grounded. And they were perceived as strong enough to trigger refusal of technoscientific innovations assumed to be for society's benefit. Getting society on board the innovation train is thus the only possible solution if one wants to remain competitive, and that requires "a solid partnership between the scientific community, policy-makers, industry and civil society." (Busquin in EC 2004, 3) Society has to "carry the progress", by giving up its scepticism and this can only be realised through more participatory modes of governance.

Thus the challenge of this chapter is to address this perception of uneasiness and lack of trust from publics that afflicts European science and society relations. Where are the identified problems? What are imagined solutions for Europe, at whichever policy or institutional level? The core message flowing from this report is that publics are never simply there, and just in need of being invited to participate, but are constructed and performed through the very process of involving them in one way or the other. STS scholars have shown in much detail how models – and practices – of public participation and governance always contain visions about relevant actors to be "invited to the table" and in that sense they are technologies of building community. (Irwin 2001, Andersen 1983/1991) These imaginations materially shape the structures and forms in which publics are able to express themselves, and in this sense partly construct the very publics to whom policy makers are supposed to be listening (Wynne 2006, Jasanoff 2005)[27].

We discuss below the multiple formats in which publics in all their diversity and varying roles are constructed, and also the kinds of knowledge, experience and ways of thinking they bring to such engagement processes, invited or uninvited. After this we will return to our point of departure and take a second look at the uneasiness and lack of trust often perceived in European policy making involving science, with a view to offering recommendations.

27. This 'public engagement' is assumed always to be invited by some institutional actor – a policy agency, a corporation, a research funder, or a scientific research body. However important forms of public engagement are often entirely uninvited, at least initially - as the long list of controversies over various innovations in Europe since uninvited opposition to nuclear power in the 1970s shows. See eg., Cambrosio and Limoges, 1991. We return to this later.

5.2. From Education to Engagement: European Framing of Science-Public Relations

Today's discussion of public participation and new regimes of governance has to be understood in the context of developments in the *Public Understanding of Science* (PUS) movement in the mid-1980s. After the techno-optimism of the 1950s and 60s, in which citizens were supposed simply to take up the assumed benefits from unprecedented economic growth and innovation, the regime of production of knowledge and technology gradually if unevenly came under challenge. Societal concerns about common goods and research needs inadequately recognised by market mechanisms, the rise of nuclear protests and environmental awareness, protest against military research and technology as well as multiplying technological catastrophes created growing demand for precaution and for broader attempts to participate in framing and deciding socio-technical issues. Thus the model of research and development governed by a largely self-regulated scientific community (representing truth), by policy makers (representing the public interest), and by industrial actors (representing consumers' needs) seemed no longer acceptable.

In this increasingly vocal context of responses to technoscientific programmes, scientific and governmental authorities became uneasy about public opposition to what was being promoted in the name of science and progress. However the initial solution to this rising problem was a one-way transmission of knowledge from science to a public imagined as passive and lacking in information. The underlying assumption was that lack of public support for science and innovation was due solely to lack of understanding, or "scientific illiteracy". Large surveys were conducted in the 1980s to monitor the "European public's" knowledge and attitudes towards science and technology.

Perhaps the most authoritative statement of these concerns over public scepticism towards the authority of science was the 1985 report of the UK Royal Society, on *Public Understanding of Science*. In this statement senior scientists and scientific policy advisers saw a gathering crisis of public scientific illiteracy for modern democracy. Public criticism was seen as an expression of irrational social reactions which threatened the progressive innovations that science brings to society. It was taken-for-granted that the public had no role to play in defining the public interest or social benefit in technoscientific domains. Thus scientists, while claiming the objectivity which was part of their established public status, were also conflating powerful normative commitments, and particular technological, policy and social choices, with that 'science'. This deep confusion continues till today, in that contestable normative choices of technology like genetic engineering to which science became committed were simply assumed to be a public good (Jasanoff 2005).

Starting from these assumptions and with little-or-no awareness of the need to contextualise scientific knowledge, public research agencies and the scientific establishment engaged in a massive effort to "popularise" science (e.g. the Committee on Public Understanding of Science, COPUS, in the UK or the "Culture scientifique et technique" movement in France). Their mission was to promote public science education so, as it was supposed, to restore public confidence in 'science'. However this PUS movement did not reflect upon the more or less implicit assumptions that were 'educating' its audiences into the momentous normative commitments which they had tacitly harnessed to science and science-based technologies. Thus 'scientific literacy' in effect meant compliance with these unacknowledged social and technological commitments.

In this same period in the late 1980s, qualitative research began on public encounters and interpretations of science as embodied in disputes about the radioactive effects of Chernobyl, new medical interventions or environmental issues. This showed resoundingly that publics were mistrustful of 'science' not solely or primarily because of misunderstanding of science (of which there was much), but because of their experiences of the ways that institutions supposedly in charge of scientific-policy issues handled the publics involved (Irwin & Wynne 1996, Nelkin 1979). The public's typical focus was not primarily on probabilistic risk of harm, as scientists assumed, but their unavoidable dependency on institutions they could hardly trust. These findings underlined the 'public deficit model' (Wynne, 1991) underpinning all the official science and policy reactions to public responses to 'science', namely, that rejection was due solely to public ignorance or 'knowledge-deficit' concerning existing scientific knowledge. Furthermore, this first wave of research also showed that members of the public hold a set of nuanced, rather refined and situated understandings of science and technology, depending whether or not there was a perceived usefulness. (Michael 1992)

Although the 'public understanding of science' movement became much more diverse these deep confusions and mutual misapprehensions have by no means been overcome. Public understanding of science is still repeatedly confused with public *acceptance* of science *and* innovations. So also has the public deficit model been officially abandoned, while re-establishing itself in new forms (e.g., public refusal in the GM case is still often explained by their misunderstanding of scientific methods). (Wynne 2006, 2007) Thus we observe a strong tension between recognising the limitations of current relations between science and wider publics and a certain resistance to changing well-entrenched ways in which science is framed and innovation is directed. This obvious incoherence suggests that the problem lies deeper, namely in a lack of trust of policy and scientific authorities in 'the public'.

Ample evidence from research, rising pressure from emerging public groups as well as troubling public disaffections with science, and also the rather unchanged outcomes of public surveys despite strong information/education campaigns, gradually triggered the policy-scientific world to reconsider the 'deficit model'. The idea of education was thus replaced by models of public dialogue and more complex learning/communication processes as central paradigms. The PUS 'paradigm of science dissemination' has been partially translated into what could be termed a 'paradigm of dialogue and participation' or *Public Engagement with Science* (PES). In some cases civic groups are even perceived to be integrated into or claim their place in the very process of scientific knowledge production. (Michael 2002) (see Box 5.1.)

BOX 5.1. - MODELS OF SCIENCE – PUBLIC RELATIONS (CALLON 2001, FELT 2002)

Public Education Model

- Science is seen as separated from society. The public thus does not intervene in the process of knowledge creation.
- Technosciences are sources of progress as long as they are well used by different actors Mistrust towards science comes from public illiteracy, ignorance and superstitions
- Thus scientists, who hold the knowledge, have to instruct and educate the public.

Public Dialogue and Participation Model

- Science has to be opened to debate (with public authorities, industry, citizens) to enrich it (the public does not participate in the creation of scientific knowledge)
- Frontiers between specialists and non-specialists become less clear
- The legitimacy of decisions comes from the existence of open debate

Public Co-production of Knowledge

- Science is seen as closely intertwined with society
- Citizens and "concerned groups" get actively involved in the process of knowledge production of direct use for them (some interactions between scientists and lay persons become permanent and build trust and mutual learning by working together in hybrid collectives)
- Knowledge created in laboratories is still central, but it is created in a different frame, nourished by actions from citizens and mutual enrichment

5.3. New European Regimes of Public Engagement

From the late 1990s onwards European institutions as well as member-states have emphasised the need for new modes of science and governance. Declarations concerning new partnerships between science and society were booming, denouncing the old top-down, one-way information politics. Experiments in participation with different formats developed in the broad variety of political cultures constituting Europe. The 5th Framework programme's "Raising Public Awareness of Science and Technology" activity was a first clear sign in the late 1990s of the perceived need for such European research. It stressed the need of "European citizens to understand better both the beneficial impact of science and technology on their day-to-day lives as well as limitations and possible implications of research and technological developments" – thus reaffirming the one-way information paradigm. However it also aimed at increasing "scientists' awareness of issues and subjects that are of concern to the public". Following the Lisbon Agenda Declaration the EC *Science and Society Action Plan* of 2001 aimed at developing stronger relations between science and the broader society by supporting measures such as public consultation, public debates, and public involvement concerning the development and assessment of science and specific technologies. Among other things, it called for an intensive exchange of information and best practices between member-states and the regions on the use of participatory procedures for national and regional policies.

The 2001 White Paper on European Governance, which includes an extensive section on science and citizens, shifted these issues to a more general level by calling for extended openness, participation, accountability, effectiveness and coherence as important principles of governance. However, as has been extensively discussed since, the ways in which citizens as well as NGOs should become involved, at what moments in time and in what kinds of decisions remained weakly defined. The citizens' side of governance still remains underdeveloped and confined mainly to individual cases, as has become visible in the negotiations of the 7th Framework Programme.

In that same vein it is often underlined that it is up to media, researchers, research institutions, educational bodies – as well as industry (and even, very occasionally mentioned, civil society organisations) – to play their public information role and to explain and argue frankly in social arenas the benefits and occasionally the limits of scientific progress. But this is not imagined to have any influence over what is undertaken by scientists as they enter the labs, and imagine, negotiate, shape, conduct and communicate their research. In that crucial and pervasive sense, the power of thought and action to define what is to be regarded as progress is very much in the hands of science and its economic stakeholders.

Further, the interpretations of this rising interest in as well as the proliferation of participatory activities remain rather uneven. For some, it is simply a process of inevitable participatory democratization expanding into closed technoscientific realms. For others it is a move to restore shaken trust in science, thus also scientific public authority, so as to foster the credibility of policy commitments to technoscientific innovations. For still others it is a unique way to change the very way of producing innovation and making policies, through new forms of mutual understanding and intersection of science and society. And for a very few, the explicit acknowledged aim is to conduct a reflexive and accountable review of encultured institutional understandings and related practices concerning science, innovation and governance. The common theme across these different approaches is that it no longer seems legitimate to think and work within the classical policy framework without including some kind of stakeholder involvement or public participation.

Given these widely diverging understandings of public engagement, it is imperative not simply to call for more societal participation in technoscientific processes, but also to reflect on such issues as: the ways participation is enacted, on the motivations behind it (solution for what problems, solution for whom), on the actors who are supposed to be participating (construction of the different "publics"), how these moments of participation and encounter are conceptualised (the very meaning of encounter and participation), when they are supposed to intervene (at what moment in the R&D process) and many more. As Chapter 2 explained, there are various ways in which concerned social groups independently develop their own responses and mobilise their own knowledge-networks, including innovation systems, on terms which do not necessarily harmonise with those of policy institutions, unless the latter make some effort to change their own priorities, meet citizens halfway. This involves learning about new social actors, their concerns and capacities, a neglected aspect of learning which we stress in Chapter 6.

Making reference to the UK 'GM Nation?' Debate, Wilsdon and Willis (2004) highlighted the central problem that most people remained puzzled as to what this encounter was meant for. No one, including those who chose to get involved, believed that there was a genuinely open outcome at stake; everyone knew that the government had already determined its preferred outcome, which had much more to do with maintaining global corporate investment in UK biosciences than cheaper or better food, or any other recognisable social benefit. This overt acknowledgement of normativity was avoided. The chair of the official debate process proposed that instead of pretending, as it did, that it had no preferred view of the issue, the government should say why it favoured what everyone supposed it favoured, and then allow open reasoned debate on an openly posed normative commitment. His advice was ignored, and instead, the debate was founded – and conducted and concluded – on a deep public sense of the dishonesty of its government sponsor.

Having said all this, it is important to ask how if at all this momentous collective effort on public engagement has helped - or hindered - its various sponsors and users, including policy-makers, innovators and scientists, to better understand 'the public' in such issues? How also might it have helped or hindered European public understanding (and expression) of *itself*, in the way that then-Commissioner Busquin (EC 2004) expressed it? Further, as hinted above, might this effort devoted at publics, have hindered institutional actors from better understanding *their own roles and responsibilities* in shaping uneasy public attitudes? How might a strong preoccupation with the ruled have obstructed the policy makers from reaching a reflexive understanding of the rulers?

5.4. Forming and Performing Publics: Ways of Collective Knowing

Over the past years many (new) ways of organising public participation on issues linked to science and innovation have been developed and experimented with. They range from public consultation exercises of different formats, from citizen panels to consensus conferences, to more long-term engagement between research and parts of publics such as patients' associations in medical research. STS researchers observing and analysing these have stressed the power of these concrete constellations over who is given voice or not, what forms of agency can be deployed, what issues or questions can or cannot be addressed, what knowledge counts as adequate, and what weight the outcomes might be given in the on-going institutional governance of science and innovation[28]. They have shown how deeply encoded different constructions of the public are in these participatory events, highlighting that they are never simply an arena in which interactive deliberation takes place, but they perform a certain vision of the public without acknowledging that they are doing this.

Since these kinds of framing vision are rarely if ever explicit, and probably not deliberate, it is useful to identify implicit distinctions and frames present in many policy documents: between invited and uninvited participation, between explicit and implicit forms of participation, between the private and public arenas (e.g. media debates). With regard to the invited/uninvited distinction, we highlight that within the imagination of participation certain players are conceptualised as a legitimate voice of society while others

28. It has been one of the recurrent complaints against such varied participatory initiatives that their practical connections with real institutional policy processes are undefined and often non-existent. One notable exception has been the Danish technologiradet, which informs parliamentary deliberations and decisions with well-crafted forms of direct elicitation of relevant public concerns, meanings and attitudes are silenced. Who is given voice in such processes may be determined by what kind of position they are expected to take, and whether this coincides with or disrupts entrenched dominant frames. However, such denial or neglect does not mean – as we have seen in concrete cases of patients movements, or NGOs public involvement (e.g. in the environmental sector) over the past decades – that they remain silent. The dichotomy between explicit or implicit participation tries to capture the fact that publics can be absent presences, in the sense that they are not physically present in policy making but get represented and imagined by actors, whether through survey results and similar tools, or by more informal processes. Finally, distinguishing between the explicitly political and other public arenas where science and innovation are addressed should sharpen our attention to cultural differences and multiplicities of understandings, as well as the fact that issues might not be as prominent in the policy arena as they are in other public life-worlds.

The different forms of publics which are enacted in such public participation exercises fall into two big categories: one around a vision of citizens as individuals and the other around the public as represented through stakeholders. In looking at these two categories, an interesting tension becomes visible. Extensive use of the stakeholder model as an ideal form of societal participation excludes a broader vision of citizenship. The term stakeholder involvement implies that the issues 'at stake' are already agreed. That this may not be the case, and may need to be explored as a question, is often neglected by institutional policy processes like risk assessment, as we explained in Chapter 3. Citizen involvement on the other hand carries no such presumption, and thus more readily accommodates diversities of 'local' cultures with different preoccupations and concerns, meanings and worldviews.

The discursive shift from 'citizen' or 'public' to 'stakeholder' thus has to be considered carefully, as it defines and reduces the scope of democratic governance issues. The idea of 'stakeholder democracy' is therefore already compromised if, as we suggest, the very term connotes that a universal primary issue in which we have a shared stake, has already been given sovereignty as social meaning. Indeed, the fact that the public at large shares certain values, experiences and ways of testing and handling knowledge claims – a capacity which Jasanoff (2005, 255) labels "civic epistemologies" – loses significance in the shift to the stakeholder conceptualisation.

"The public" as an imagined collective of individual citizens can be invited to the table in a metaphorical sense. Representativeness here becomes a central issue and is often of concern when it comes to the impact and credibility of the outcomes of such public engagement exercises. While much could be said about how, when and why these constructions occur, two different imaginations of the citizen illustrate the variety of performances that can take place. The first example could be labelled "the ordinary citizen". Behind this figure ¬– often used in the context of citizen panels or consensus conferences (e.g., an explicitly used label in 2005 EC public engagement with science exercise, "The Meeting of Minds"[29]) – stands the idea of a person who has not made up his/her mind on a given issue, who is not entrenched in any political movement, and could thus take an "innocent" position on an issue. Through this figure, any sustained engagement with an issue is seen as hindering an "objective", "distanced", "value-free" judgement about science and innovation issues. This approach seems to "prioritize the 'open minded' (or 'innocent') citizen over those with existing views (the 'activists')." (Irwin 2006: 315) And it fosters the imagination that in such a model of democracy stakeholders could be marginalised and any kind of strong polarisation avoided. The untouched innocent participants need first to be educated and to acquire expert knowledge which should form the basis of their decision. Participation then is firmly confined by the scientific input given and the agenda so framed.

A second example is the figure of the "monitored citizen" which emerges in large-scale surveys such as Eurobarometer. Here the public is constructed out of a representative statistical sample of appropriately selected citizens of each member-state, understood as objectively representing "the public". Through posing a clearly defined, closed set of questions to its respondents, and inviting unambiguous responses, through analysing changes over the years, as well as through diverse ways of comparing countries and other socio-

29. ***http://www.meetingmindseurope.org/***

demographic parameters, imagined communities – women, people in southern Europe, people with lower education – are created with seemingly shared attitudes towards science and technology and holding certain types of knowledge. The following quotation from the most recent Eurobarometer survey on "Europeans, Science and Technology" summarizes the responses to the survey attitude test-statement "science makes our ways of life change too fast": "Women, the oldest populations, those with the lowest level of education, manual workers and persons living in rural areas are the most numerous to feel this way." (Eurobarometer 2005: 66) Such survey research, sophisticated as it is, never simply represents the public, but also shapes public identities and attitudes in subtle and powerful ways. These processes, operating beneath the explicit, accountable and deliberated level, suggest the need for collective reflection, and for European policy institutions to acknowledge and take up their responsibility to cultivate and learn such reflection, if they wish to achieve better science-society relations.

Besides addressing the European public as individuals, there are rich examples of newly emerging groups of actors in the fields of science, innovation and governance. They show different ways of organising and engaging with science, grounded in substantially different collective ways of life, frames of meaning, and epistemic frameworks. These associative and citizens engage with research – often also labelled third sector of knowledge production - in order to introduce a different logic into the production of knowledge, to explore alternative sociotechnical futures, and to produce scientific knowledge of a more local relevance; they thus try to establish an alternative model of innovation. (Finn 1994, Sclove 1995)

One such group is patients' associations, the number of which as well as their upstream involvement in defining scientific research are growing steadily. Instead of simply being affected, they mobilise to intervene in the orientations of new research and contribute actively to the useful knowledge about "their" disease. They have thus entered a domain which was before reserved for specialist knowledge (Callon 1999); in this sense they are new actors in the science, innovation and governance domain. They bring to bear experiential knowledge concerning their medical condition so that research can find solutions to the real problems they encounter. In the case of AIDS research in the US, Epstein shows the transformation of 'disease victims' into 'activist-experts'. (Epstein, 1996) In a similar though institutionally different setting, Rabeharisoa and Callon (2002: 63) show the important strategic involvement of patients' groups in the French context. They argue that "the involvement of patients' associations in scientific and clinical research is contributing to the as-yet hesitant emergence of a new model for the production and dissemination of knowledge and expertise." The struggles involved in reconfiguring such deeply-embedded knowledge-practice hierarchies are intense and demanding. This is true whether the social and governance innovations involved are primarily about innovation of new products and services, or protection (as with risk-knowledge and management), or both.

Similar accounts could be given about NGOs or other civil society groups' involvements with the 'internal' shape and trajectories of science. The WIKI movement is one case of a "non-invited" form of participation, which in distributed ways tries to implement an alternative model of a knowledge-building community mediated through new information and communication technologies, organised in new relationships. The farmers' seeds movements, the free software movement or consumer groups described in Chapter 2 are also groups who have become agents of extra-institutional distributed forms of creation of useful knowledge, supplementing or transforming institutional scientific expertise where needed.

A key element of these exercises of engagement is that their participants can be seen as knowledgeable agents, and ones who are capable of experimental practices. Through informal collective practices these agents evaluate the robustness and validity in of those knowledges seen as salient to their life-world concerns. These practical capacities are not usually codified and explicit, but are rather implicit sets of rules articulated and tested through practices. As a consequence judgements are rarely made according to clear sets of explicit criteria, but this allows for the adaptive management of more complex situations and meanings where – in contrast to technoscientific policy knowledge – lack of complete control is taken for granted.

Such civic knowledge should not be seen as an alternative to scientific knowledge. The central issue here is not to claim better knowledge of one party or the other, except in specific and precise contexts. It is to understand the grounded specificity of civic knowledges in their approaches to sense making, independent from those of institutional authorities. This means in turn that citizens have capacity collectively to express knowledge-based doubt and reluctance – which is reasonable but not of course beyond contestation – from within their own ontological frameworks of meaning, experience and value. The problem is that expert counterparts' positions on the same issues have been posed as if they were beyond reasonable and legitimate contestation, which stance inevitably and gratuitously depreciates their citizen interlocutors by refusing recognition to their very being as reasoning subjects.

5.5. Conclusions: The 'Growing Unease' Revisited

Throughout the report we have tried to argue that public unease is not so much based on the outcomes of science and technology in the form of innovations, but much more on how these developments are shaped, and about the behaviour of the institutions primarily in charge of innovation, and risk regulation, and public engagement. One pervasive and ramifying element of this problematic complex is its attempts to respond to public concerns about science, innovation and governance in ways which tend to exacerbate rather than alleviate them. Thus public unease should be attributed to the relations as well as the forms of denial in play, and not to the mismanagement (or 'misunderstanding') of risks, or unpopular (or 'misunderstood') innovation choices.

We suggest in addition that public unease could be caused by over-concentration on the "hardware" of engagement – the methods, focus groups, citizens' juries, evaluations, a big industry now – that are meant to give the public a voice. As argued before, publics tend to hold differentiated and contextual visions of technoscience and innovation. Consequently, they also have varying expectations with regard to science, governance and the kind of participation they judge adequate. (Felt et al. 2007) The modern governance of science and technology thus should become more open, controversial and case specific. The focus should shift more to the "software" – informal codes, values, norms – that governs scientific and policy practices. This software or cultural dimension is more pervasive, less visible, escapes design, and is harder to change, but nevertheless seems to be a key to the issues involved. (Stilgoe et al. 2005)

Simply having more participation or communication – as is definitely the case in the early 21st century – does not turn out as a solution to public alienation. The more basic and reflexive questions posed in this chapter appear to be more salient in motivating appropriate responses and learning from twenty or more years of experience of public understanding-participation-engagement with science.

Cooke and Kothari (2002) have introduced the unsettling question: is "Participation [as] The New Tyranny?". Their argument is based on many case studies showing how invited forms of public participation with science and expert planning end up manipulating their publics by imposing top-down conditions and framings which never challenge entrenched assumptions, interests, power-structures and imaginations. Just the same kinds of critical question can be posed for EU and other public engagement with science initiatives.

Our discussion underlines the crucial conditions which have to prevail for such exercises to have positive and not damaging effects. In addition to the common problems of imposed non-participatory framing of the accepted issues, and delayed participation which comes only after entrenched commitments have become virtually irreversible, public deliberation and up-stream engagement remain too-often misunderstood as one-off moments. (Wilsdon & Willis 2004) Yet many understand that these issues are dynamic, complex and interactive, and have to be revisited. In that sense each case needs to develop its own logic of participation. It seems risky to follow a more technocratic pattern of defining a standardised repertoire of "good practice". Not surprisingly, some of the most successful cases of participation involve new actors such as patients groups as they manage to create long-term settings in which knowledge is negotiated on a more continuous basis.

Finally the idea that consensus is central to participatory exercises – as expressed in consensus conferences – should be rejected. Indeed we should ask why consensus should be a better input for policy making than identifying the central areas where authentic disagreement, or even dislocation remain. In that sense dissent should not be understood as a failure but rather as a vital form of keeping public engagement with science authentically alive and not under the control of agents whose own culturally embedded assumptions, imaginations and practices may well be part of the problem.

Chapter 6: Learning, Reflective Reason and Collective Experimentation

6.1. Introduction

Amidst a huge and varied body of research and understanding on '*social learning*', we decided that our focus on science and governance, from a STS perspective, should highlight relevant aspects of institutional learning. Our particular concern here was to contextualise how such learning is selectively shaped, by relationships and practices which may have become routine and no longer objects of deliberate attention and review. When bigger changes of context are occurring, such as multiple dimensions of globalisation, the changing role of the state, and the commercialisation of science, these may shape learning in science and governance – and obstruct it in important ways – without anyone's being aware of these effects. We choose those issues for learning which are brought into profile by our earlier identification of some key problems in EU policy: science and innovation; risk, uncertainty and precaution; ethical issues; and public reactions to institutional treatments of these so-called scientific issues. This means taking up the reflexive ideas of knowledge and learning introduced by Schon (1983); and it means including not only instrumental ideas of learning, but also what we call reflexive, and relational learning. By these less obvious and less mainstream forms of learning, we mean insight into the assumptions which tacitly shape our own understandings and interactions (reflexive), and learning about the independent integrity of others whose ways of life and thought we may be tempted to assume are just irrational, disruptive, even threatening. These forms of learning are of course supplemented in all arenas by the third important category, instrumental learning and knowledge.

Philippe Busquin, then-European Commissioner for RTD, indicated the relevance of these distinctions, in his observation that "part of forging a knowledge-based society is knowing ourselves – our aspirations, our needs and our concerns" (EC 2004). Despite such authoritative reference to the need for both the reflective and 'relational' aspects of learning, these have suffered neglect through the de-facto emphasis given to instrumental learning and knowledge. These different categories are not mutually exclusive, and we suggest that instrumental learning could be more effective, robust, inclusive and sustainable, if tempered by the other two. Implicit in this is also learning about each-other and how to handle differences in civilized, peaceful ways.

Awareness, in an ethical and reflective intellectual sense, of the limitations of our knowledge, thus modesty in the claims we make with it, is another crucial learning dimension of a mature knowledge society[30]. Awareness of 'the other' can also be usefully enlarged to include not only different cultures and their autonomy from our ways and means; but also, as discussed in Chapter 3, the epistemic other, of the *unknown* which always lies beyond our positive knowledge, and which scientist-philosophers like Polanyi (1958) defined as the essential ethical inspiration for scientific research practice.

30. Historians and philosophers (Hacking 1989) have long made the important distinction, still typically confused by practitioners, between ontological uncertainty (in the behavioural processes themselves of interest), and epistemic uncertainty (in the knowledge we have of them).

Varieties of learning are innumerable, but shadowing these are also humbling reminders of the subtlety, pervasiveness and significance of unintended *un*learning. These are processes of unnoticed forgetting through discontinuation of material practices of specific knowledge-cultures, including, crucially, of scientific knowledge which we have been taught to understand as relentlessly cumulative. If we must become increasingly dependent on scientific knowledge's instrumental powers in technology, then developing these more reflective dimensions of collective awareness – including about risks of staking too much too early on the supposed certitude and exclusivity of existing knowledge, and about 'roads not taken' – may become increasingly important, not less.

In this chapter therefore we select and develop in relation to foregoing chapters what we see as key issues for European science and governance, and learning about our capacities, and incapacities, under present and imaginable future conditions. We will use a European case-study with global ramifications, that of the scientific and policy learning in the wake of the 1986 Chernobyl nuclear accident's radioactive fallout. This single case has several salient dimensions which we describe, but which arise sometimes separately, in other science and governance cases. Finally we also introduce a possible mode of collective learning which is derived from insights in previous chapters, and which might allow the development of greater relational and reflexive capacities; namely, deliberate forms of collective experimentation (Chapter 2).

6.2. Learning and Imagination

Learning from experience, including mistakes, is recognized as essential to a mature and robust knowledge society, not only for the instrumental reasons of avoiding harmful mistakes, but also for the democratically-accepted legitimacy of our institutions of policy and politics, and of the science which shapes these. But this and the associated notion of 'evidence-based learning', or 'evidence-based policy', while unimpeachable in principle, brings with it certain problems. For example, this normative way of framing the process of developing knowledge for policy suggests that imagination plays or should play no role in public policy. Evidence or material experience it is implied, if drawn from the proper sources (e.g., peer-reviewed, selected expert), speak for themselves and carry their own meaning. Imagination is superfluous, and untrustworthy.

Thus in innovation and regulatory policy, a distinction is often drawn between 'real' risk, and 'theoretical risk', the latter being dismissed as 'unreal'. This effectively asserts that existing theory, validated in the normal professional ways, is somehow an unreliable basis for belief and commitment. Only empirical evidence of harm is deemed reliable. Yet evidence only becomes evidence in the framework of some theoretical commitments which give the putative evidence salience, and validity. Imagination in this sense is pervasive and essential to rational thought, and to scientific evidence and its uses. Yet whichever imaginations take root typically lies unexamined.

One of the key issues which arises from the collective self-examinations which occur in the aftermath of such human-made mistakes as the 1986 Seveso explosion, Chernobyl, the 'mad-cow disease' or the contaminated blood scandal, is: what sort of assumptions were the key actors in government and science making, when they entered into the commitments and reactions which defined the crisis? Moreover, a question often confused here is whether those assumptions were made knowingly, as self-conscious assumptions-as-questions? Or were they made unwittingly, as just taken-for-granted 'assumptions' which operated as beliefs whose very status as questions was concealed by habituated conviction, and was only exposed as the issue evolved?

Given our focus on the factors underlying the cited public unease with institutional science in Europe, it is notable that these and related public issues involving science have made up a large part of the evidence-based learning experience of European publics, of things done, in the name of science, by the institutions of governance and science on whom those publics know they are dependent. Learning about the syndromes of built in, taken-for-granted assumptions which come to take on the status of institutional scientific and policy convictions, when they should be recognized and dealt with accountably as questions, thus forms a substantial part of this learning chapter.

Concealing Contingency as Cultural Habit

An example of unstated commitments effectively operating as inadvertent assumptions was the seriously mistaken UK scientific and policy response to the 1986 radiocaesium fallout from the Chernobyl nuclear accident in the English Lake District. Over several years the advisory scientists made a succession of mistaken assumptions and responses to information which could have allowed learning. Initially, as radiocaesium was being threatened to be rained out of the atmosphere onto land, the scientists asserted that there would be no problem at all. But they soon had to reverse this when it was found that lambs on Lake District hill-farms were contaminated above the EU action level. The mistaken scientific reassurance was based on the implicit scientific 'assumption' that when rained out of the atmosphere, the caesium would contaminate hill sheep on a once-through (one-pass) exposure only, before being washed off the surface vegetation eaten by sheep, and then locked-up in the soil. On this basis they concluded publicly that radiocaesium would be non-existent as a sheep-meat human food-chain public health issue. They were then refuted by subsequent empirical experience of continually contaminated sheep and thus restricted sheep-movements and sales. These restrictions, and their initial and only slowly-overcome denial by scientists, drastically affected not only hill sheep farmers' livelihoods, but also their and public onlookers' attitudes to official science. This 'assumption' was not *consciously posited and tested as such* by the scientists involved. Instead it was a conviction that was only exposed as a question by its high-profile refutation in evolving policy and scientific practice.

Learning in such cases[31] requires more than learning to correct the false 'assumption'. This is instrumental learning, and as such, valuable, even essential; but alone it is not enough. Two more general features of scientific knowledge for public policy and governance arise here, and which we develop in this chapter.

- One is the importance of (self-)*reflective* reasoning, or indirect learning, as distinct from instrumental, direct learning alone.
- The other is the unrecognised dimension of *unlearning* which inevitably but silently accompanies disciplinary knowledge-production and instrumental learning processes.

Both of these dimensions of learning processes remain little recognized in scientific and public policy circles. Yet they have major implications for effective and trustworthy European science and governance. This is especially the case in contemporary situations where:

a) sustainability and precaution are rising long-term issues, both of which hinge on the ethical as well as intellectual question of how much faith should we place in our knowledge which we use to justify new interventions in nature; and

b) the public dimensions of science, and lack of public trust – in innovation-oriented as well as protection-oriented science – have become such a central and persistent concern.

If we give attention to the issue of public unease with science, then these reflective and relational dimensions are seen to need extra attention, and deliberate moves to help develop and entrench them in EU scientific and policy cultures. In the rest of this chapter therefore, we focus on these less obvious aspects of

31. This is typical of scientific knowledge as policy authority, for example in environmental risk assessment of GMO releases, as the risk assessment agenda of scientific questions is continually revised and expanded as previously-denied areas of scientific ignorance are pointed out, rendered salient, and then sometimes encompassed by official scientific regulatory risk assessment. The revised scientific culture ignores the historical learning which is available at such points, about its own socially- and culturally-shaped endemic epistemic limitations. This neglect of a more reflective, modest mode of public reason is not accidental and ad-hoc, but is more systematic, as historians of science have noted about the myth-making character of indigenous cultural versions of the history of scientific knowledge-development (Kuhn, 1962) learning for a 21st century knowledge society, and make proposals as to how they might be constructively and democratically embraced in what Commissioner Potocnik (2005) refers to legitimately as "the fostering of a research-friendly European society".

As we suggested in Chapter 4, EU science and governance is in need of generating, at member state as well as EU levels, a diverse overall institutional capacity for deliberating the normative human and social dimensions of public issues which have been unduly and falsely technicised and instrumentalised as if they were solely scientific security issues, of 'what size are the risks and how do we control them?' The social and normative questions of innovation knowledge and commitments, questions of their directions and not only their growth, have been obscured by an almost exclusive attention to questions of risk, and latterly, (individualized) ethics. We suggest that Europe needs deliberately to work out how to develop the learning processes collectively to address such normative societal issues as well as the instrumental protection-oriented ones.

The three kinds of learning we identified earlier, instrumental, relational and reflexive, are not seen as mutually exclusive, but interpenetrating. A further key dimension of learning is that of practical skills and tacit knowledge, where what one 'knows' may be beyond one's own knowledge of it, thus inarticulate – but even so, morally and instrumentally crucial. Many knowing communities studied by anthropologists for example, harbour their significant knowledge implicitly, and in indirect practical forms whose formal rationalizations would be difficult maybe impossible. Scientific practitioners have been found to hold such tacit knowledge too (Collins, 1984; Polanyi, 1958). Their knowledge is more intimately woven with their patterns of social relations, practical craft skill traditions, and moral boundaries which are not subject to explicit deliberation but are cultural givens.

Dominant conceptions of learning in modern science-dominated cultures show several distinct defining assumptions about science, innovation and governance, for example:

facts can and should be established first, and only after this should values be admitted;

- learning is primarily an instrumental enterprise, just as knowledge is presumptively always about object-worlds and their means of behavioural manipulation, prediction and control,
- when it comes to uncertainty, learning categorically and progressively amplifies knowledge, reduces uncertainty and increases control.
- foresight, horizon-scanning, and more sophisticated idioms of prediction in the face of complexity are the highest form of future-oriented policy learning.
- learning is the improvement of deemed precision in such chosen key scientific-policy parameters or deemed objects as '*the climate sensitivity*', 'sustainable development', or 'risk'.

Various undersides exist to these dominant institutional discourse-practices of learning, and they require some examination.

6.3. Learning and Forgetting

Learning is conventionally taken to be essentially irreversibly cumulative, with no remainder or underside. Yet the development of a body of knowledge is usually accompanied by a corresponding process of '**unlearning**' other forms of knowledge (Robinson, 1988). Even if these are not in equal measure, what is lost can be important. Likewise as knowledge is acquired, new forms of ignorance are also created, or mobilized (Wynne 1992a, 2005; Ravetz 1986). Powerful knowledge traditions are created by successful channelling and the social-intellectual exclusion of ambiguities, contingencies, and alternative potential knowledge. This has further consequences.

In these terms then, social learning is about the unlearning of old, as well about the learning of new forms of knowledge. As we see below, this includes science. We also note that commitment to a particular knowledge-trajectory also normally involves not just the destruction-obsolescence of existing knowledges-skills, but also the non-pursuit of alternative possible knowledge-trajectories that could have been developed.

These *unlearning* processes may be subtle and inadvertent. The post-1986 Chernobyl example is relevant again. In the recrimination-filled aftermath of the mistaken scientific predictions about the chances and then duration of radioactive lamb-contamination, denials of any prior knowledge of the different behaviour of radiocaesium in the peaty Lake District hilltop soils from other soils were forcefully made. Yet this scientific knowledge had been published in the 1960s, inter alia in the annual scientific reports of the public UK Agriculture Research Council. This 1960s explicit scientific knowledge had – by no deliberate design or recognition – become practically redundant and discontinued, thus literally unknown to science, by the time of Chernobyl's radiocaesium fallout in 1986. What had been scientifically known, had been inadvertently but completely unlearned[32] when it was needed. Does science carry this kind of enlightening reflexivity as to its own conditional quality? How do we deal with what we do not know, and thus cannot specify? And if we have as human societies created those unknown conditions or effects (including ignorance), then how do we as a self-consciously learning, knowledge-society, formulate appropriate societal responsibility for them, rather than pretend that they are 'acts of god' (thus no-one's responsibility)? As Chapter 3 indicates, risk analysis alone cannot be expected to deal with these inherent dilemmas which beset it. Larger institutional, and perhaps cultural changes, are suggested.

The 'innocent factual' learning which policy leaders and scientific spokespersons have repeatedly asserted as essential, has always been heavily weighted with unacknowledged but obvious moral normative prescription. One example is UK Prime Minister Blair's 2002 speech to the London Royal Society:

> *"Science is just knowledge…science does not replace moral judgement. It just extends the context of knowledge within which moral judgements are made…*
> *The fundamental distinction is between a process where science tells us the facts and we make a judgement; and a process where a priori judgements effectively constrain scientific research…let us know the facts; then make the judgement as to how we use or act upon them" (Rt. Hon Tony Blair MP, "Science Matters", London Royal Society, 23 May 2002)*

Included in 'the facts' here are the avowed societal benefits of GM crops, a social values stance which scientists themselves have also called scientifically factual (e.g. Burke, 2004). Moreover the politically instrumental dimensions of the invocation of science as attempted public authority are equally manifest while also being denied as such. Whether this is an innocent or deliberate deception, is beside the point in terms of its apparent failure to ameliorate public alienation. It is stated that "science does not replace moral judgement", yet it is made to do *precisely* that in the assertion that a particular commercial technology's natural and unqualified benefit to society – a normative, moral view; legitimate, but legitimately contestable – is a function of rational scientific factual knowledge. The effects of this on public trust of science have been overlooked. This seems a significant *failure* of learning. Under this established institutional philosophy, it seems difficult to imagine how the unnoticed dimensions of scientific knowledge and its uses we have indicated – and which we understand to be a major contributor to the public unease with science problem – could come to be learned-about, acknowledged and addressed.

6.4. Risking Collective Experimentation

Previous chapters have from various directions stressed the importance of recognizing the contingencies which underlie scientific knowledge, its production and uses. What does this imply about learning? Because

32. There are further social dimensions of this scientific knowledge-development published elsewhere, eg Wynne 1992a, 1996.

we have often been able temporarily to suspend or externalize the destabilising effects of contingencies, or lack of control, it has been usually misrepresented as uncertainty which will be under control once we have done a bit more research, and experimentation. It is defined more like residual imprecision than authentic contingency. The Chernobyl radiocaesium case is one such example, where the unrecognised contingencies in the knowledge, once tacitly exposed by the failed predictions, were defined as marginal errors which would soon be corrected by adjustments to, not wholesale replacement of, the established knowledge (and its key assumptions) in play.

These unavoidable contingencies (McKenzie 1990; Krohn & Weyer 1989) mean that even after all the elaborate pre-market testing of innovations under controlled conditions, there remain experimental processes to be engaged in. As innovations diffuse, they always necessarily meet new, unprecedented conditions of deployment, in which previous testing is not completely salient. This has always been the case, but has become more significant as innovations from lab to market have been speeded up under commercial pressures, and as they have become more materially and socially complex. Thus we are in an unavoidably experimental state. Yet this is usually deleted from public view and public negotiation. If citizens are routinely being enrolled without negotiation as experimental subjects, in experiments which are not called by name, then some serious ethical and social issues would have to be addressed. Even if no simple or accessible solutions exist to this problem, if our concern is public trust, surely a minimal requirement is that we acknowledge the public predicament.

Two generally accepted insights shape our view of the importance of experimental idioms of thought and practice for social learning for European science and governance. These are:

- first, the *contingency* of scientific knowledge as considered for potential use in public arenas of all sorts, whether innovation and technologies, or regulatory policies, or combinations; and

- second, the recognized redundancy of the traditional framework which supposed that all technological innovations introduced into society were first tested under the controlled and isolated conditions of a laboratory, which left society protected from premature release of uncertain entities. Thanks to the incessant intensification and growing scale of technologies and technosciences, as Krohn and Weyer first put it in 1988, nowadays "society [and the larger environment] is the laboratory".

Strictly-speaking, neither of these conditions is historically new. The continuing experimental character of the social diffusion of fully-tested technologies for instance, has always been the case in the sense that laboratory experimental testing can never fully anticipate and enact the sheer complexity, contingency, variety and combinatory flux of the conditions of use even of a simple hammer or paper-clip, let alone a stem-cell or a guided-missile system. However the possibility of replicating in prior laboratory containment, the salient conditions of implemented and enacted technologies like: full nuclear energy fuel cycles; automated computer-controlled aviation technologies; or commercial-scale GM crops, their environmental interactions and their full, segregated food chains; has become utmost challenging. For more complex and networked technologies especially, experimental conditions, open-endedness and unanticipated new interactions and behavioural demands – new test conditions and questions – continue way out into society's farther reaches, well beyond formal societal regulatory testing, approval and release.

However if society is indeed now the experimental laboratory without walls, and by implication therefore, social subjects are also the subjects (guinea-pigs) of such open-ended techno-social-environmental experiments, it is necessary to begin discussion of the implications for governance, science, publics and technology. What is meant by experiment here? And if everyone is in principle a guinea-pig, then who is participant in the experimental design, and interpretation – and who has right to its veto?

In the usual model of experiment the scientist is supposed to know all the salient conditions of the test, and what questions are being posed by the experiment. As sociologists and historians of science have observed from studying scientific practices, and as scientists themselves have sometimes recognized, real scientific experiments are more ambiguous than the conventional model allows. Thanks to imagined, theoretically-driven suppositions, particular results come to be confidently expected rather than remaining open-ended questions. More significant, unexpected results occur which were not simply a function of known unknowns, but are inexplicable in any existing understandings. It is when such anomalies disrupt the normal experimental routine that practitioners may return to try to examine what they had been unquestioningly but mistakenly assuming as given facts. In laboratory experimental science, mistaken premise and false prediction create no wider harm. The post-Chernobyl surprise radiocaesium behaviour in the English Lake District illustrated this more general condition.

Even when the already once-corrected public predictions were falsified again by further empirical evidence, of lambs staying contaminated after the predicted time-period, the unquestioned assumption about soil-immobilisation that was embedded in the heart of the scientific reasoning was not placed in question. Predictions were simply adjusted to the idea that the contamination was taking a little longer for reasons unknown. Eventually, when it became undeniable that the predictions were not just marginally imprecise, but utterly mistaken, the scientists were forced to review their prior knowledge and identify the assumptions woven into it. Among these were the convictions that radiocaesium would behave as it did in clay alkaline soils, and that sheep would suffer only a one-pass contamination. It was thus a blind experimental test, an accidental scientific stumbling across a question – does the soil in this place behave the same in this respect as elsewhere? – whose existence and salience had not even been imagined when the Chernobyl fallout occurred. It was in this sense an unknown unknown, concealed by institutionalised lack of collective self-reflection. Science does not always know the questions it is asking, even in its own designed and 'controlled' laboratory experiments, let alone in the open-ended 'experimental' situations which typify science, technology and innovation in today's world. Where is this reality represented in science and policy?

Deliberate Collective Experiment as Policy: an Example

So far we have emphasized what might be seen as the 'regulatory' side of insights about the contingencies which always beset scientific knowledge when deployed as public resource, in innovation, or in protection role. These can and should be joined by more positive opportunities where such contingencies can be addressed and exploited positively for European society. An illustration of such a deliberate experimental collective participatory learning process could be performed in public sector food and agriculture scientific research, a domain of obvious European importance in several respects. Currently, the main stakeholders represented at the tables of national scientific funding bodies such as the UK BBSRC, and similarly for EC framework programmes, are a small minority group when seen against the diverse array of social and economic stakeholders interested in food and agriculture techno-social innovation. Many stakeholders are not represented at all, thus their concerns and knowledge-needs register little as feeds to potential scientific research trajectories. A process of deliberate collective experimentation could instead assemble a different network of stakeholders, including farmers, suppliers, retailers, processors, consumer groups, traders, investors and transporters who may wish to develop viable commercial food-chains which are traceable, local, low-input and sustainable, farm-to-plate. What sorts of knowledge-questions would arise from such network deliberations? How would these be translated into salient research questions, and how would such a research agenda be created, funded and implemented? How would this be shaped by patent and timetable concerns? What sorts of applications and uses questions and opportunities would arise? How would this compare with the existing agriculture-food knowledge-network and its imaginations of needs, priorities, viability, and quality?

A further array of questions is imaginable for example about how the scientific knowledge that such a collective experiment generates might differ from existing conventional scientific knowledge? Moreover, whether the resultant scientific knowledge-ability would be more socially-distributed or concentrated, with what effects for innovation and public good? Is there a different fundamental ethos of science available or implied in a social constitution of scientific research which builds from a different perhaps more inclusive, distributed and diverse societal base than one which is more concentrated, selective in its social interests, visions, and forms, and more reflective of larger units of economic capital and technology-intensivity? As Andersen (1983/1991) has put it, different "imagined communities" are in play here, with implications for what is deemed to count as valid knowledge, thus for what is recognised as public good science. There may be a more vibrant, scientifically dynamic and constructively-engaged, socially-supported science available if the currently intensive but inevitably more narrow, reductionist model which predominates at both national and EC level were to be experimentally diversified and decentralized, as a deliberate collective learning process.

In a very different domain, precursors to this arose spontaneously as 'alternative corporate R&D plans' in 1970s and 1980s defence-engineering (Mort 2002; Wainwright & Elliot 1982; Cooley 1980). That these were never even tested indicates an intriguing challenge with far broader potential.

6.5. Conclusion

In this chapter we have examined some aspects of learning, including scientific learning when that knowledge is being imagined as for public policy uses. We have also identified some neglected factors in existing EU science and governance cultures which obstruct important dimensions of learning in the science and governance domain. These include the inherent connections between knowledge and practice (Ingold 2001), and the subtle forms of scientific ignorance which are created, as knowledge-practices and preoccupations shift arbitrarily, under contingent conditions. We have also indicated how substantive, sound scientific knowledge of policy-relevant processes like those of risks, is shaped by implicit social imaginations, of scenarios (for example of human exposure) which are not recognized as such and which may silently, unknowingly determine choices of scientific parameters and criteria of validity.

In the face of such pervasive contingency, scientific knowledge can only stand a chance of cultivating sustained, robust European public respect and identification – the very aims which the EC and EU rightly prioritise in the field of research, science and governance – if they first admit that such contingency is indeed the general case. The dominant idioms of control and prediction, and of uncertainty as *residual* uncertainty, thus have to be revised and relearnt as a different practical culture of science, innovation and governance. Learning has been understood mainly as about learning within such premises of improving control, social or technical, and greater instrumental power, social or technical. In addition to this, our analysis has opened up a different, much wider and more open panorama where reflective learning in the spirit of Schon's analytical perspective, and relational learning in the sense of learning about the salience of new actors and their differences with our own assumptions, thus about the need to embrace an ethic of non-control, become more important and in need of deliberate cultivation.

These different forms of learning from the dominant culture of instrumentalism almost as end in itself, are connected through the identical factor of learning about 'the independent other' with a different ontology from our own familiar and taken-for-granted one – whether this other be human, or natural, or both. In this sense there is a deeply moral dimension to this learning, which allows consideration not only of means, but also of human ends, just as indicated as a policy need in Chapters 3 and 4.

It would be consistent with public understanding of science research to suggest that if there were such an institutional acknowledgment of contingency, lack of full control, and difference, European citizens would eventually be in greater sympathy with the science and policy institutional actors committed to it. For ordinary citizens, uncertainty has always routinely included lack of control, and lack of predictability, of many significant behaviours which impinge on daily social worlds. This is contingency. It requires readiness to blend reflection about conditions of knowing with intelligent adaptation to the unpredicted; and it still allows stabilities and predictabilities, measures and even certainties, albeit always conditional ones. Instead of bracketing them out, or steering around them as if they were not there, learning would embrace these typical states of contingency. Thus relational questions would properly emerge as key, since many of the key contingencies and conditions which affect substantive outcomes such as risks, are embedded in autonomous relationships of various kinds.

Under such conditions, we suggest that EU policy, scientific and industrial-commercial institutions which are rightly anxious about their declining public legitimacy, could expect to encounter a growth of public respect, trust, and legitimation, in exchange for the policy and scientific claim or ethical ambition to control.[33]

A final observation drawn from this chapter is about the importance of recognizing, alongside contingency (as distinct from 'uncertainty'), the importance of collective experimentation in fields of innovation, science, and governance. This has two dimensions: first the ethical and political rethinking of the routine involvement of citizens as experimental subjects of such 'experiments'; secondly the opportunities which would exist for European science, and European society to introduce research- and innovation-governance cultures in the spirit of collective experimentation. If society is now the laboratory, then everyone is an experimental guinea-pig, but also a potential experimental designer and practitioner. Whose experiments we are involved in, and what is being tested, are mostly confused, blind and inadvertent, and open-ended. We have not yet even acknowledged that this is the state we are in, as a prelude to defining what kinds of experiment, to what ends, under what conditions, are acceptable. Basic democratic principles require that this new realization be acknowledged, and acted-upon. We suggest that in early 21st century conditions this societally distributed capacity is in need of deliberate development, in the face of intensifying techno-scientific demands on our trust and credulity.

33. Here is an important gender issue which this report has been unable to address, but which deserves such attention.

Chapter 7: Imaginaries, Master Narratives, and European Science and Governance

7.1. Introduction: Why Narratives?

All societies make use of characteristic, shared narratives that express wider imaginations about the world, how it functions, what is to be valued in it, and the place and agency of themselves and others in that world. These narratives are much more substantial than mere 'stories' – they intersect dynamically with the material institutional, economic, technical and cultural forms of society. They reflect prevailing institutional structures and reinforce collective aspirations. In worlds of policy practice, narratives, as we have observed throughout this report, tacitly define the horizons of possible and acceptable action, project and impose classifications, distinguish issues from non-issues, and actors from non-actors.

Narratives are routinely reproduced as normal and taken-for-granted, and this tends to mask their historical origins. The masking is not necessarily intended by their authors or enactors. Indeed widely shared narratives have long-since left behind any possible association with specific authors, interests, or intentions. They are part of the cultural fabric. In consequence, such narratives also shape our futures, often in powerful ways. Societal narratives, like myths, can be in parts both empirically grounded and fictional. They are thus founded in collective imaginations and associated material objects and institutional practices, together constituting what social scientists sometimes refer to as imaginaries. To the extent that narratives are constituents of already designed and lived social imaginaries, they may lie almost beyond rational debate or deliberate redesign.

Europe's future stability and welfare depend on the development of a collective capacity for open reflection, and perhaps revision, of European policy narratives: in the present case, about the huge, sprawling terrain relating to science, innovation and governance. In key respects our institutions and modes of science and governance are strongly framed by accumulated habits, imaginations and routines patterned by such master narratives, which may have been valuable before, but which in changing times invite renewed reflection and review. In this chapter we address this issue in relation to those aspects of scientific knowledge, innovation and democratic governance already covered in previous chapters.

Narratives that shape society operate at many different levels and in different forms. There are what we call master narratives, sweeping accounts, such as that which conflates general societal 'progress' with technological 'advance'. More confined narratives focus on specific, local events aiming at stable explanations which usually foreclose alternatives. Public policy narratives usually lie somewhere between these two levels. They are framed by and build on master narratives about society and how it should function; yet they also articulate diverse more situated narratives pertaining to particular causes, effects and desired endpoints. The overcoming of intra-European violence and instability created by two world-wars through the 1953 commitment to the European Coal and Steel Community, then later the European Economic Community, is one master narrative of today's European Union. Beneath the reasoned analysis, contention and debate which mark EU governance, this tacit concern about potential disorder is never so distant. Such efforts to stabilise preferred visions of social order, to prevent its collapse into chaos, even violence through discourses of science and reason are not without precedent. Hobbes' dictatorial Leviathan, the supremely undemocratic political authority which would prevent society's descent into 'the war of all against all', is one such example. That vision was countered by the emerging scientific revolution championed amongst others by Robert Boyle and his then-radical experimental approach to science. This was part of a wider revolutionary programme which aimed to build order and authority out of disciplined and orchestrated – but collectively and credibly witnessed – empirical testing of nature's objective laws (Shapin & Schaffer 1984). Historically, then, the birth of European science was linked to the rise of European democracy.

Science still contributes seminally to constructive narratives of European past, presents and futures. But science cannot serve as the sole or ultimate authority for a stable or progressive political order. Science's voice, we have learned to recognize, is one of several social voices that must be heeded in a fragmented, uncertain world. How to accommodate the voices of science with those of democratic pluralist politics is the central challenge we confronted in this report, and the grand narratives which shape our imagination with respect to this issue deserve attention.

7.2. Narratives, Master Narratives, and Reflection

The environmental historian William Cronon's (1992) account of the desertification of the arable heartlands of the US during the 1930s, the Dustbowl, illustrates the possible coexistence of multiple narratives. Different accounts of the Dustbowl attribute responsibility to different agents, social and natural. Thus one narrative attributes the disaster to irresponsible water-use and soil-dehydration by farmers recklessly expanding production and wealth, with only short-term horizons, encouraged by equally irresponsible industrial agricultural producers. A different narrative provides a tale of farming families beset by a capriciously persistent long-term drought against which they battled for years. Many eventually capitulated, but not before showing extraordinary courage, commitment and endurance. Each narrative offers its own heroes, villains and victims, and its own lasting moral prescriptions for confronting other crises.

In modern technoscientific societies, narratives that blame ignorance and privilege scientific knowledge have become sufficiently entrenched to be regarded as master narratives. Their normative power is illustrated in Leach and Fairhead's (2003) account of a master narrative West African environmental controversy of the 1990s. They show how the region's widely-observable mosaics of forest and savannah in were wrongly interpreted by western development experts as the results of large-scale deforestation and desertification caused by primitive local land-use practices. This account was taken as evidence to support an already-emergent global master narrative about pre-scientific practices of slash-and-burn agriculture and indiscriminate fuel-wood use causing soil-erosion, desertification, global warming and environmental disaster. This master narrative in turn legitimated developed-world agency interventions to control indigenous livelihood practices. Leach and Fairhead's investigation of this dominant narrative showed it to be historically and empirically unfounded. However, versions of this master narrative persist as justification for continuing interventions, and the corresponding dogma that indigenous cultures cannot compete with modern scientific rationality in global environmental management.

This development narrative has assumed the force of a given, a commonplace whose evidentiary basis is no longer an issue. It simply makes sense; and that sense further dictates the selection of what *counts* as 'evidence', and what is not and need not be seen. Woven into this ostensibly descriptive master narrative are associated structured imaginations about who 'naturally' knows best, on what grounds, and through what kinds of interactions with nature.

We review below some of the dominant narratives which shape and frame key dimensions of European science and governance. In the absence of adequate critical reflection, the once functional properties of these master narratives or myths may become dysfunctional. In the field of science, innovation and governance, such a time of possible "civic dislocation" (Jasanoff 1997) – people losing trust in government – is upon us, with the potential for massive disruption and alienation. The key first step to restoring trust is to develop a collective capacity to reflect upon the salient narratives and their roles in shaping society. Such reflective capacity is a key condition for making a robust European knowledge-society.

Over the last decade the sheer volume of science policy documents, statements, brochures and other materials aimed at different publics has grown enormously. Reasons for this include an increased feeling for a need to legitimate decisions taken, and to prepare future roads to take, and a growing ideology of information dissemination, justification and communication. But we interpret this proliferation of science policy narratives partly as a reflection of the felt need to construct coherent, unifying narratives of imagined and promised European futures, in order to justify interventions and pre-empt disruptive public responses.

7.3. Narratives as Normative and Performative

Policy narratives not only represent the world but enable actors to intervene in and perform roles within it (Hacking 1983; Lynch & Woolgar 1990; Andersen 1983/1991; Law & Mol 2002). In the context of science and governance, the key forces shaping policy are not only apparent facts, but the ways in which the relations of science, technology and society are imagined, both descriptively and normatively.

In a November 2005 speech to the Budapest World Science Forum, entitled "Truth, Progress and Responsibility: the key values that anchor science in European societies", EU Research Commissioner Potocnik (2005) communicated several insightful and progressive observations about science and society. Among these were that 'valid science' requires asking the right questions, rather than only providing correct answers to whatever questions are asked; that deliberative, inclusive framing and validation of knowledge about risks outside of artificial laboratory conditions is essential, that citizens may have constructive knowledge-roles to play in this regard; and that it is now "crucial to give up the classical fiction of the fact-value divide in public technoscientific issues," and rather to recognise the human values that are usually hidden beneath such 'factual' facades.

These sentiments represent substantial advances over Commission pronouncements of only a decade ago. However, the speech also displayed a deeper, only indirectly asserted, framing narrative: that innovation, and the knowledge it derives from, are not socially shaped, even if risk knowledge is. This assertion rests in turn on the frequently drawn distinction between scientific research and expert knowledge. While research scientists are imagined to pose questions defined only by independent science, in the case of expertise the questions are seen as imported from the outside, and scientific knowledge is then mobilised to address them. That scientists' own *research* questions might not be independent remains unchallenged. In that sense, this narrative reproduces the classical idea of a supposed independent and self-governing scientific community that produces factual truth before any use or application. Yet this is the very same "facts-before-values" master narrative which the speech denied, yet which is embodied in the long-standing "risk assessment before risk management" assertions of the EC (and US) on risk and precaution.

Again we can see in this example how policy narratives are anything but 'only' narratives. They have consequential and performative dimensions interwoven into them. Moreover as Potocnik's otherwise admirable statement also shows, these commitments are so deeply ingrained that they can be expressed in tacit forms even when in contradiction of more explicit representations, as in the commissioner's overt rejection of the facts-before-values master narrative.

Master narratives not only purport to describe a situation, they also normatively 'perform' it, or assert how it should be. In this case innovation, as intimately woven in with scientific research, is described, implicitly, as a supra-societal process which simply unfolds in particular shapes and forms out of reach of any human agency; simultaneously it is also prescribed to be in this form, as a normative social and political commitment whose safeguarding should be a collective priority. In this way narratives powerfully project public meaning into society without offering opportunities for counter-narratives from society.

7.4. Master Narratives of Science, Technology and Society

Master narratives serve simultaneously as prior framing, starting-point, justification, and mode of sense-making for the policy domain. They have become durable through enactment into established procedures, continual reinscription into institutional practices and routines, and indeed the shaping of social identities. Many imaginaries of Europe as a social and policy arena are closely connected to master narratives concerning science and technology, both shaping and being shaped by them. Accounts of the European public as given in EC Science and Society Action Plans and related activities, as discussed in Chapter 5 and other parts of this report, are of this kind. Thus when examining master narratives of European science and technology more closely we find ourselves confronting Europe as an idea and a political, social and economic reality (Jasanoff 2005; Waterton & Wynne 2004).

Science, Technology and Progress
Narratives of technoscientific progress and its importance for Europe's development have existed for decades, but have intensified since the 2000 Lisbon Council meeting. For example, an important recent policy document "Creating an Innovative Europe" (Aho Report 2006) stated that Europe needs to break out from an unsustainable path. Europe is characterised as a society endemically averse to risk, science and innovation, reluctant to change, and fast becoming unable to sustain its comfortable position in a competitive global knowledge environment. Europe will fall behind with regard to productivity, in capitalizing on new technological knowledge-developments like ICT, biosciences and nanosciences, because commercial knowledge-investors see more rewarding social environments in which commercial technoscience can thrive through consumer enthusiasm for whatever is forthcoming fastest from the global knowledge-factory.

Science and technology in this imaginary are staged unambiguously as the solution to a range of social ills, including the problematic identity of Europe itself. To the extent that S&T are recognised to generate problems, these are cast solely in the form of mistaken technological choices. There is no question about whose definition of society's problems or needs S&T should to address, nor any prior question about who participated in determining what is seen to be a 'worthwhile' (commercially profitable or socially needed?) objective or outcome. Accordingly, the immensely normatively-loaded term 'progress' is black-boxed and its democratic examination is curtailed.

Innovation in this imaginary, and the master-narratives that sustain it, is always conceived as unconditional good. Problematic aspects – if at all recognised – are mainly externalised, into the ways that innovations are implemented or in the public's misperception of technology's achievements and benefits. What values are embedded in the very concept of progress, and for whom those values have meaning, are thus rarely addressed.

The master-narrative of progress is often linked to themes of threat, risk and responsibility

> *"Europe and its citizens should realise that their way of life is under threat but also that the path to prosperity through research and innovation is open if large scale action is taken now by their leaders before it is too late." (Aho Report 2006, 9)*

Risk here is not linked to the consequences of an innovation, but more to missing a technoscientific opportunity and suffering the threat of dire societal consequences. That 'progress', 'science' or 'innovation' might be subject to shifts in the imaginations which drive them is – or indeed that there might be competing visions of progress in a given society – is left out of this master narrative. Responsibility for economic and social failure is instead implicitly delegated to citizens who do not feel obliged to act according to this particular ideology of progress. The master narrative poses an all-or-nothing option. In Chapter 4, we saw similar moves under the aegis of European bioethics discourses, implicitly disabling European citizens from taking part in such deliberations in a mature, orderly but potentially time-consuming way (that is, in practice, one which might inhibit the race to innovate as fast as possible in whichever way is profitable to the market).

The speed imperative, to act immediately, "before it is too late," is tightly linked to European S&T policy. A January 2003 EC press release warns: "Today's fundamental research will turn into tomorrow's growth, competitiveness and better quality of life. The US has understood this. The EU is still lagging behind. Ours is a wake-up call: we need to act now to reverse this situation and fill the gap."[34] Within this temporal narrative, reinforcing the singular, narrow, 'no-alternative' vision of scientific progress, social mechanisms such as law and ethics, or public engagement of a serious kind, are always defined as lagging or braking progress, as noted in Chapters 4 and 5.

Objectivity and Rationality

Having recourse to an independent, objective and rational science is central to public policy. Yet it is expertise, not science, that informs policy, and where expertise should be drawn from, and in relation to what problem definition, are seldom explicitly questioned. "Evidence-based" decision making has become the new credo. The conventional wisdom takes for granted that in any policy decision making, scientific facts should "shape the landscape for meaningful alternatives, and set both the potentialities and the boundary constraints of the [assessed] situation" (Potocnik 2005). That is, facts in practice must precede any exercise of values. Chapters 4 and 6 especially have exposed the problematic character of this supposition.

Recent discussion of Mode-2 science (Gibbons et al. 1994; Nowotny et al. 2001) has pointed out that ways of producing technoscientific knowledge already extend well beyond the classical 'independent' mode of basic science. Stronger roles of applications contexts and imaginations in the very production of knowledge, transdisciplinarity, and socially as well as epistemically extended peer-review are but a few elements which indicate much broader social involvement in how knowledge is produced and validated. This co-production of science and society changes the very meaning of notions like objectivity and rationality.

Against this background, the three principles of scientific advice put forward by the White Paper on European Governance (CEC 2001c) seem inadequate:

quality, meaning excellence in research, integrity through transparency of dependencies, and pluralism of advice;

openness meaning transparency in relation to the way issues are framed, experts are selected, and results (including its various uncertainties) handled; and

effectiveness meaning a balance between short-term costs against anticipated longer-term gains such as robustness of actions taken;

These terms presuppose that there is indeed a fully objective, independent and impartial domain of technoscience that experts can tap into, and that the only challenge is to ensure they do so with integrity. That narrative, however, does not come close to addressing the complexities of contemporary science and governance, and thus need to be redefined and extended to make allowance for more inclusive and democratic values and Recent experiences have shown that citizens who engage with technoscientific issues can develop a fine-grained understanding of the problems at stake, including their technical as well as

34. *EC Press release January 2003;* ***http://ec.europa.eu/research/press/2004/pr1501en.html*** *The linear fountain model of 'scientific knowledge begets innovation/technology which begets growth' has been contradicted time and again by historians of science and technology, but outlives all falsification.*

normative aspects. Under appropriate conditions, citizens can thus be participants, critics and knowledge-creators in an extended model of knowledge-production and collective reasoning.

The Public: A Problem or a Resource?
The Lisbon Agenda made central the question of "the public" and its role in innovation-regulation-diffusion-consumption lifecycles. This accompanied official complaints about public's ignorance of science causing rejection or delay of urgently needed technologies. This narrative presents a central contradiction. On the one hand the public is seen as an important resource for the support of science and technology, and closer 'public engagement' is therefore seen as essential. The 2001 white paper on governance, the Science and Society Action Plan, and many other European policy statements champion the broadening and enriching of public debate and engagement with science in this way. On the other hand, when science is depicted as **the** solution to the most fundamental social problems, the public is cast as the obstacle to progress rather than as a partner in policy legitimation.

Although it has become common in European policy circles to reject deficit model explanations of public resistance to innovation, that model nevertheless continues to be reconstructed in sophisticated new forms (Wynne 2006). One could say that while the public is rhetorically given more rights to participate in technoscientific developments, at the same time the idea of the public is often framed in more restrictive ways. Implicitly, upstream public participation is welcome so long as it complies with the innovators' demands. Thus the EU Research Commissioner in 2005, expressed the enlightened view that "public resistance to technoscientific developments cannot be understood as simply rooted in ignorance or anti-scientific orientation"; but then he simultaneously appeared to imagine that public engagement cannot usefully inform innovation-oriented research, only questions relevant to risk science. Thus the new master narrative of upstream public engagement needs to be revisited in full recognition of the point that 'the public' is always an imagined construct – but one which can and should be compared with evidence of public concerns and ways of reasoning (Andersen, 1983/1991).

As in the eEurope Action Plan (EC2004a), a lot of hope is invested in the World Wide Web to become an important tool for more socially inclusive European policy making. This medium however leads – as also argued in a recent *Science* article by Tim Berners-Lee the founder of the Internet – to new forms of exclusion as well as inclusion. As Berners-Lee warns, a fantastic amount of background work has to be performed not just on the infrastructure itself, but by users, in order to make the technology work. The electronically enhanced imaginary of democracy then becomes totally contingent on a vulnerable, fragile and highly-stressed socio-technical system. As with many innovation trajectories, the promise of beneficial outcomes deserves much more careful scrutiny before being given support (e.g., van Lente, 1996; Sunder Rajan, 2006). Yet the rationality of such realistic scepticism is often decried by policy leaders in the rapid and efficient pursuit of European science, knowledge.

STS research has shown that knowledge is not simply handed down from science to people, but is actively translated, recombined, reinterpreted in the context of new conditions, purposes, questions, and of existing experience. Autonomous agents of civil society act and interact epistemically and socially in their own independent worlds and cultures. Against the dominant narrative of a singular hierarchy of knowledge, with publics imagined as epistemicially-incompetent, thus untrustworthy, European institutions have the evidence-base (see for example, Chapters 2, and 5) to attribute a more active and creative role to their publics – and, as a result, to further encourage such social capacity. A democratically-committed knowledge society might have the moral and intellectual imagination to work out how multiple social worlds could creatively interact with a freer, more open and diverse science. This could result in more constructive, culturally-rich and sustained relations than is achieved in many existing formal programmes of 'public engagement with science'.

Unintended Consequences: The Dominant Narrative of Failure
Narratives of technological failure are consistently addressed in the policy world by consolidating all unpredicted and embarrassing events under the label “unintended consequences”. But this term leaves us with many open-ended questions that policy processes do not adequately address. For and by whom were these consequences unintended? Does “unintended” mean that the original intent was not achieved, or that things happened outside the scope of that imagined intent? The notion also carries an implied exoneration from blame, since anything ‘unintended’ was implicitly unforeseeable, even if things somehow subsequently went awry.

Specifically downplayed in this trope is the possibility of unwanted effects being due to inadequate understanding on the part of experts. The narrative of unintended consequences sets aside the possibility of acting irresponsibly on inadequate knowledge that was not recognised as such. Yet, just this sort of public concern has surfaced as an issue in well-documented cases such as the mad cow and GM controversies. While there is abundant need for stories of improved prediction and management, evidently there is also need for more diversified and clear-headed narratives of failure or public rejection.

7.5. Conclusions

Master narratives of technoscience and the policy practices that make them durable seem to disconnect our knowledge, experience and imaginations from history. In particular, the urgent societal narrative of “no time to lose” and its associated notions of a global race to lead in technoscientific innovation detach the search for progress from any live sense of a larger historical trajectory which gives us perspective. This also inhibits our institutional capacity or willingness to experiment with possible alternatives. We therefore risk subordinating ourselves as citizens to the imagined force of that grand narrative. This disempowering effect seems to grow relentlessly, and so does public awareness of it.

In this chapter, we have emphasised the need to reflect on the narratives that drive current S&T policy and to imagine alternatives to them. With major science-intensive cutting edge technologies like stem-cell research or GM crops, the complexities and contingencies of the systems we are creating and trying to predict make it necessary to assess the potential of scientific knowledge in relation to the objectives we want to achieve with it. Dominant science and society narratives as reviewed here tend to obscure this need and this responsibility. The rightful policy concern to establish more robustly constructive relations between European science and European citizens will be addressed only if those master narratives are critically reappraised, and different approaches and imaginations cultivated in their stead.

As we attempt in the next chapter to draw some conclusions and recommendations from our analysis, and bearing in mind this chapter’s focus on established master narratives, imaginaries, and their historical and cultural foundations, we have to recognize two things: first that in the nature of this analysis, direct ‘solutions’ and ‘remedies’ are unlikely to have purchase without institutional modifications that offer hitherto unavailable opportunities for critical public reflection and deliberation; second, that striving to change conventional understandings, and developing more diversified imaginations, both moral and practical, may be the most important initiative to which policy actors and institutions can commit.

Chapter 8: A Robust and Sustainable European Knowledge Society: Conclusions and Recommendations

In this report, we have analysed key issues and presented insights concerning science and governance in the EU. These contributions follow closely from the working group's terms of reference to examine "the widespread sense of public unease with 'science' which has manifested itself in Europe over recent decades". Additionally, we were asked where appropriate to address the EU's commitments to the newly ascendant policy issues of sustainability and precaution. In particular, we were asked to focus on insights and measures which could help Europe lead globally in addressing these, while also helping sustain or improve the quality of EU citizens' lives.

Implicit in this agenda are fears amongst policy leaders and officials that if and when science defines the proper actions in mitigation of climate change and global biodiversity-loss, or similar sustainability issues, the associated necessary civil society commitments may fail to materialise. There are hints here, then, not only of a broad public mistrust of science, but also of an unstated but deep mistrust by experts and policy makers of the publics themselves.

These are complex and weighty problems, emerging from powerful and pervasive socio-political forces. They have accumulated and condensed into the forms we have tried to identify, over long periods of time[35]. Therefore they are unlikely to be productively addressed by direct or short-term measures alone. Nor is it appropriate to presume that the relations between science and the rest of society must be always smooth and harmonious. Disruptive dissent and even conflict, if non-violent, may provide important learning opportunities for valuable changes. In drawing conclusions and making recommendations for both EU and member-state levels of governance, as well as for independent institutional actors, we therefore include both: (a) general conceptual observations and proposals which need to be digested and reflected on for their long-term implications; and (b) more practical steps which could be introduced soon as initial steps toward further learning and beneficial change.

We start with the more general, less direct but more challenging observations, and then move to more immediate, 'first-steps' practical recommendations.

8.1. General (Conceptual) Observations

An overall observation is that dominant assumptions about science, policy, and citizens which implicitly define existing institutional approaches to these issues need to be rethought at a fundamental level.

Policy and its Ambiguous Objects – Discrepant Scientific and Public Imaginations

Issues of social and policy concern, like sustainable development, risk and uncertainty, precaution, and biodiversity, are conventionally assumed to focus on independent objects which exist 'out there' in nature

35. As should be clear by now, we do not share the view that public mistrust is pervasive, indiscriminate and dominant. The much more typical examples of everyday public trust in science are almost unseen because they are so taken-for-granted, leaving high-profile exceptions like the GMOs or MMR issues to misleadingly define the whole terrain.

and are knowable through science. On the contrary, as we have argued, the substance, meaning and implications of these issues are not intrinsic, simply awaiting scientific revelation. In key respects – for example, the ways their boundaries are framed, their dimensions selected and their meanings defined – these issues are also essentially humanly constructed. Of course, this does not mean the issues are not profoundly structured and constrained by natural realities[36]; rather, the particular shapes that they take are open to a variety of equally legitimate and authoritative interpretations.

This means, we suggest, that new ways should be found to promote 'reflexive' thinking about the multiple meanings and normatively salient dimensions of these objects of attention. In other words, there needs to be explicit acknowledgement and deliberate public exploration of the socially and normatively constructed dimensions and characteristics of issues and their objects that lie at the intersection of science and governance. The way to achieve this is the adoption, both in the governance of science and the use of science for governance, of new institutions and procedures for more inclusive and pluralistic discussion, learning, and challenge. It is only through explicit official recognition of the ambiguous and open-ended character of supposedly 'scientifically-revealed' public policy meanings that civic engagement becomes meaningful.

Complexity, Contingency, and Post-Prediction

We have documented in almost every chapter – especially Chapters 2, 3, and 6 – a widely-observed point that follows from the observations above. This is that the outcomes and effects that science seeks to know and regulate are better regarded as contingent, than as the ostensibly determinate predictions represented by sound scientific knowledge. As public life becomes more interdependent, global, and more complex, and as technologies become more extensive, sophisticated, heterogeneous and network-coordinated, and vulnerable to disruption, so these contingent dimensions facing (and embedded within) science, are only likely to grow. Thus it is all the more urgent to avoid making the problem of public alienation or mistrust even worse, by perpetuating institutional failures to acknowledge the realities of contingency and lack of control.

It follows from this, that there is a serious need for explicit official and scientific acknowledgement of the existence and importance of contingency, and of the consequent value of socially- and culturally-distributed knowledge in Europe. We should therefore encourage policies which recognise and nurture the wider distribution of societal knowledge. Alongside the equity-benefits that such a stance entails, it also reduces the vulnerability of society overall by increasing capacity to respond effectively and coherently to unpredicted events and findings.

Normativity and Knowledge

As we noted in Chapters 3 and 4 especially, there is a syndrome in EU policy culture which encourages political and institutional differences (and potential conflicts) to be displaced into surrogate technical problems[37]. An example is the attempt to recognise only through the lens of standardised risk assessment the much wider contextual and normative differences between some member-states and the EC, over the politics and ethics of GM food and agriculture.

In this way, the underdeveloped democratic political culture of the EU can become a seeding ground for unacknowledged pan-European civic identities that are, in effect, imposed from above without appropriate delegation or deliberation. This is particularly described in Chapters 4 and 5. In order to avoid backlash against these perhaps well-intended but arguably quite unaccountable, and under-legitimated normative settlements, we suggest that the EC should undertake as a medium-term strategic commitment the institutional development of more robust, informed and accountable ways of articulating a collective normative capacity in the settling of trajectories for research and innovation.

36. It would be a major advance if the persistent fallacy - that reference to ‚social construction' of scientific public knowledge means it is claimed just to reflect whatever social interests want to believe, and that nature plays no part in constructing scientific knowledge - could be finally buried.

37. We do not wish to imply that this is always a negative process; but that it may have developed too far, and is a contributory cause of 'public unease with science'.

Reimagining and Reinscribing Master-Narratives

Some dominant master-narratives of science and society in EU science and governance, need to be reconsidered and replaced. Three that are particularly challenged in this report are:

- that most innovation comes in a linear progression from pure research, to ideas of application, to design, testing, choice and demonstration, then social diffusion (Chapter 2);
- that 'sound science' or 'evidence-based' approaches to policy, (that is: 'establishing the facts' as the objective boundaries to public choices), involve no prior normative, social framing commitments (Chapter 3); and
- that innovation-oriented research and knowledge-trajectories are not imbued with normative understandings about the possible, desirable or expected social benefits and purposes of the research, or about the imagined beneficiaries (Chapters 2 to 6).

Although the details differ between protection-oriented science (risk assessment etc.) and innovation-oriented research science, it is clear in both domains that there is an essential neglected role for clarifying and deliberating the crucial assumptions and commitments which frame ostensibly 'neutral', 'objective' scientific activities. This again requires new forms of institutional design and cultural practice. Such innovations are a necessary (although not sufficient) condition for public legitimacy and support for science. Such steps will in turn help meet a more general EU political challenge, which is to develop and mobilise in a sustained way, over the longer term, more diverse democratic capacities, both in existing structures of governance and in wider civil society.

Reflective and Relational Learning

This report has followed a large research literature in attributing a significant proportion of the reasons for public unease with science in Europe to institutional behaviour and practices. This contrasts with the frequent resort in official policy discourse to explanations for such unease that focus on characteristics of the public: public ignorance and/or irrationality, NGO exaggeration and faulty reporting by the media. Not that these do not exist; but they do not explain public resistance when it occurs. We have repeatedly illustrated apparent institutional inertia and resistance to the acceptance of the research findings that institutional behaviour and structure matter,

Possibly as a consequence of the institutional 'imagination' of recalcitrant publics, NGOs and media, officially established expert bodies are rarely encouraged to question their own framings of issues, or the implications that would follow from their alteration. Despite their public responsibilities, institutional experts typically do not openly reflect on how their 'natural' knowledge has been shaped and delimited, what conditions may apply to its range of validity, what other forms of knowledge and practical experience may be relevant or how these might differ from their own.

Even in those fields where controversy has been intense, and where reflective learning about participants' encultured assumptions and frames might thus have been most expected, conflicts have often been interpreted as purely propositional disagreements. In other words, explanations are sought in narratives under which one or other school of thought was simply wrong, incompetent, or perhaps exercising a hidden interest. It is rare that such disagreements are recognised to involve a clash of incommensurable values or incompatible cultures.

The tendency to redefine cultural differences and dislocations of the kind underlying 'the European public uneasiness with science' problem as if they were solely *pedagogical problems* – matters of public education and correction – is part of the production of yet further public unease. A corrective would be procedures for achieving more deliberate forms of 'reflexive' learning, occurring before (rather in the wake of) public opposition and failure to exercise authority. Many of the controversies in which European authorities have been embroiled, from nuclear energy to GM crops, have shown features of the kind outlined here, where greater reflexivity and relational learning on the part of official authorities – as well as their protagonists

– would have transformed the situation in constructive ways. This kind of more comprehensive learning, not replacing but better framing instrumental knowledge and learning, deserves to be promoted.

8.2. Practical Recommendations

We turn now to some specific practical recommendations which arise from our analysis. These are not all necessarily expected to be ready for immediate implementation. Some would require ancillary procedural or institutional changes, some of which would have to be identified in further work. Others are designed more to stimulate knock-on effects which we believe would change habitual ways of thinking and practice in positive cultural directions.
We begin with a group of proposals relating to conventional regulatory processes, thus often involving risk:

I 'Fourth Hurdle' regulation
As discussed in chapter 3, debates over risk regulation have become confused in unstructured claim and counterclaim over the benefits of the innovations in question. Yet apart from the special case of regulation of ionising radiation, there is typically no formal need to 'justify' risk-exposures in terms of the countervailing benefits. Despite well-established understandings of market failures, price externalities and the motivating power of vested interests, it is an entrenched assumption that the mere advancement to market of a new product, process or technology is demonstration of social 'benefit'. As a result, putative or imagined benefits are left unexamined or subjected to formal public accountability. Adopting this '4th hurdle' in regulation, (supplementing the usual three questions, of efficacy, safety, and environmental risk) makes logical sense, in that weighing risk against benefits has long been recognised – not least in economics – as the classically reasonable way of making decisions. Indeed, the now-routine practice of 'regulatory impact assessment' with respect to the potential disbenefits of regulation further underscores this view, making it all the more inconsistent that the same logic is not applied to claimed social benefits of innovation.

II Thorough Regulatory Appraisal

The list of 17 practical measures given in Box 3.2. (chapter 3) should be made formal requirements of EC and member state regulation processes. This would improve risk assessment and appraisal in line with the critique of existing inadequacies in institutional risk assessment. Given that this is a demanding set of requirements, the EC should set up a working group to assess under which conditions some of these measures might be relaxed and some passed-over. Specific reasons should be given as justification in every such case. For those actions where alternative innovation or R&D trajectories may be suggested in order to make a portfolio more robust, R&D funding sources should be established if they do not already exist. Requirement number 9 of Box 3.2., to include appraisal of alternatives to the proposal initially advanced, should be given the necessary support as early as possible, given lead-times for knowledge-generation.

III Proper Treatment of 'Uncertainties' – Revise EC Precautionary Principle

The 2000 Communication on Precaution should be revised to take explicit account of the need properly to address the full range of different aspects of uncertainty which underlie scientific risk assessment, and which are summarised in Box 3.1, Chapter 3. This involves formal recognition of the need to ensure precautionary assumptions are made in risk assessment as well as risk management, and that this entails a broad based process (rather than a simple decision rule) involving all the measures described in Box 3.2. (see II above). The resulting amended formulation should then be officially adopted as a basis for all regulatory activities currently citing the original Precaution White paper as a guiding authority. See also IV and VIII.

IV Expose RA Framing to Accountable Deliberation

The framing of the terms of reference defining risk assessment questions in EU legislation should be opened to more deliberative processes, as also should the more specifically technical interpretations of these into scientific regulatory practice by scientific advisory committees when making individual advisory determinations of applications.

V Shift to Plural Conditional (not Single Prescriptive) Advice

It should be established as a guiding principle in the terms of reference for all EU scientific advisory bodies that their recommendations be presented to policy in the form of 'plural and conditional advice', rather than as – under current practice - single prescriptive recommendations. By 'plural and conditional' (Stirling, 2005), we mean that advisory bodies should explicitly explore and transparently state the conditions under which any favoured recommendations apply. The resulting licence to deliberate over such conditions, will prompt greater attention to (and rigour over) the uncertainties, ambiguities, ignorance and indeterminacies highlighted in Chapter 3, as well as a number of contending options and their respective substitutes. This could also have positive effects on innovation processes. Although not forcing disagreement where there is genuine consensus, this would help mitigate the pressures for group-think and suppression of dissent in such committee processes.

VI Avoid Misleading, Insensitive Public Definitions

Recalling the observations made in chapters 3, and 5, about the institutional habit of reducing wider political discussion over technology solely to 'risk', documentation produced by EU bodies on such issues, should include explicit acknowledgement of the importance of avoiding this over-simplification. Although a rather general recommendation, the cumulative effect of such small measures might be to help foster a more sensitive institutional culture on this matter.

VII Regional/Local European Capacity

It should not automatically be ruled out that regional public authorities might in some circumstances be appropriate competent authorities for more openly deliberative risk assessment and regulatory appraisals, within an overall European legal framework. The necessary resources of expertise and procedural support would need to be available; and this would need to take place in defined collaboration and division of labour with national or EU authorities. Large scale but locally-sited cases like radioactive waste or other hazardous waste facilities could be one such example. Where scientific findings come into conflict with institutional imperatives – as where the recognition of regional ecological diversities in regulation of GMO releases clashes with imperatives of the Single Market – adjudication between the contending pros and cons should be explicitly justified and rendered a matter of democratic accountability.

VIII Enact and Enforce Current EU Rules

The guidelines for environmental risk assessment of EC 2002/63, in which standards are described for the documentation of all uncertainties and disagreements in the scientific knowledge-base, and of EC Regulation 2002/178 (Art 30) on dealing with disagreements in risk assessment between EU authorities and member states, should be fully and transparently enforced, and this audited externally[38]. This should be enforced for all risk assessment domains, not only for food where it has mainly arisen thus-far. Similar requirements should be pressed on member-states, and help given to new member states to be able to enact this.

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38. EU Regulation EC 178/2002, Art 30, states that when different scientific opinions emerge, EFSA and the member state(s) "are obliged to co-operate with a view to either resolving the divergence or preparing a joint document clarifying the contentious scientific issues and identifying the relevant uncertainties in the data. This document should be made public"

IX Accountability

The structures and procedures of such external audits as proposed in VIII, designed to both practice and demonstrate accountability to European citizens, would need further consideration, in order to identify to which form of always approximate representation of 'the European public' such arrangements should be referred. The Parliament and its committees should be the proper body, perhaps in conjunction with independent European agencies like the EEA, but this would need examination.

X Institutional design

The new institutional processes required to implement the recommendations made thus far concerning the addressing of the broader uncertainties and the benefits of innovation, should be developed through niche-based 'pilot' processes of experimentation.

XI Review Social Distribution Implications of IPRs (and related policies)

As a further element of such innovation-governance, following Chapter 2 there should be a full review of the implications of existing intellectual property laws, regulations, guidance, and interpretive practices in relation to these, for the distribution or concentration of knowledge and knowledge-ability (in the sense of access to and rights to use salient materials and knowledges in diverse innovation and experimental practices). Other general factors influencing such social distribution aspects should also be identified and their influences assessed, and if necessary amended with the aim of promoting diversity, independence and collective experimentation. Open innovation systems and knowledge-commons should also be explored and supported.

XII Value Social Distribution of Knowledge

When 'social capital' is being considered and defined, as for example when specific skills or informal services are valued in aggregate across society, the general question of how to capture as part of this, the value of the social *distribution* as against concentration of knowledge and knowledge-ability, should be recognised and measures developed. For example, intellectual property rules which inhibit or even prohibit some kinds of independent, diverse and situated collective experimental learning practices, might be seen to be of negative net social value. The point would be to provide measured practical support for practices and initiatives which enhance this distributed, decentralised and diverse social-epistemic quality.

XIII Support Autonomous Collective Experimentation

There should be a survey of the ways in which the diversity of autonomous collective experimentation in innovation have advanced on the ground, across Europe, with special attention to conditions of support, and to obstacles, in new member states. From this extensive fieldwork it should be possible to identify cost-effective policy inputs to cultivate the right conditions for such innovations to develop. This could involve working out which new concerned groups might be emerging, with which knowledge and innovation needs. EC facilitation of independent network-connections between new and established member-states should also be actively considered.

XIV Establish a New 'Community Research Council'

These kinds of concerned collectives could perhaps be assisted in their knowledge and innovation needs, and their learning, by experimenting institutionally, for example by establishing a European 'Community Research Council'[39]. This would be responsible to an independent board composed mostly of diverse

39. *This echoes an early-1970s proposal by the British Society for Social Responsibility of Science, for a UK Community Research Council of this sort. Such a body would of course now reflect very different conditions including opportunity-patterns, from that time.*

civil society network members and independent scientists, and its task would be to seek out and make connections with such independent actors with salient concerns which could have knowledge and research needs addressable by research-scientists of whichever specialism, in teams which might well need to be deliberately composed for the issue in question. This institution could expand the existing dispersed experience of European science-shops.

XV Develop EC Institutional Ethics

In the relatively new area of the institutionalisation of ethical appraisal in EU regulatory processes, the terms of reference of such committees should be changed so as to reflect the importance of alternative ethical paradigms, for example, discursive or deliberative ethics. This should be aimed at explicitly avoiding the effective role currently given to such ethical advisory bodies, in that they operate as experts who 'discover' an abstract given truth of the normative questions involved. Instead they should become overtly deliberative, and have as one of their tasks the identification of ethical issues embodied in citizens' concerns, even if these do not correspond with definitions of academic ethical paradigms. Consistent with this, the ability to focus ethical appraisal on institutional rather than individual action needs to be developed.

XVI Audit All EU Legislative and Regulatory Initiatives for Diversity Implications

Consistent with our emphasis of the democratic, instrumental, and normative importance of diversity, including intellectual diversity within scientific research and funding and its external networks, we recommend the establishment of an audit of all new European legislative, regulatory, and investment (including RTD) initiatives. This would assess the potential impacts of those proposals on such dimensions of diversity in European society, and make recommendations to the relevant bodies for appropriate changes to advance such diversity.

XVII 'Training' Needs

Over some of these steps, which *inter alia* involve cultural change in the institutions (thus cannot be done to design-blueprint), carefully-designed step-wise or evolutionary internal Commission 'training' processes may be valuable, specifically on science, innovation, and governance and including 'publics'. These might be extended to external bodies of various relevant kinds.

We do not assume that this list of specific proposals is comprehensive, thus one extra role it can play is to stimulate further thinking and proposals for additional and consequent initiatives in line with this overall orientation. Furthermore, realistically, we do not expect that all or even a majority of these recommendations will be welcomed and taken up in policy, as they involve a strong degree of challenge, cultural change, and thus institutional risk. We present them partly as a measure of just how serious we feel the recognised symptoms of unhealthy democratic relations with science to be – that it would take this much, in our view, to address them. This is not just – or even especially – true for Europe, which has many deep strengths and resources to call upon in facing these challenges. How far we progress along these lines is a matter for European democracy to resolve; and for which the European Commission should take responsibility to explore in practice.

We have done our best to offer some steps, and some substantial reasons, for setting out.

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