Proceedings from the PACITA 2013 Conference in Prague

Technology Assessment and Policy Areas of Great Transitions

Edited by
Tomáš Michalek, Lenka Hebáková,
Leonhard Hennen, Constanze Scherz,
Linda Nierling and Julia Hahn

PACITA

TECHNOLOGY ASSESSMENT AND POLICY AREAS OF GREAT TRANSITIONS

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Foreword

Lars Klüver

PACITA (Parliaments and Civil Society in Technology Assessment) is a so-called Mobilization and Mutual Learning Action Plan, financed by the Science-in-Society programme of the Seventh Framework programme for research of the European Union. As such, the mobilization and mutual learning, which happened in the European Technology Assessment Conference in Prague March 13 – 15, 2013, was at the very heart of the idea of PACITA.

PACITA has four main aims, namely 1) to document the praxis of national and cross-European Technology-Assessment activities, 2) to establish training and learning on Technology Assessment among users and practitioners, 3) to intensify the debate on TA with the aim of expanding the Technology-Assessment landscape in Europe and 4) to provide state-of-the-art examples of projects, methods, dissemination and impacts of Technology Assessment, both on the national/regional and European level.

There is a sincere hope that through PACITA, new initiatives, activities and institutions can be established that would implement policy-oriented Technology Assessment close to the decision-making processes on all levels in the European Union. This is in line with the history of Technology Assessment and the long-term stated wish from MP/MEPs for a strengthened TA across Europe and in the new member states, as expressed by the European Parliament, the European Commission, many member states, the Council of Europe and the European network on Parliamentary Technology Assessment, EPTA.

Technology Assessment has its core mission in providing comprehensive knowledge, clarification and policy options for policy-making on issues pertaining to the societal use of science, innovation and technology. It is aimed at policy-making at all relevant levels – from decisions made by single citizens, organizations, enterprises and political decision-makers on local, regional, national, trans-national and global levels. It does that through studies, research, open processes of stakeholder involvement, citizen consultations and participation, policy dialogues and communication activities strictly targeted at the decision-makers who are the main users of the outcome.

In the PACITA project, the whole array of methods and issues is being documented, trained and debated, but there is a special focus on those methods and activities in which citizens and policy-makers are directly involved in the Technology-Assessment process. Such "interactive" methodology has proven to be a specific trademark for Technology Assessment and is of special interest today when the focus of research and innovation is turned towards the Grand Challenges of our societies. It is characteristic for these challenges that they demand a high degree of societal co-creation and collaboration because of the uncertainty and complexity involved and because they most often demand an active participation on all levels of society to be effectively met.

The PACITA conference, “Technology Assessment and Policy Areas of Great Transitions”, treated many aspects and objects of Technology Assessment in connection to the Grand Challenges of our societies. It was, from all perspectives, a much needed and very successful conference, which I believe is clearly documented by the papers in this book. What cannot be documented by a book, though, is the learning and mobilization achieved at such an event. The fact that this conference was the first European Technology-Assessment conference in more than two decades is both sad and promising at once. Sad, because the conference showed the obvious need for continuous exchange, networking, discussions and documentation – in short, mutual learning and mobilization – that such an event provides, and thereby shows that there should have been such events with a reasonable frequency in the past. Promising, because Technology Assessment has shown to be a practice still in the making and continuously expanding its reach and borders, which gives hope for a future with a larger and more branched-out professional community, and for this conference being only the first in a row of future European and international Technology-Assessment conferences.

The conference and this book have been made possible by the engagement and hard work of many people and institutions. The European Union provided the opportunity for PACITA to become real and thereby for this conference to be held. The participants at the conference brought their ideas, knowledge and enthusiasm into play by contributing with papers and in discussions. The speakers ignited our thinking and reaction. The facilitators led us through the days and motivated the discussions among the panels and the audience. The PACITA project contributed by arranging the conference and publishing this book. On behalf of everyone present at the conference, I wish to thank you all for making the conference such a great success.

Two institutions and one person should be mentioned with a special and even deeper gratitude. The ‘Technology Centre of the Academy of Science of the Czech Republic’ and the ‘Karlsruhe Institute of Technology’s Institute for Technology Assessment and Systems Analysis’ were the PACITA partners in charge of the conference, and they delivered three days of highly inspiring and very well organized conferencing for which I would like to give my sincere thanks to all the colleagues involved. Lenka Hebakova of the Czech Technology Centre was the person in the middle of it all, putting an incredible effort into giving all of us a good, professional experience and making us all feel warmly welcome in Prague. Thanks enough cannot be given to Lenka and I hope she understands how impressed we all were and are of her personal investment in the conference.

This conference will be followed be a second PACITA Conference in Berlin on 25 – 27 February 2015, which will mark the finalization of the PACITA project under the promising title “The Next Horizon of Technology Assessment”.

It is the hope of the PACITA project that this book provides insight into the nature, activities and importance of policy-oriented Technology Assessment and that it will motivate for even more activity in this field, thereby providing more mobilization and mutual learning on Technology Assessment in the future.

Lars Klüver
Coordinator of PACITA
Director, Danish Board of Technology Foundation

Introduction

**Tomáš Michalek, Lenka Hebáková,
Leonhard Hennen, Constanze Scherz, Linda Nierling and Julia Hahn**

Our time of great transitions is characterized by great challenges, which can result in uncertainty, risks and a plurality of interests and values. In this situation, many questions arise. How can we provide a reliable system of energy supply that, at the same time, meets the needs of climate-change prevention? How can we prepare ourselves for changes in our everyday life and our working environment due to pervasive ICT technologies? How can we create a sustainable system of transport infrastructures? What changes in behaviour are needed to establish a societal mode of sustainable consumption? What are the prospects of healthcare systems in the face of an ageing society and new medical options offered by modern biomedicine? These and other pressing issues that we are facing in society and policy-making processes indicate upcoming great transitions connected with scientific and technological development on a global level.

In this setting, it sometimes might appear as if we are walking up spiral stairs without really knowing where we will end up and without the ability to look further up than the next few steps. There is no way to predict the future path of society, but there is, nevertheless, a call for reliable and reflexive knowledge on (future) technologies, on alternative and viable paths of development but also on dangers and risks that have to be taken into account. Technology Assessment (TA), as a concept of problem-oriented research, policy consulting and societal dialogue, aims to support society and policy-making in understanding the problems ahead connected to the great transitions and to assess the available options for managing them.

Technology Assessment has its roots in the US of the late 1960s when policy-making not only had to face an ever growing dynamic of technological and societal change but also, for the first time, had to deal with broad social debates and conflicts about the implementation and use of technologies. In the following decades, TA developed as a support for policy-making and especially for national parliaments in many European countries. A community of academic TA institutions, political advisory bodies and practitioners evolved. Besides the growth of networks, such as the European Parliamentary Technology Assessment Network (EPTA), this was documented in a series of conferences, which functioned as meeting venues of the European TA community. Conferences held in Amsterdam ("1st European Congress on Technology Assessment", 2 – 4 February 1987), Milan ("2nd Congress on Technology Assessment", 14 – 16 November 1990) and Copenhagen ("3rd

European Congress on Technology Assessment", 4 – 7 November 1992) made significant contributions to the concept, philosophy and institutionalization of TA. Looking back at these conferences, it becomes clear that the European debate on TA took place on several levels between international groups of scholars, experts and officials.

Two decades later, in March of 2013, the TA community gathered in Prague (Czech Republic) in order to re-establish this tradition of interactions and discussions. The conference, under the title "Technology Assessment and Policy Areas of Great Transitions", was organized by the EU-funded "Parliaments and Civil Society in Technology Assessment" (PACITA) project and invited guests from all over the world to present and discuss their views on TA and bring together the wide spectrum of TA research. In 22 sessions over three days, 250 participants covered topics ranging from healthcare and medicine, energy supply, climate change and mobility or use of computer technology in all areas of society as well as questions, such as what kinds of knowledge, methods and dialogue are needed for decision-making.

In this way, the conference reflected the wide range of topics, debates and methods covered in TA. Its problem-oriented focus allowed TA to speak to a number of addressees, to policy-makers and scientists but also to social interest groups, stakeholders and the general public and citizens. Continuing in the same spirit, a second European TA conference organized by the PACITA project is scheduled for February of 2015 in Berlin.

Topics Covered in the Proceedings

The following proceedings are divided into five parts: (1) Challenges for TA - contains articles by the keynote speakers; (2) Institutionalization of TA – covers aspects of TA from different (and not only European) points of view, (3) Participation in TA – includes methodological as well as practical studies of participatory TA; (4) Questions of Sustainability – deals with sustainable food, energy and mining or mobility issues; and (5) Facing New and Emerging Technologies – includes different healthcare and privacy dilemmas. A final summary is presented in the afterword.

In the first keynote speech, Wiebe Bijker described the so-called Dutch democratic experiment about handling nanotechnologies as an exemplary case. According to him, the state should return from its neoliberal retreat and become an advocate of democratic governance. In the second keynote speech, Stefan Böschen called for "opening the black box of scientific expertise-building" to allow for meta-expertise as a link between epistemic and cultural values to be included into the political decision-making process. The third keynote speech by Rut Bízková dealt with smart infrastructures as a prerequisite for sustainable competitiveness. There is a paradox of the long-term horizon of sustainable development and short-term economic interests.

For researchers as well as policy-makers, the forms and problems of institutionalizing TA practices remain important, especially in view of the continuous expansion of TA and problem-oriented research. In the so-called TA-emerging countries, where technology assessment is yet to be institutionalized, there are many on-going TA-like activities. A case study from Poland describes the successful implementation of foresight. Instead of the quite common SWOT analysis, the paper presents less frequently used foresight methods, such as intellectual capital measurement. In the Czech Republic, research and development mainly focus on forward-looking studies and methods. They aim at establishing a solid link between researchers and society and thus creating a ground for the introduction of TA. In this regard, the biggest challenges are an inadequate business environment and the decision-making structure of research and development. Nevertheless, some positive signals can be found especially in the health TA practice, which has starts to appear at Czech universities. Emerging technology assessment in Poland faces quite similar challenges. In Japan, as a result of the Fukushima nuclear accident in 2011, the government tries to recover the lost public trust by launching an innovative education and research programme including TA, which was introduced for the first time in history. These various situations show the challenges and specific situations TA faces.

Several authors deal with participation. On the one hand, citizens and civil society organizations wish to be more active in decision-making regarding complex technological developments. On the other hand, some politicians themselves are interested in involving interested laypersons in decision-making processes. Other authors see a democratic gap between citizens and policy-makers created by the globalization of policies affecting daily life. A lack of consensus on the global level greatly affects the local, where, for example, the negative effects of climate change are often mostly visible. In this sense, sustainable behaviour can only be fostered by participation of the general public in local policies (e.g. the e2democracy project). For some, there is a clear need of a social and technological co-evolution. Some authors are in favour of creating a participatory technology roadmap of hypothetical socio-technological situations (or tangible fictions). In line with this future-oriented strategy, another article presupposes that an action-enabling mechanism in future energy systems will be a governance of trust. Symbols of trust and trust-sensitive factors will become much more important than traditional regulations. But there are some who claim that while citizens' involvement in technology assessment is required, many people are not really interested in actual engagement. An answer to this challenge could be to have laypeople debate TA issues and, at the same time not to steer away from addressing all relevant scientific aspects of emerging technologies.

Sustainability is a frequently heard term when talking about energy and mobility but also in regard to questions of agriculture, manufacturing, energy and mining. The trend described in several studies here is that acting in a sustainable way means being closer to the user. Private-household practices have a crucial impact on sustainability concerning food and energy. One aspect of this is explored in the articles on the bioenergy field in the region of Central Europe. They recommend, for example, that governments stimulate the heat production from locally available biomass and the development of traditionally regional bioenergy markets. In this regard, different socio-technical scenarios on a regional scale and key action fields are analysed. While electric cars are considered to be a green technology, a full life cycle analysis reveals higher resource consumption in their production phase. A look at sustainability from the other end of the world is offered in two articles about manufacturing and mining in Australia. Mining activities are currently expanding, bringing social and environmental costs on one hand and social and economic benefits on the other. Global competition and latest technologies are changing manufacturing, too. An example from Tasmania shows how critical collaborations between industry, tertiary education and government agencies are when tackling low skill levels and geographically dispersed labour markets. Further, agriculture and food systems are seen as key sectors towards sustainability. Widespread ecological degradations, increasing concentration of land ownership and diet-related diseases are among the most visible unsustainable characteristics of the current situation. Again, getting closer to the end user seems to be a remedy for many of them (such as food sovereignty of households, creation of family farms and independence on input industries among others).

Emerging technologies, ethical values, security and privacy are essential issues for TA. Technologies under the label "emerging" are an important topic of debate in regional and national contexts. But with respect to political regulation, they need to be addressed at the European (or even international) level. There is a discrepancy between macro-economic gains of new technologies and their potential negative impact on individual self-determination. Concerning healthcare, authors explore user-producer interaction in early diagnostics of Alzheimer's disease, equity in access to healthcare services and regulatory challenges of neuromodulation and nanomaterials. The use of robotics in healthcare must be ethically justifiable. One of the currently observed side effects of the excessive use of new technologies is a loss of privacy. Respect of privacy and data protection becomes key, especially with regard to security technologies.

Doing technology assessment in Europe still remains a challenge. The broad variety of the proceedings' topics and the positive resonance to the conference show that there was a great necessity to revive the tradition of European TA conferences. It is a substantial gain that TA practitioners and policy-makers from countries with established TA practices are able to get involved in discussions with colleagues from countries where TA is still is in its beginnings, not only to give advice but also to reflect on their own traditions and established TA practices. Beside the national perspectives, cross-European TA must, among other obstacles, face the tension that may arise between the different levels of decision-making structures: European and regional/local. The editors' hope is that this book provides a helpful overview and an inspiring input for thinking onward: which TA topics will be important and popular during the next years? What can scientists learn from their experiences of working together with stakeholders and politicians? One of the aims of TA is to relate technological questions and knowledge to societal and political demands and perspectives. It seems highly relevant to strengthen the exchange of scientific know-how between researchers from different (national) traditions as well as between scientists, policy-makers and society.

PART I

CHALLENGES FOR TECHNOLOGY ASSESSMENT

Articles from the PACITA 2013 Conference Keynote Speeches

Technology Assessment: The State of Play

Towards a Hybrid and Pluriform Process of Governance of Science and Technology

Wiebe Bijker

Abstract

Technology Assessment (TA) was first about technology, then about citizens and now, I will argue, must be about democracy. When conceived in the 1970s, TA was mostly about technology, innovation and science. In the 1990s, TA also became about users and citizens in processes of innovation and technological and scientific development. In this opening keynote address to the Prague PACITA conference 2013, I will argue that the time has now come to make TA also about democracy, about the role of the state and its relations with citizens and science and technology. Reviewing the state of play in TA in Europe, I will argue that the conceptual development of TA during the past four decades has been converging with the conceptual developments in technology studies and with developments in European societies. This then, I will propose, requires TA to think about more active and novel roles of the state (in its various forms). To develop such novel ways, we need to experiment with our democracies, and my conclusion will be that TA should play a central role in these experiments.

Technology Assessment: The State of Play

To understand the state of play in TA at this moment, it will be helpful to briefly review the development of TA. For its early history I am drawing on the analysis by Ruud Smits and Jos Leyten (1991).

When the Office of Technology Assessment (OTA) was created by the US Congress in 1972, its mission was to provide 'early warning' of critical technological and scientific developments that without such warning might cause societal and political trouble. The underlying assumption was a rather linear and simplistic view of the relation between technology and society: technology develops autonomously and it has an impact on society. OTA was created mainly to give Congress more power of information in relation to the executive branch of the government, in particular about large government-funded technological projects (Est/Brom 2012). This view is called ‘technological determinism’; for a more sophisticated discussion of technological determinism, see the review by Sally Wyatt (2008). This early phase of TA can be characterized as “reactive TA”: TA’s agenda was set in reaction to technological developments so as to give an early warning to politicians and policy makers who could then take proper action.

Already in the early 1980s, the practice of OTA became less reactive and more actively supporting policies of Congress that related to science and technology. This style of TA, “active policy supporting”, is still present in all TA institutions as at least one important ingredient of their TA activities.

Later, and especially when TA was taken up in Europe, broader questions about the development of society as shaped by science and technology became part of TA agenda – we can call this the phase of “active strategic TA”. Though OTA was dissolved in 1995 to realize budget cuts by the Reagan administration, American TA work continued in a more dispersed way in the context of the Human Genome Project’s Ethical, Legal and Social Implications (ELSI) Research Program (Collins et al. 1998). In Europe, this concept was broadened into ELSA (or even E3LSA; see the Table 1 for a list of acronyms).

TA	Technology Assessment
PTA	Parliamentary Technology Assessment
ELSI	Ethical, Legal and Social Implications
ELSA	Ethical, Legal and Social Aspects
E3LSA	Economic, Environmental, Ethical, Legal and Social Aspects
CTA	Constructive Technology Assessment
STOA	Scientific and Technological Options Assessment (at the European Parliament)
IPTS	Institute for Prospective Technology Studies (EC, Sevilla)
EPTA	European Parliamentary TA Network

Table 1: Frequently used acronyms in Technology Assessment discussions

In the 1990s and since the beginning of the new millennium, TA has increasingly been about the participation of citizens, users and stakeholders in technology development. This has been helped by the more prominent role that Europe took in developing TA practices. Consensus conferences, at first mainly in the area of medicine but later about other questions as well, and public debates have shifted the focus from scientific experts to citizens and users.

If we consider the underlying ideas on technology and society in each of these three TA conceptions, a pattern emerges. The first TA initiatives were built on the expectation that scientific knowledge could signal an early warning and guide decisions on technology development. Accordingly, scientists played a dominant and exclusive role in this form of TA. In this context, decision-making was assumed to be organized around a single, clearly identifiable decision-maker (parliament, minister, manager), and it was also assumed that it could be improved by rendering it more rational. The result of such TA efforts was always a report that presented scientific facts constituted the basis for political decision-making. The importance of the process, which involved experts and stakeholders, was well recognized; it was necessary to produce a report that would need to be viewed as "neutral" in order to be useful in the highly politicized culture of the US government (Est/Brom 2012). The current TA conception deviates from the previous one in major respects. The limitations of scientific knowledge are better recognized and in combination with seeing the importance of non-scientific sources, there is now a more balanced involvement of users, producers, and policy makers, in addition to scientists. It has become clear that political decision-making is a fragmented process. Decisions are normative rather than rational. Nowadays, TA rarely results in a single report (however important that still is) and is nearly always supported by different forms of societal discussion. (I will revisit the current conception and practices of TA below.)

Similar conceptual shifts have occurred in the underlying ideas about the relationship between technology and society in studies on technology and society performed during the past decades. Early studies on technology, before the 1980s, built on the assumption that there was a strict separation between the technical and the social aspects. This gap between technology and society was bridged from only one direction. Technology did have an impact on society, but it was autonomous in its development – the previously mentioned "technological determinist" view. In this early "standard" view, technology has an unambiguous, "ingrained" meaning – whether a machine works well or not, for instance, is only a characteristic of that machine itself and not dependent on its context. Since the 1980s, this standard view of technology has been substantially adjusted. Instead of being autonomous, technology is now seen as socially constructed. And indeed both machines and social organizations are analysed as sociotechnical ensembles. The "working" or "not-working" of a machine is the result of social processes, not (just) a source of social change. Technology and society develop in a mode of co-evolution as two sides of one coin - hence the new unit of analysis that I will propose below: technological culture.

The two conceptual developments I have sketched – in technology assessment and in technology studies – clearly converge. They converge to create a theoretical framework in which technology and society shape each other; in which technology has an impact on society; in which technology is socially constructed; and in which this constructivist analysis of technology and society shows openings for political intervention in the shaping of technologies and the building of societies (Bijker/Law 1992; Jasanoff 2004). One way of underlining this conceptual convergence is to redefine our unit of analysis.

We Live in Technological Cultures

We live in technological cultures. Today's societies are thoroughly technological, and all technologies are pervasively cultural (Bijker 1995). Technologies do not merely assist us in our everyday lives; they are also powerful forces acting to reshape human activities and their meanings. When a sophisticated new technique or an instrument is adopted in medical practice, it does not only transform what doctors do but also the way patients, nurses and doctors think about health, illness and medical care. Coastal defences (I mean: dunes, dikes and levees) in the Netherlands and the United States mirror the differences in risk culture in both countries and their different vulnerabilities (Bijker 2007). Indeed, one way to summarize the two decades of research in the field of science, technology & society studies (STS) is this statement: we live in a technological culture. All technologies are culturally shaped and all cultures are technologically constituted.

So, cultures are technological cultures because technology plays a crucial role in constituting them. However, technological development does not only support and strengthen the structures of societies. The high-tech character of modern societies makes these structures vulnerable at the same time. Such vulnerability is an inherent characteristic of today's technological cultures. If you are not part of the globalized financial system, you do not suffer when the mortgage market on the other side of the world drops into a crisis. If there are no airplanes, terrorists cannot steer them into high-rise buildings. If you have no dikes, they cannot break. And it is even worse: technologies do not only make accidents possible – they ask for them. Once you have such large technological systems, accidents are inevitable. Accidents, Charles Perrow (1999 (1984)) argued, are 'normal' in complex and tightly knit technological systems.

The conceptual shift from "modern society" to "technological culture" has recently been complemented by a shift from studying "risks" to studying "vulnerabilities" (Hommels et al. forthcoming in 2014). Together, these conceptual shifts have created a framework for the analysis of the promises and threats of new technologies in our societies and for asking questions about the democratic governance of these technologies. TA is one important domain where these new forms of understanding can lead to new forms of intervening. However, it does require a new and more active role for the state. Democratic governance of science and technology cannot, I want to argue, be left to the market. The state has to return from its neoliberal retreat of the past decades – it is the state's turn. (I do use the word "state" with tongue-in-cheek. The last thing I want to propose is a return to a centralized state with an overpowering bureaucracy. I am using "state" as a shorthand for a combination of the various public institutional arrangements that societies have created for their self-governance. These arrangements exist at all levels from local to regional, national and European.)

TA's Call for Action: Various Forms of Engagement with Science and Technology Needed

Change is in the air. It is significant, I like to think, that the new research programme of the European Union is not called "(8th) Framework Programme" like the ones before – but "Horizon2020" – and it boldly aims to "tackle grand societal challenges". Here the European "state" is assuming responsibility and taking the lead in defining what the agenda for its science and technology should be. Of course, there are many who deplore a strong "Brussels", and we all know that these voices have become stronger over the past few years. But I want to argue that the alternative cannot be a neoliberal belief in the self-governance of markets. Instead, we should think about making "Brussels" into a more democratic European "state". And new forms of parliamentary TA are crucial in realizing that goal.

Jurgen Ganzevles and Rinie van Est, in one of the first reports from the PACITA project, characterize TA as "an activity at the interplay between parliament, government, science and technology and society" (Ganzevles/Est 2012: 13). I will follow their lead and present my plea – for reinventing the state and innovating democracy through TA – in terms of these four societal spheres: parliament, government, science & technology and society.

Let me return to the current conceptions and practices of TA, which is where I left the historical overview in the first section. The 1990s brought ELSI in the US and then "constructive technology assessment" (CTA) in Europe. CTA provides an economics-oriented "new paradigm for management of technology in society," with explicit attention to social, political, and cultural aspects (Rip et al. 1995). The "constructive" in CTA is also meant to highlight the design process of technologies and thereby focus attention to other social groups than just engineers. CTA recognizes the heterogeneous character of technology development and instead of a linear stimulus-response model, CTA conceives the shaping of technology development in terms of "niche-management." Most of CTA's primary orientation is on one specific actor - often parliament or government. Since the 2000s, the practice of TA has broadened to include a wider variety of stakeholders and civil-society groups. Public participation, public debate and societal dialogue - these have become the new buzzwords. In the 2010s, this trend in TA was further strengthened by the attention to "responsible research and innovation" and developed into what is sometimes called "reflexive TA" (Clausen/Yoshinaka 2004; Hellström 2003; Schomberg 2012).

One of the best examples of CTA that I know has been developed and implemented by Arie Rip and his colleagues in the Dutch nanotechnologies programme, NanoNed (Rip/Lente 2013). The NanoNed programme was the national Dutch nanotechnologies research programme that ran from 2005 to 2010 (now succeeded by the NanoNext programme) and put together partners from universities and industry; its total funding - from sources in the government, universities, EU and industry – amounted to some EUR 235 million. The TA NanoNed subprogramme had a budget of EUR 1 million and was conceived and directed by Mr. Rip; his successor in the role of TA programme director in the current NanoNext programme is Harro van Lente.

One problem of TA, including CTA, is that an analysis of the societal impact of technologies that do not yet exist may easily turn into science fiction. The TA NanoNed programme addressed this challenge "by creating socio-technical scenarios about near-future developments, applications and responses, and use[d] them in strategy-articulation workshops with stakeholders and third parties in addition to those who [were] directly involved in the development of the technology." (Rip/Lente 2013:9). This approach meant paying close attention to ongoing developments in research and innovation rather than studying ethical, legal and social aspects from an outsider's perspective. This insider's critical engagement with science and technology is appropriate given the position of the programme as a part of an R&D consortium. However, Rip and Van Lente explained that this position can create tensions when researchers view the TA researchers as intruders. The TA researchers need to keep some critical distance. This tension often emerges because people hesitate to spend time on other projects not because they would be unwilling to cooperate. Especially "PhD students and postdocs in the TA NanoNed programme were experiencing these force fields: overall agreement with regard to the importance of TA/ELSA and reluctance to invest in it in practice." (Rip/Lente 2013:9). The leadership of NanoNed was quite unambiguously in favour of the TA activities, but it proved a different matter to have researchers spend some of their valuable lab time on it.

The choice in NanoNed was explicitly "to focus on broadening nano-developments rather than on investigating and perhaps stimulating societal perceptions of nanotechnology." (Rip/Lente 2013:9). Rip and Van Lente observed that this restriction of scope was possible because of the TA landscape in the Netherlands: the Dutch Rathenau Institute for technology assessment is primarily targeted at articulating social and ethical aspects, stimulating societal debate and advising Parliament and Government. The resulting division of labour is one element of the hybrid and pluriform governance process of science and technology in the Netherlands, which I shall describe below: the state's turn.

An Example: Technology Assessment of Nanotechnologies in the Netherlands

I will reconstruct the history of the Dutch engagement with nanotechnologies to plead for a hybrid and pluriform set of governance mechanisms to deal with modern science and technology (for a more detailed account, see (Est et al. 2012)). The nanotechnology story in the Netherlands begins with the Rathenau Institute identifying nanotechnologies as an important issue for consideration by society, politics and policy makers (Est et al. 2004). Dutch scientists started lobbying for the NanoNed programme and some international reports were indicating the relevance of public attention (Roco 2003; Society/Academy of Engineering 2004). However, it is unlikely that any member of the parliament at that time knew what nanotechnology was, and there was no explicit governmental policy on nanotechnology. The Rathenau report resulted in getting nanotechnologies on the public agenda, though without any explicit positive or negative undertone. At that time, the following paper was presented: "A sober view of nanotechnology as a tool in the social debate" (Est et al. 2004:66). This is the first element of the hybrid and pluriform governance process that I want to propose: agenda-setting by a semi-governmental TA organization (see also table 2 for a summary). I characterize this TA organization as "semi-governmental" to capture two combined characteristics: (1) it is largely funded by the state, and (2) it is expected to act relatively independently from the state and, if necessary, in a critical manner. The three forms of PTA institutions that Christien Enzing and colleagues (2011) distinguish – the Parliamentary Committee model, the Parliamentary Office (or Parliamentary Unit) model, and the Independent Institute (or Interactive) model – are all semi-governmental in the described sense.

The second step in the Dutch nano story was for the government to ask advice from its most important scientific advisory body in matters of science and technology, the Health Council of the Netherlands (Gezondheidsraad). An advisory committee was formed in 2004 with the task to "provide an overview of the risks and benefits in its investigative advisory report" (Gezondheidsraad 2006:121). This report mapped "the opportunities and threats that nanotechnologies present for human health [and] insofar as they are connected with health, broader social consequences are also discussed" (Gezondheidsraad 2006:3). The committee was quite careful in presenting the risks and benefits as symmetrically as possible; at one moment the secretary-scientist even counted the number of pages that were devoted to negative and positive aspects as a check of this balancing act. This advisory report developed a wide-ranging set of recommendations and was therefore presented to five different Ministers: of Health, Welfare and Sport, of Agriculture, Nature and Food Quality, of Economic Affairs, of Housing, Spatial Planning and Environment, and of Social Affairs and Employment.

The Gezondheidsraad is a "semi-governmental" organization in the same sense as the Rathenau Institute: funded by the government, annually agreeing with the government on its work programme but expected to be autonomous, independent and critical. This is by no means an easy task, and it is indeed amazing that an institution like the Gezondheidsraad still enjoys such a high esteem in a world where all authorities are questioned (Bijker et al. 2009). In a detailed analysis of the "back stage" work that the Gezondheidsraad performs to maintain such a highly respected "front stage" authority in scientific advice, we have highlighted several paradoxes. The first was already mentioned and sets the problem at macro level: how to maintain authority in a society where most authorities are constantly under criticism? The second is at the micro level of the daily work: the back-stage work shows all the characteristics of social-constructivist scientific work that I summarized above, while the resulting front stage scientific advice almost always has a Popperian scientific solidity. The third paradox, at meso level, is the most relevant for my argument here. We have shown that confidentiality of deliberations within the Gezondheidsraad committee is crucial for its quality. Additionally, we have concluded that it is also important to have experts rather than representatives on these committees. And here, then, is the third paradox: to plead for an institution that is not itself democratic (for example because not having representatives form various stakeholders in its functioning) as a crucial element in a democratic system of hybrid and pluriform governance: "Institutions for scientific advice such as the Gezondheidsraad or the US National Academy of Sciences are crucial ingredients for a democratic governance of technological culture – and they are so precisely because they form relatively exclusive, confidential scientific realms without explicit representation of stakeholders on their committees" (Bijker et al. 2009:165).

Type of institution / Type of governance action	**Institute for technology assessment (e.g. Rathenau Institute)**	**Governmental scientific agency (e.g. RIVM)**	**Scientific advisory council** (e.g. Gezondheidsraad)	**Parliament**	**Government**
Setting an agenda for public debate	Working document by Rathenau Institute (2004)			Was alerted to nano issues by Rathenau Institute in "hearings" (2004)	
Giving scientific advice			Advisory report on benefits and risks of nanotechnologies by Gezondheidsraad (2006)	Debates the scientific advice and the government's reaction to it	Formally asks advice from Gezondheidsraad; sent advice to parliament; the advice shaped government's vision on nanotechnology (2006)
Providing scientific data		KIR nano Centre: website, reports, newsletters (since 2006)			Maintains relevant agencies such as RIVM and makes appropriate use of them
Organising public dialogue	Rathenau Institute provided crucial kick-off, though the Societal Dialogue was organized by an independent ad hoc committee (2009-2011)			Individual members participated in various activities	Government funding of Societal Dialogue; Cabinet Ministers participated in starting and closing events

Table 2: Elements for a hybrid and pluriform governance process of science and technology, with examples from the Dutch nanotechnologies case

Let me briefly return to the contents of the Gezondheidsraad report because it not only advised the government on its nanotechnologies policy but also sketched the outlines for the hybrid governance process I am proposing here. The core of that sketch followed the analysis by Renn (2005) in order to distinguish different categories of risk situations: (1) simple risks where we have full scientific knowledge (e.g. the risks of radioactive radiation), (2) uncertain risks where scientists warn that they do not completely understand the risks (e.g. toxicity of nano particles) and (3) ambiguous risks where there is no consensus in society what the dominant values are (e.g. human enhancement). The committee drew a general and a specific conclusion from this analysis.

The general message of the advice was to outline a hybrid landscape of different forms of deliberation with varied participation of experts, stakeholders and citizens. In the case of simple risks, only scientific experts need to participate in the deliberations. However, in deliberations about uncertain risks, scientists are not enough to make balanced decisions (because of the self-proclaimed lack of scientific certainty about the situation), and stakeholders need to be invited in addition to scientists. In the third case of ambiguous risks there is no other way than to involve the whole of society and invite the citizens to the table. In this landscape, the Gezondheidsraad and the Rathenau Institute have their specific but different roles. The advice added the warning that "The concept of 'trust' is a critical factor in the dialogue between the government, industry, directly affected groups and the general public. This also applies to the debate surrounding nanotechnologies. To win the public's trust, it will be essential for institutions to subject their own performance to continual critical reflection. Besides expertise, decisiveness and integrity, openness and accountability are key concepts in this." (Gezondheidsraad 2006:18).

The specific message of the advice was to continue research investment in nanoscience and nanotechnologies while increasing research into nanotoxicity. Also, it recommended "that the decision-making process should involve stakeholders, including the general public in certain cases" (Gezondheidsraad 2006:16), which was then translated by the government into a societal dialogue (see below).

The next actor in this tale of hybrid governance is the government itself. An interdepartmental working group was formed with high-level civil servants from nine different ministries. This working group prepared the Dutch governmental vision on nanotechnologies (Regering 2006). The advice to pay more attention to nanotoxicity was translated into creating yet another actor:

The increased attention to nanotoxicity led to the creation of a special actor: the "Risks of Nanotechnology Knowledge and Information Centre" (KIR nano) at the National Institute for Public Health and the Environment (RIVM). KIR nano was commissioned by several Dutch ministries. Its task is to closely monitor possible risks of nanotechnology. KIR nano is not a research centre but a data portal: "KIR nano itself emphatically does not conduct any research. However, to be effective, it does require close collaboration and exchange of information within the field of research, within RIVM as well as on national and international levels. For this reason, the centre continually builds on and maintains a wide national and international network for the performance of its tasks." (http://www.rivm.nl/; last consulted on 19-11-2013). In my summary table, this actor is characterized as a governmental scientific agency. It is completely funded by the government and firmly anchored within the area of science though it does not carry out any research. It does not give the kind of politically charged and meticulously crafted scientific advice that the Gezondheidsraad does, but its scientific work is directly relevant for policy.

The Dutch Governmental Vision on Nanotechnology followed the 2006 Gezondheidsraad advice almost completely, including its proposal to involve stakeholders and citizens in a public debate on the future of nanotechnologies because of the uncertain and ambiguous nature of the risks involved. This was probably the most far-reaching consequence. Four times previously did the Netherlands have such a broad societal debate on an emerging science and technology topic: the "broad societal discussions" on nuclear energy (1981 – 1983), on cloning (1998 – 1999), on xeno-transplantation (2000 – 2001), and on genetically-modified food (2001 – 2002) (Est 2011). Especially the last was not an unequivocal success. The "Eten en Genen" (Eating and Genes) public debate was mainly weakened by doubts amongst vocal citizens that the discussion was not open – instead, they accused the government that it had already made up its mind and was only using the debate as a societal lubricant. So, the decision to have a public debate on nanotechnologies was not an easy choice and not without risks itself. However, the government realized the inevitability of the dilemma that was first identified by David Collingridge (1980): either you assess a technology in its early stage when you can still change its course but have no insight into its (positive and negative) consequences, or you wait to evaluate the technology until you better understand its consequences, but then it is too late to change its course. Caught in that dilemma about nanotechnologies, the Dutch government decide to have a debate and try to address the problem of lack of information instead of waiting another five years until more would be known about the risks and benefits.

The organization of such a public debate is typically a task for a PTA organization, such as the Rathenau Institute. In this case, and in line with the previous two societal discussions, the Dutch government established an independent ad hoc committee to organize the "Societal dialogue on nanotechnology" (http://www.nanopodium.nl/CieMDN/; last consulted on 19-11-2013), which ran between 2009 and 2011. Since this was a relatively innovative endeavour and an important ingredient for my proposed hybrid and pluriform governance process, I will elaborate on the design choices with a little more detail (see table 3 for a summary). This analysis was prepared for, and benefited from, an international workshop that the Committee held in 2010 and to which experts in TA and STS were invited to critically reflect on the design and process of the dialogue.

The organizing committee was to be clearly independent from the government. The main reason was to avoid suspicion that the dialogue was biased in favour (or against) nanotechnologies. One important element in the relative failure of the "Eating and Genes" public discussion was that some perceived the organizing committee to be the mouthpiece of the government and the agenda not to be as open as claimed. The financial administration of this Societal Dialogue on Nanotechnology was handled by one of the Dutch universities, and for the secretariat, Technopolis, a consulting and an STS research agency, was contracted after an open tender. Civil servants from some of the relevant ministries often participated in an advisory role in meetings of the Committee but were explicitly ruled not to have any decision power.

A budget of approximately EUR 4 million was made available by the government. The Committee decided to outsource most of the activities. Two open calls were published in which individuals and organizations were invited to propose subprojects that would address aspects of the societal dialogue. The subprojects were to have budgets between EUR 15 and 130 thousand; TV programmes could be more expensive, and subprojects with smaller budgets were decided on separately. In response to the two calls for proposals, the Committee received 140 expressions of interest; 73 applicants were invited to submit a full proposal, and 35 subprojects were granted. There was no formal evaluation of the

Design element	Design choice	Intended benefit	Potential cost	Result
Organizer	Independent ad hoc committee, supported by sub-contracted secretarial team (provided by Technopolis, Amsterdam)	Avoid suspicion that the dialogue was "rigged" by the government	No political mandate and thus no a priori commitment by government to results	Worked well: participants trusted the process; vice-minister of social affairs publicly received dialogue's outcome with positive speech
Budget	EUR 4 million, to be spent mainly through two open calls for proposals for subprojects (with budgets between EUR 15 and 130 thousand)	Substantive budget helps to generate high-quality input; Out-sourcing will help to engage broad range of experts	Waste of money; Out-sourcing may result in lack of quality control	Worked well: project generally considered valuable; most subprojects of good quality with only few exceptions
Agenda	No agenda in terms of pro/contra nanotechnology; a working conference with experts and stakeholders helped the Committee to decide on content themes and dialogue activities (Charge was: to stimulate and facilitate a societal dialogue on nanotechnologies, including their social and ethical aspects, resulting in a societal agenda for nanotechnology)	Open agenda allows for broad range of questions, issues and perspectives	Lack of focus	Worked well: most relevant questions were discussed; participants felt welcome and taken seriously to raise issues. One aspect was insufficiently addressed: international and development questions (including the potential effects on reaching the UN's MDGs)
Content themes	Five priority themes were defined: •Health and food •Nature and sustainable society •Security and privacy •International aspects •Sustainable economic growth Focus on concrete applications and products was recommended	Limited set of themes provide focus dialogue and increased opportunity for synergies between subprojects	Wrong choice of themes that does not resonate sufficiently with interests and agendas of participants	Worked rather well: good for structuring the dialogue; but rather an uneven interest distribution in practice, resulting in relatively little attention to international economic aspects
Process phasing	Dialogue process 2009-2011 had three overlapping phases: 1.Information 2.Awareness 3.Dialogue	Cope with lack of knowledge about nanotechnologies amongst many participants	Lack of attention to politically directly relevant issues	Worked very well: good for structuring dialogue process and for selecting subprojects; subprojects did not feel the phasing as a straightjacket but used it relatively loosely
Participants	Invited by open call in Dutch daily newspapers and by direct invitation: •Experts •Stakeholders •Citizens	For discussion of "ambiguous" and "uncertain" risks participation is needed by experts + stakeholders + citizens	Dialogue of the deaf	Worked well; many activities had heterogeneous participation but some were fruitfully focused on sub-sets of participants (e.g. school children, members of the protestant churches, chemical industry, etc.)
Media & means & activities	Broadest possible spectrum of media, means and dialogue activities (including websites, social media, school courses, TV programmes, science cafés, theatre play, etc.)	To reach a broad range of participants and to allow for very different styles of thinking, engagements and discussions	Lack of focus	Worked well; different media clearly catered top different groups of participants

Table 3: Design choices in the Societal Dialogue on Nanotechnology in the Netherlands, 2009-2011; for details, see: Commissie Maatschappelijke Dialoog Nanotechnologie (Nanotechnologie, 2011a, 2011b)

efficiency of the way the 4 million Euro were spent (if that would have been possible at all), but there seemed to be a general agreement, also amongst members of the parliament, that the dialogue was worth it.

Time and again the Committee underlined, in private meetings and in public, that it did not have an opinion on nanotechnologies, and that any outcome of the dialogue would be communicated to the government. This message was further emphasized by the open calls for proposals and the granting of very different subprojects to applicants as diverse as a foundation for Christian philosophy, several university groups, the national consumers' organization, an action group against animal testing, museums & science centres, a regional industry organization and multi-media firms. The formal charge of the committee was "to stimulate and facilitate a societal dialogue on the social and ethical aspects of nanotechnology". During the process, the outcome of the dialogue was defined as "developing and presenting a societal agenda for nanotechnologies." The openness of the agenda could have led to a lack of focus and of a sufficiently thorough discussion. This was not the case, and the level of discussion was generally quite high. Only on international and developmental aspects, including the possible effects of nanotechnologies on realizing the United Nations' Millennium Development Goals, it did not result in satisfactory outcomes. This was, however, the Committee concluded, not caused by a lack of quality of the relevant subproject but by a lack of interest on the part of participants.

Even though the agenda was fundamentally open, the Committee decided that some focus would help. To choose such a set of content themes, a working conference with experts and stakeholders was organized at the very beginning of the process. This resulted in five themes (see table 3), with social and ethical aspects cross-cutting all themes. The themes were not implemented as a straightjacket but did help in the selection of subprojects. They also resulted in some "critical mass" of activities around each of the themes which then led to synergies between the subprojects. Such synergy was actively encouraged by the Committee through the organization of workshops for the joint subproject leaders.

Even though the Dutch government decided, in this nanotechnology case, to have an early dialogue, the previously mentioned Collingridge dilemma did not go away: at the start of the dialogue process, only half of the Dutch population had ever heard of "nanotechnology" and only 30 % had an idea what it meant. To alleviate the problem, the Committee decided to follow a three-phase process: first, information about nanotechnologies would be provided (including all aspects, from science to ethics, from lab to clinic); second, awareness was to be raised that there is something to consider, to choose, to embrace or to stop; and third, the dialogue itself could take place. This distinction of three phases, again, was not applied very strictly but helped to select the subprojects and helped to explain what the whole process of the dialogue comprised. The phasing thus was not so much about cutting the process in three distinct time periods but rather about making an analytical distinction. Subprojects could contribute to more than one phase, but they had to at least explicitly reflect on their focus in this respect. This decision to have three phases (plus the previously mentioned open agenda) came with a potential cost: certain questions with direct political relevance might not be addressed. In practice, this risk was countered by the organization of some parallel communication activities, such as a working dinner with members of the parliament, to make sure that concrete political issues, if there were any, would surface and be picked up.

The Gezondheidsraad's diagnosis to consider issues of nanotechnology as "ambiguous" and "scientifically uncertain" implied, as I argued above, that scientists and stakeholders and citizens were to participate. Some scientific experts and stakeholders were directly invited to various plenary and centrally organized activities and, notably, to the working conference during which the choice of content themes was discussed. Another important instrument were advertisements with the invitation to join the debate in two major Dutch newspapers and in the free "Metro" paper. All activities, whether organized by the subprojects or centrally by the Committee, were separately announced. The Nanopodium website was created to provide a portal for all activities and worked well. What could have become a dialogue of the deaf, turned out quite well. Probably partly because the different subprojects allowed for some differentiation in target audiences, but mostly because – I like to believe – most participants made a real effort to converse; jargon was avoided, difficult issues were not shunned, and the other's perspective was appreciated.

This all resulted in a dialogue that spanned a very broad range of media and activities. The Committee centrally organized the kick-off and closing events (both with the responsible Cabinet Minister participating), conferences, workshops, a festival, and the Nanopodium webportal. The subprojects produced books, a special journal issue, exhibitions, TV programmes, design & art objects, a children's novel, websites, social games, course material for schools, Internet films, comics, theatre performances and panel and podium discussions. All subproject leaders reported on the details of both their activities and the content of the dialogue outcomes; additionally, the Committee contracted a small group of journalists to visit the various activities. With all these inputs, the Committee could draw on all activities, even though they had been so broad-ranging, and this finally resulted in a societal agenda for nanotechnologies in the Netherlands.

What, then, was the result of this experiment with democracy? By surveying the understanding of and opinions about nanotechnology among the Dutch population, before and after the dialogue, the Committee could conclude that the dialogue resulted in a small but statistically significant increase in awareness (from 54 % to 64 % of the Dutch population) and in understanding (from 30 % to 36 %). This awareness and understanding included both the promised benefits and the potential risks. Even though citizens and stakeholders now better realize that nanotechnologies also entail risks, the support among the Dutch populace for nanotechnology had increased. In various subprojects, and notably in the science-café discussions, we observed that "being informed about the risks of nanotechnologies did not weaken the positive views of nanotechnologies but, on the contrary, resulted in increased support." (my translation (Nanotechnologie 2011a:10)). I would like to generalize this to the following raison d'être for TA in general: "citizens are not afraid of new science and technology, but they are afraid of governments, scientists and industrialists who do not tell them everything, including information about risks."

Conclusions: The State's Turn and TA as an Experiment with Democracy

I have summarized the histories of TA and STS and argued that these converge to an integrated understanding of and intervention into science, technology and society, which I summarized with the phrase "we live in technological cultures." For their democratic governance, these technological cultures acquire activities "at the interplay between parliament, government, science & technology and society" (Ganzevles/Est 2012). I suggest that the standard array of democratic instruments that are currently in play do not suffice. We need to innovate our democratic instruments and experiment with our democracies – as much as we do scientific experiments and make technological innovations. I have proposed that the state should return from its neoliberal retreat – we need a new and active role for the state. But the state also needs to be reinvented into a multifaceted state with the government, parliament, scientific agencies, TA offices, etc., feeding into a hybrid and pluriform governance process. What exactly this governance process should look like, I do not know. It is highly probable that it will take different shapes in different political cultures. Even if the Dutch "democratic experiment" about handling nanotechnologies does not suggest the single best way, it does demonstrate that such a new hybrid and pluriform process of democratic governance is possible.

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Opening the Black Box: Scientific Expertise and Democratic Culture

Stefan Böschen

Abstract

Technological innovations often spark controversies about their chances and risks, with different expertise competing and opposing. The article raises the question of how to gain (relatively) uncontested expertise by structuring consensus and dissent of different offers of expertise despite the all-present non-knowledge in risk-decisions. The article puts forward the thesis that answering this question requires opening the "black box" of scientific expertise-building; and that this opening will only be successful if our knowledge about expertise is enhanced and new forms of meta-expertise are created. On the theoretical basis of "civic epistemologies" (Jasanoff 2005b, Miller 2005) and by the example of REACH, the article proposes three knowledge qualifiers that enable us to compare expertise from different knowledge sources in order to build up meta-expertise.

Introduction: the Need for Meta-Expertise

The modern world feeds on innovation. Yet, technological innovations often carry a certain risk to the environment or people and therefore often spark controversies about their implementation and use. The old paradigm of dealing with these conflicts is dominated by a technocratic viewpoint and can be summed up as "technologies of hubris" (Jasanoff 2005a). However, during the last decade, participation and contextualization have been seen more and more like a magic formula for solving such conflicts despite the chances and risks of innovation and for guaranteeing precaution and control. These new forms of knowledge and new forms of governance allow us to take a step forward towards a democratic control of technological progress.

Hence, contrary to the old paradigm of dealing with these conflicts, Sheila Jasanoff (2005a) proposes to establish "technologies of humility". These are characterized by four aspects: "framing", "vulnerability", "distribution" and "learning" and they aim "to make apparent the possibility of unforeseen consequences; to make explicit the normative that lurks within the technical; and to acknowledge from the start the need for plural viewpoints and collective learning" (ibid, p. 384). Nevertheless, the "technologies of hubris" still influence and dominate the public debate through labels such as “sound science” or “evidence-based science”, which are used to stabilize technocratic thinking and institutionalization. This aspect is also highlighted by the so-called “agnotological” studies (cf. Oreskes/Conway 2010; Proctor 2011), which have provided some instructive insights into the strategic use of non-knowledge. They uncovered, using the examples of the tobacco industry and the climate change problem, how economic actors are spearheading endeavours to minimize non-knowledge but with the underlying goal of repulsing regulation efforts with the argument of not yet having enough knowledge for reasonable and well-founded regulations. It is rather difficult to disentangle this set of strategies.

Against this background, the key question has to be addressed: how to attain a relatively uncontested expertise by structuring consensus and dissent of different “offers of expertise” and thus creating strong incentives for action and unfolding regulatory potential – although “facts are uncertain, values in dispute, stakes high and decisions urgent” (Ravetz 1999, p. 649)? How to map the different forms of expertise? And how to combine them? How to decide which expertise to follow?

This article tries to answer the outlined questions by putting forward the thesis that this requires the opening of the “black box” of scientific expertise-building; and that this opening will only be successful if our knowledge of expertise is enhanced and new forms of meta-expertise are created. Meta-expertise has to be seen as a link between epistemic and cultural values. It, therefore, allows a political debate about the problem-centred evaluation of different “offers of expertise”. My reference to the topos of “meta-expertise” is related to the holistic approach of Harry Collins and Robert Evans as elaborated in their work “Re-Thinking Expertise” (2007). Therein, Collins and Evans construct a “periodic table of expertises” (ibid, p. 14) to classify all different sources of expertise – including the various forms of tacit knowledge and meta-reflections.

I would like to start with a more modest attempt. A well-chosen starting point should allow us to reconstruct not only the connection between cultural and epistemic values (cp. Kitcher 2011) but also the empirical links to the debated problems. Therefore, with reference to the philosopher of science Christoph Hubig, I would like to propose that meta-expertise should start with the differentiation between three dimensions: criteria, indicators and observables, as well as their linkages (cf. Böschen/Hubig 2013). This scheme can be used as a heuristic for thinking about meta-expertise. “Meta-expertise” allows a critical assessment of different “offers of expertise” and the social configurations under which they are processed. In this article, I will focus on the epistemological aspects of the addressed question. Still, we have to keep in mind that the development of a democratic culture depends on the creation of institutions that enable participation and contextualization to be socially effective and legitimate. The effectiveness of meta-expertise depends on its institutional embedding. Without institutionalization, there is no development of a democratic culture.

The article is structured as follows. As a first step, I would like to introduce the conceptual framework with reference to the concept of “civic epistemologies”, which was mainly brought into the debate by Sheila Jasanoff and Clark Miller. Presenting an observation that struck me – a form of knowledge-politics by implementing the IPBES-process in Busan (2010) – I combine the thoughts about civic epistemologies with the aspects of meta-expertise mentioned before (criteria, indicators, observables) (chap. 2). As a second step, I focus on a case study, namely the debate about and the implementation of the new regulation of chemicals within the EU, REACH (Registration, Evaluation, Authorization and Restriction of Chemicals, 2007). I thus reconstruct the problems of implementing the precautionary principle with respect to the scheme of the three knowledge elements for meta-expertise (criteria, indicators, observables) (chap. 3). Based on this, I present some ideas to generalize these insights and draw some conclusions by reformulating these insights into challenges for Technology Assessment (chap. 4).

Civic Epistemologies and the Concept of Meta-Expertise

I will start with some conceptual considerations. My argumentation is based on the concept of "civic epistemologies" (Jasanoff 2005b; Miller 2005). Jasanoff and Miller define this concept in a quite similar way but with interesting differences in priorities. The two definitions read as follows. Sheila Jasanoff wrote in her valuable book, "Designs on Nature": "Civic epistemology [...] refers to the institutionalized practices by which members of a given society test and deploy knowledge claims used as a basis for making collective choices." (Jasanoff 2005b, p. 255) In this definition, the focus is on the institutional aspects of knowledge processing. Clark Miller emphasizes another aspect of civic epistemology, namely "practices, methods, and institutional processes by which the community identifies new policy issues, generates knowledge relevant to their resolution, and puts that knowledge to use in making decisions." (Miller 2005, p. 406) Miller mainly addresses the openness of the situation with respect to practices. The social, cognitive and temporal dynamics in civic epistemologies allow processes that open black boxes. Thus, the heterogeneity resulting from different knowledge resources can be ordered and institutional environments for processing different forms of expertise can be created.

Exemplified by the case of the IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services), we can observe the beginnings of the forming and establishing of a civic epistemology (cf. Brand/Vadrot 2013). This platform was established as an independent and intergovernmental science-policy interface for strengthening the link between science and the biodiversity policy. After seven years of consultation and negotiation, the IPBES was finally established in April 2012. As these processes have been very complex and really multifaceted, I would like to illustrate my argument by two excerpts of the IPBES Busan-Meeting, which was held in June 2010. One excerpt is taken from the opening speech, the other from the so-called "Busan Outcome". The guiding question in reading these excerpts is: What knowledge is needed? We start with the opening speech presented by Achim Steiner (UNEP) on 7 June 2010. In his speech, he answers this question as follows:

"[To enhance; SB] developmental and economic life […] is only possible through sound, solid and uncontested science. Science that revels in the different approaches, encompasses all available knowledge bases including traditional knowledge and brings in the best available data from all corners of the planet in order to reach meaningful and actionable conclusions."

What are the different social and epistemic demands articulated in this speech? Concerning the social demands, Steiner mentions two aspects regarding the quality of science itself, namely a sound and solid science. Moreover, the knowledge produced by science has to hold the quality of usability which is expected to be higher, the lower the conflict rate is. Therefore, it has to be uncontested science. And finally, science has to allow meaningful and actionable conclusions. But there are also epistemic demands. Science has to revel in different approaches. This confronts science with the heterogeneity of its various disciplines. But moreover, the knowledge has to have a transdisciplinary basis, because Steiner states that it has to encompass all available knowledge bases – also the non-scientific ones. Finally, it has to bring in the best available data, no matter where produced or by whom. That is quite a challenge!

Let us compare these statements of the opening speech with the findings in the final document (Busan Outcome; 11.06.2010) – what knowledge is needed now?

"The new platform should perform regular and timely assessments of knowledge on biodiversity and ecosystem services and their interlinkages, which should include comprehensive global, regional, and, as necessary, subregional assessments and thematic issues at appropriate scales and new topics identified by science and as decided upon by the plenary. These assessments must be scientifically credible, independent and peer-reviewed, and must identify uncertainties. There should be a clear transparent process of sharing and incorporating relevant data [...]." (Busan Outcome 2010, p. 3; emphasis added)

Not surprisingly, science is to govern the assessment process and frame it by identifying new topics. The scientific procedures guaranteeing the quality of methodic examination of knowledge are highlighted, namely peer-review processes and the institutionalized independence of science.

Indeed, there seems to be no alternative to the established social forms of constructing scientific credibility – but what are their effects? Mainly, the place of other forms of knowledge, such as local knowledge, remains unclear. What is the systematic place for local knowledge in this process? As an example, and with respect to the importance of local biodiversity knowledge: What about shamans of the rain forest? – What are the peer-review procedures for them? Systematically speaking: there is a lack of symmetry between scientific and local knowledge. But how to resolve this tension, or, more accurately: how to proceed with this tension?

Against this background, I will introduce the heuristic for building up meta-expertise, namely the reflection on criteria, indicators, and observables. These three knowledge qualifiers can be defined as follows: Criteria evaluate indicators against the background of main cultural values or interests. Indicators are representing an effect-related aspect of a problem, which should be considered or solved. And finally, observables concretize indicators by providing specified methods for empirical observations or test strategies. Why should we proceed that way? My thesis is that this scheme allows clarifying to which layers the different arguments or empirical evidences are related to. Therefore, it enables us to classify any sort of knowledge with respect to the description of a problem. This can be tested on a specific and well-established debate, the regulation of chemicals, in which a civic epistemology was formed over a long period of time – and yet a reorientation took place in the last years. What happened?

Civic Epistemology Concrete: Chemicals Regulation

The regulation of chemicals has been an important issue since the beginnings of a "science-based industry" (for an overview, see: Böschen 2014). Thus, this civic epistemology is well established (with its specific networks and cooperation structures), so that changes are unlikely and also difficult to realize. Astonishingly, there has been a change at the very beginning of the 21st century. After ten years of a public-political debate, a new European regulation for chemicals, REACH (Registration, Evaluation, Authorization and Restriction of Chemicals), was established in 2007. There are many aspects worth mentioning. But with regard to my argument about the necessity of meta-expertise, I will concentrate on the most relevant facets. All aspects are connected to questions about the knowledge-bases for decision-making and their transformation. The generalization of the precautionary principle made the question of "Low Doses, High Stakes?" (EEA 1998) an important stimulus for the debate on the re-ordering of regulation. One main aspect was that regulators came to realize that the full-test strategy had reached an impasse. The full-test strategy aimed to map all damages associated with a certain chemical and decide whether this chemical was harmful or not. But the insight grew that chemical risks can neither be exhaustively described nor predicted and that it therefore makes no sense to base regulation exclusively on manifest environmental damage or well-known effects on human health. Instead, it was indicated as necessary to find strategies that can take varying degrees of empirical evidence into account. Therefore, there was not only the need to accelerate the production of risk-knowledge (i.e. to come to "better" decisions with a minimum amount of knowledge) but also the need to introduce new indicators to support the criterion of precaution.

On the limitation of the full-test-strategy: starting with 100 000 industrial chemicals in 1981, only 10 assessment reports were completed in 1997 and about 100 in 2004. Sven Hansson and Christina Ruden (2005) stated accordingly that the full-test strategy would need about 5 000 years to cover all chemicals registered. Speaking on behalf of science and research, this sounds quite fantastic – but with respect to regulation, this spells a catastrophe. One important objective therefore was to minimize the resources necessary for obtaining the information stipulated by the legislation. Accordingly, the White Paper presented in 2001 bundled the main objectives for the new legislation: 1) time limits for the discharge of hazardous substances, 2) producer responsibility, 3) guidelines for the application of the precautionary principle, 4) costs of risk assessment should be financed by the industry and finally 5) the definition of PBT-indicators – in analogy to CMR-substances. The paradigm shift is hidden in the abstract formula "PBT equals CMR". PBT represents the following indicators: "persistency", "bioaccumulation potential" and "toxicity". CMR represents the following indicators: "carcinogenicity", "mutagenicity" and "reproductive toxicity" of a chemical substance. Why does this equation "PBT equals CMR" mean a paradigm shift? This is illustrated in the following chart (Figure 1).

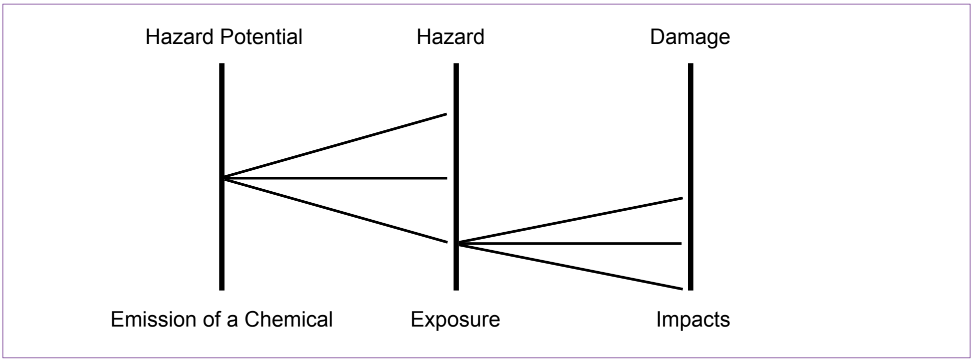

Figure 1: Different layers of hazard and damage (simplified version of Scheringer 2002, p. 76)

Here we can see the emergence of the precautionary principle in the field (cf. Scheringer 2002). As shown in the chart, there are different levels to be addressed in risk considerations. The first level (hazard potential) concerns the emission of a substance, whether as a product itself or as an unwanted by-product. The second level (hazard) is that of exposure: humans or certain species get exposed to a single substance or a mix of substances and might be harmed. The third level (damage) addresses an actual damage with observable effects caused by a certain chemical. The strategy of the pre-REACH era aimed to map all damages associated with a certain chemical and decide whether this chemical was harmful or not (full-test strategy). Therefore, the focus lay on indicators describing the impacts in detail. But with respect to precaution measures, the set of indicators used to describe risk situations has been broadened. Moreover, there was a shift in focus from the level of damage to the level of hazard: PBT-indicators are hazard indicators, whereas CMR-indicators are damage indicators. This shift must be seen as a revolution. For many decades, the evidence of a real danger had to have been proven to allow regulation. Nowadays, regulation can be implemented when a possible harm is indicated.

This paradigm shift was accompanied by institutional innovations. Two main innovations concerning the institutional procedures took place. The first one was the establishment of a new administration unit, the European Chemical Agency (ECHA) in Helsinki, and the associated re-structuring of the division of work between industry and the administration. The responsibility for data production shifted from the administration to industry. The industry is now responsible for fulfilling the data requirements, whereas the newly founded ECHA is responsible for controlling whether the data requirements are fully met. The second innovation is the design of a new system of risk-knowledge production and sharing. As a result, a chain of risk-knowledge production had been established. This new system is connected with two other innovations. Firstly, along the manufacturing chain from producers to downstream-users, a platform for sharing knowledge and generating risk-knowledge has been implemented. Thus, the upstream-producers (chemical plants) share their knowledge with downstream-users. But the users can also collect knowledge from the contextualization of specific chemicals and communicate their insights back to the producers. Secondly, this system was combined with a standardization of thresholds of risk knowledge. The registration of a substance depends on the fulfilment of specific data requirements (slogan: "no data – no market"). Because there are a vast number of complex problems connected with the production and sharing of knowledge, the so-called RIPs (REACH Implementation Projects) were set up. These projects serve to identify the best available tools for testing chemicals and combining data from different sources to draw a "coherent picture".

The system seems to be perfect – but there are some very important limitations that are worthy of being reflected upon in more detail. One touchstone is located on the level of specific criteria, indicators and observables; another one on the level of the social organization of the collection of risk-relevant knowledge at the European Chemical Agency (ECHA). As mentioned before in my description of the conceptual framework, the differentiation between the three dimensions seems to be a useful tool for analysing processes of knowledge build up for decision-making. Regarding the three knowledge qualifiers: criteria, indicators and observables, the main question whether the transformation of the civic epistemology in the field of chemical policy induced by REACH was a success or not, can be answered as follows. Some important innovations had been made: new criteria, such as the precautionary principle or the wish for a unified system solution, evolved and structured the knowledge-building process. To support these criteria, specific new indicators were highlighted with respect to these criteria: persistence, bioaccumulation potential (and to some extent: spatial range). Yet the question concerning the observables in the REACH-process remains unanswered. Did the guiding principle of the new legislation: "No data – no market" succeed? Let us have a look inside the black box.

To answer the question concerning the observables in the REACH-process, I will analyse four levels: a) The institutional level of legislation: What is the fixed setting of observables in the law itself? Do the observables defined there support the PBT-analysis? b) The practical level of the existence of PBT-related data: Do we have enough data? c) The level of communication between industry and the administration: Are the industry-produced data placed at the disposal of the administration well elaborated and sufficient? d) The level of administration: In what ways does ECHA organize the data base and come to conclusive assessments?

1. ***Institutional level of legislation.*** To thoroughly analyse this level, we have to take a closer look at the annexes of REACH (cf. Scheringer et al. 2006). The REACH annexes VII to X define the data requirements for the different tonnage levels. Tonnage levels mean the yearly production volume of a chemical. The idea behind is that the higher the production volume of a chemical, the more likely are adverse effects even in cases in which they have not been observed yet. Moreover and with regard to the costs of tests, it seems plausible to link the amount of tests (and therefore production costs) with production volume. Therefore, the different PBT-related data requirements are increasing with the production volume. For the three tonnage levels from 1 to 10, 10 to 100 and 100 to 1 000 tons per year, different PBT-observables are listed along in annex XIII of REACH (cf. Scheringer et al. 2006, p. 703). The interesting and important point is that the comparison of the required data with the observables shows that the PBT-indicators can only be supported at a production level of at least 100 tons per year. But only 10 % of the chemicals are a part of this class. This is also due to the fact that the industry campaigned against certain tests to reduce their costs. One example is the long-term toxicity test for daphnia that had been obligatory (under specific circumstances) at the level of 1 ton per year in an earlier draft of the law; in the current version, however, this test is required only at a level of at least 100 tons per year. Against this background, the initial goal of undertaking a complete PBT-assessment after the registration of a chemical was abandoned. Such an extensive PBT-assessment is not compatible with the criteria accepted in the final version of the law.

2. ***Availability of PBT-related data.*** There are about 95 000 industrial chemicals in production and use. It seems to be obvious that a full data-set of all these chemicals is an unrealistic expectation, but what about the availability of data, especially the data related to the newly established indicators? Data relating to one of the indicators exist only for 2 663 chemicals. And only 91 chemicals underwent observations with respect to all three indicators (compared to the 95 000 chemicals used in industry) (Strempel et al. 2012).

3. ***Data requirements to be fulfilled by the industry.*** As a result of the new legislation, ECHA has to rely on the industry. This raises new problems of control, as shown in the Progress Report by ECHA in 2011 (cf. Gilbert 2011). Jukka Malm, director of regulatory affairs at ECHA, stated: “Industry has not taken full responsibility for the quality of data.” (ibid, p. 151) More precisely, the report notes: “The quality of many of the chemical safety assessments is of concern.” (ibid) In particular, it criticizes that the quality of the scientific arguments put forward by the industry to justify their use of read-across methods and to skip additional safety tests is “not high enough” (ibid). And “Sebastian Hoffmann, a toxicologist based in Cologne, Germany, who works as an industry consultant on REACH, says that companies seem to have been ‘creative’ in interpreting REACH’s demands for them to fill data gaps” (ibid, p. 150). There seems to be plenty of room for improvement.

4. ***What about the working-routines of ECHA?*** One important trend can be noticed, namely the strategy to abandon extensive standard testing procedures in favour of an approach tailored to specific substances (Ahlers et al. 2008). This strategy is supported by various arguments: On the one hand, substances can be characterized by their specific properties and on the other hand, the available data is limited and highly variable. However, no procedures had been created to combine the heterogeneous knowledge resources, nor was specified how to ensure the comparability of results achieved with different methods. Therefore, the following question remains unanswered yet: What kind of expertise allows for the sorting of different assessments?

The first conclusion is as obvious as it is frustrating: although innovations with respect to new criteria and related indicators took place, the required observables were not configured in an appropriate way (main problems: inadequate data requirements, failure in test strategies, problems in handling observables). The second conclusion serves as an explanation: Although there had been an agreement about the set of indicators, the strategy failed. The indicators were restructured according to the precautionary principle, since this was the guiding principle in EU environmental law. But the need for an appropriate scope of observables and link between observables and indicators was not taken into consideration. The main problem is not that there are no observables or limited data, but that there was a persisting conflict between industry-based criteria and the principle of precaution. As the conflict was shifted down to the level of observables, it was turned down. The EU bureaucracy failed in defining clearly the sets of indicators and the linked observables needed for a PBT-analysis. Therefore, there was no clear strategy to meet the cost-arguments of industry. The outcome is dramatic: de jure, the EU pursues a politics of precaution, while de facto the EU is unable to enforce it.

Use of Meta-Expertise and their Relevance for TA

What can be concluded from this specific case to gain some more general ideas about how this toolset of criteria, indicators and observables can be constructed and used as meta-expertise? This might seem like a quite trivial starting point – but it is indeed crucially important to keep in mind that real-world problems are highly complex. This means that, firstly, there are lots of indicators and even more observables to describe them. Normally, these indicators are a part of a political conflict ("politics of indicators"). Different actors are competing by articulating specific parts of the problem as being the most important ones to be addressed. On that score, the conflict can be reconstructed as a conflict between different indicators as well as the underlying criteria. But the conflict can be transformed to the level of observables – a strategy that is chosen in many cases. This is due to the fact that this transformation normally means a de-politization and technocratization of the problem. Moreover, even if there is a consensus about the indicators, the set of observables might nonetheless be unclear or contested.

To disentangle these complex settings, meta-expertise is essential. And as demonstrated above, the three mentioned knowledge qualifiers are useful. Applying a five-step procedure might prove beneficial. First of all, it is important to map the different indicators offered to describe a problem. In what sense are they representing a problem? What are the specific assumptions underlying the selected indicators? Secondly, these indicators are to be described in connection with their related criteria representing specific interests. What are the underlying values? Can these values be generalized or are they specific (e.g. group- or branch-specific)? The third step is to evaluate the coherence between indicators and connected observables. Moreover, every meaningful observable, even if not yet connected to an indicator, should be taken into consideration. Fourthly, it is necessary to understand indicators as representatives of different knowledge cultures (epistemic cultures as a special case) and their values. Finally, we have to order the different indicators in relation to problems of decision-making. This means that the collectively constructed hierarchy of the problem should not only include a hierarchy of the different indicators seen as relevant to describe the problem, but also reveal the key criteria guiding the "construction" of this particular hierarchy.

What could be the next step to proceed further? Normally, when a problem becomes more complex, its set of indicators is expanding as well. In the case of environmental chemistry, the indicators of cancerogenicity etc. were complemented by the indicators of persistence etc. It was quite challenging to reach this conclusion as it is more likely that there is no agreement on the relevant set of indicators when the complexity of the problem description is increasing. For generalizing these insights and learning something for other cases, it might be helpful to discuss two general strategies while being confronted with complex problems. These ideal-typical (and therefore abstract) strategies could be described as follows:

Strategy 1: Transformation to the level of observables and uprating the density of observation (for example "general surveillance" as in the case of post-release monitoring of genetically modified organisms). The point is that in many cases we know something in general (on the level of indicators), but it is highly unclear how these indicators could be shaped by specified observables. Against this background, the no. 1 strategy is trying to learn something about the problem itself and the ways it can (or should) be understood by science. With regard to this, it is important to map the different options promoted by different disciplines to underlay selected indicators with specific observables. In order to fulfil the no. 1 strategy, it is necessary to improve the trans-disciplinary co-observation of problems and to make sure that any relevant discipline with its specific observables is included and adequately taken into account. In summary, transforming the problem to the level of observation and also the tension fuelled by not yet resolved conceptual questions regarding the indicators seen as relevant can be addressed by research.

Strategy 2: Transformation to the level of criteria and the creation of a specific institutional framework to process non-knowledge, ambiguity and ambivalence. The strategy tries to transform the knowledge-conflicts into a defined process of knowledge-production. Therefore, this strategy puts the focus on problem-solving structures and the boundary conditions of social learning processes. The main goal of such a strategy is to enhance "civic epistemology" by reorganizing the institutional setting for problem-solving while offering the opportunity for a better processing of political conflicts rooted in different criteria settings. This strategy offers options for maintaining decision-making processes although the dispute about the framing values is not yet solved (because it might never be solved). Moreover, another important aspect is the chance to uncover the underlying criteria and their values in the decision-making process. In this regard, this strategy offers options for more transparency in decision-making.

With these general strategies envisioned, I want to propose some conclusions and final remarks. Firstly, and with regard to both the conceptual considerations and empirical findings: meta-expertise can be built up using the mentioned knowledge qualifiers: criteria, indicators and observables. This set is useful for reconstructing the different knowledge perspectives with regard to their theoretical strategies and empirical practices. Epistemic cultures (such as molecular biology or high-energy physics; cf. Knorr-Cetina 1999) can be characterized by their specific schemes for configuring criteria, indicators and observables. Therefore, meta-expertise can clarify what kind of knowledge is produced by which kind of epistemic culture. But the most important point is to offer expertise about the relation between indicators and phenomena to be observed and classified. And it is also useful to reconstruct the "politics of indicators" pursued by the different actors. Meta-expertise can uncover the "selective positivisms" of each (collective) actor involved through highlighting the relevant debated aspects. Thus, meta-expertise connects values to empirical insights and enables a political debate about what dangers are to be averted and what innovations are to be aspired to.

In this sense, such a form of expertise is an important building block in the development of a democratic culture because it enables a political debate about knowledge for decision-making. In this process, Technology Assessment (TA) has some important tasks to cover: it can help to build up the mentioned form of meta-expertise. TA has outstanding expertise in observing different practices and classifying the different types of knowledge sources and their systematic forms. TA can reveal links between indicators and their criteria as well as indicators and observables. This is necessary for enabling a political debate about problems and for avoiding technocracy. TA can make suggestions as to whether to follow the no. 1 strategy (enhancing trans-disciplinary co-observation), the no. 2 strategy (enhancing civic epistemology) or both.

Finally, Technology Assessment, understood in this way, can work as the "Honest Broker" in the sense of Roger Pielke (2007): "Honest Brokers of Policy Alternatives would not simply seek to better 'communicate' the results of science to the policy-maker, or to advocate a single 'best' course of action, but to develop the capability to place science into policy context […] [and to fulfill; SB] the obligation to provide independent guidance on the significance of science for a wide scope of policy alternatives." (ibid, p. 151)

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Smart Infrastructure as a Prerequisite for Competitiveness

Rut Bízková

Abstract

Smart infrastructure forms one of the leading emerging concepts that are applicable not only in "standard" network industries like energy, transport, communication or waste-water management but also in the development of human capital. For the Czech Republic, energy, transport and ICT are major challenges for the introduction of smart solutions to increase the competitiveness of the national economy. In addition, the smart-cities concept based on the synergy of the three pillars – buildings, technological infrastructure and transport – can be taken as a practical example of the smart solution that has a high potential (not only) for the Czech Republic. In any case, smart solutions cannot be developed and managed without robust research and development background.

Introduction

War strategists know that logistics is behind many great victories and defeats, many more than just the textbook example of Napoleon's great struggle at the gates of Moscow. Despite the fact that the technical conditions and circumstances of what we do change with time, the basic scheme of human activities remains the same: to thrive on the market, good infrastructure is essential. Without it, the famous 'just in time' method of Henry Ford would not exist.

We have found out ourselves in the early 1990s when roads replaced railways as the main means of cargo transport. The way our industry functioned gradually improved and production grew. However, the price we have paid and continue to pay is the pollution of the environment and the adverse effects on the quality of life it brought along.

However, as technologies develop and our possibilities grow, we can make infrastructure "smarter." This applies to all network industries – energy, transport, communication, water or waste.

Aside from its importance for our competitiveness in the production and distribution of goods, smart infrastructure has a similarly strong impact on another part of our lives: it allows people to live, work or spend their free time with more freedom than ever before. This is of great and ever increasing importance as human capital becomes an ever greater determinant of our competitiveness.

Megatrends – Prediction of Future Developments

During the past few decades the world around us has been changing and developing faster than ever before. In the future, there is also something else we need to take into account. Especially in the field of research, development and innovation, weak signalling and wild cards need to be included as well.

Weak signalling is, as the name suggests, a symptom of slower changes that are about to occur in a few years' time. However, the changes it indicates could be abrupt and powerful. If not noticed and analysed, weak signals could bring events nobody expected. A generally used example is that of alert levels: orange light indicates something that is not happening but may very well happen; smoke may result from fire. Wild cards are somewhat similar; these are occurrences with very low probability of happening and major consequences. One could hardly find better example than the attack on the World Trade Center buildings in September 2001. My husband often uses a different illustration: a two-degree decrease in the temperature of water does not mean much when you go from 33 to 31 degrees; however, when you go from plus one to minus one, it is something completely different. Who knows how do marginal and somewhat random occurrences turn out?

Recently, concept of resilience (ability of a complex natural or anthropogenic system to keep stability in the case of abrupt change of external conditions) has started to be applied and understood by many as an operational form of the sustainability concept.

That said, there are methods of unravelling the main global drivers behind the changes, global megatrends; main social, economic and environmental powers that influence the development of the society. In case of the Czech Republic, a small, open and export-dependent economy with ties to (most noticeably) Germany, the EU and whole world, these are of utmost importance as the drivers stemming from commodity trade or decisions of multi-national corporations often overpower our regulatory bodies and may influence our society to a large extent.

In this globalized world, infrastructure plays an important role for human well-being in different parts of the world.

Czech Republic – Example of the Changing World

The Czech Republic is a country located in the heart of Europe and has historically played the role of a trade node between the east and the west, hence the dense network of roads, highways and railways. Our economy was historically oriented on industry, but this has changed after the Velvet Revolution. Some companies, particularly in the industry sector, collapsed due to their unability to meet the quality requirements of our new export markets, such as Germany. The rest improved and adapted. However, the highest share of the GDP is still generated by the industry sector, and material and energy flows are above the EU27 average. There are several basic indicators:

Energy Effectiveness

Since 1990, the consumption of energy and materials has been gradually decreasing, and the levels of pollution have followed suit. Despite this development, the values still stay above the average of those of EU27, mainly because of historical orientation of the Czech Republic on heavy industry. In 2011, the values dropped for the first time despite continuing economic growth.

After the decline of the energy intensity of the mid-1990s, which was caused mainly by the restructuring of the economy, the economy fell into a recession around 2000. Since then, economic performance has been growing, but energy demands have remained the same, which pushes the use of primary energy sources per unit of the GDP towards the EU average.

Material Consumption

The situation with resource intensity is similar. The decline in the use of resources during the 1990s was given predominantly by the decline of fossil fuel consumption, mainly hard and brown coal. This decline was caused by the restructuring of the Czech economy which led to the closure of mainly metallurgical and chemical industry installations, the substitution of solid fuels by liquid and gaseous fuels and the introduction of new and more efficient technologies.

Electricity ProductionNonetheless, more than 50 % of the whole amount of electricity is produced by coal-fired power plants and a roughly 30 % of electricity produced in the Czech Republic is exported, which puts pressure on the grid.

Transport Effectiveness

The Czech Republic continues to be a significant transport node, especially for road transport. During the past decade, the importance of road transport grew, and its volume increased by 15 % while rail and other means of transport decreased. 85 % of the increase in road transport was generated by inter-country transport. Despite its continuing role of a node of transport and trade, the Czech transit network is substandard compared to those of the western countries, particularly due to the absence of city by-passes.

The picture of the Czech Republic as an intermediary is even more apparent when looking not only at the map of roads and railways but also at a map of oil and gas pipelines and the electricity grid. Only recently have networks between the Eastern and Western Europe been built that do not go through the Czech Republic. The alternative routes crossing the whole Europe are a consequence of the political changes that swept through the former Eastern bloc; similar changes that might come in the future have the potential to destabilize the whole continent.

There are three ways to achieve energy safety and security:

- Quality improvements of already built networks
- Diversification and development of new transmission capacities
- Solutions that do not need extensive networks

The rapid development of technological possibilities in the rapidly changing world could be perceived as a challenge to find new, more efficient ways of achieving said security, to fulfil the needs of the final consumer of goods and services. That said, despite the growing number of the ways IT could be used to improve the situation, there is still a need for a network of roads and highways and for the pipelines and the grids. Sad as it sounds, you still cannot download a bread roll… The smarter the solutions to these problems, the better, safer and more secure the infrastructure.

Strategic Documents – Formulated Ideas for Smart Infrastructure

Since after the Velvet Revolution, there has been an on-going debate about the basic drivers behind the competitiveness of the Czech Republic and its businesses. The most recent contribution to this discussion has been the Strategy of international competitiveness, which was approved by the government in 2011, with its motto Back to the top. The aim of the strategy is to bring the Czech Republic back to the top 20 most competitive countries in the world by 2020 and to ensure a high and sustainable quality of life based on a strong, competitive basis. Three pillars were established to reach this goal: high quality of institutions, sufficient and smart infrastructure and innovations stemming from research and development. The strategy is accompanied by a list of forty measures.

The infrastructure is understood to be the backbone of the economy as it is necessary for entrepreneurial activities to develop further. The strategy covers three kinds of infrastructures: transport, energy and information and communication technologies (ICT).

The first infrastructure is related to the quality of traffic links between less developed regions with the centre. This strongly improves the growth possibilities of those regions and shortens the “real” distance of one from the other. An insufficient infrastructure would result in the deepening of the difference between the centre and the periphery. Highway and road connections to neighbouring countries are important especially from the intra-European viewpoint. Should our country not get interconnected, the trade and investments will avoid it.

Energy and its reliable supply were identified as another necessary condition for the development of business in the Czech Republic. Currently the biggest issue in this field is the insufficient interconnection between sources and consumers, particularly in the field of renewable energy, which threatens the energy safety of the country. Thus, it is necessary to expand the numbers and capacities of backup sources and to reinforce the grid. A similar issue is relevant for heat distribution.

The energy pillar is also an important part of the Europe 2020 strategy as one of its key initiatives tackles the issue of energy and material dependence of the EU. The aim of the initiative is to support the development of the society towards a lower dependence on resources and a higher efficiency in the use of natural resources, lower emissions of greenhouse gasses, increased competitiveness and higher energy safety. However, there is a widespread agreement among the EU member states that the long-term goals of the energy policy, particularly the sustainable and safe energy supply at fair prices without adverse effects on the GDP, are not attainable with current technologies and the business-as-usual approach. We need new technologies in the broad meaning of the term. On the EU level, the Strategy Energy Technology (SET) Plan is to be implemented. It focuses on research, development, innovations and demonstrations of new technologies.

The third and final infrastructure is ICT networks, particularly broadband access to the Internet. ICT communication networks and services contribute to faster and higher quality communication, which in turn helps the society to improve. Efficient use of ICT increases the productivity and competitiveness of the country. The digital technologies agenda, the flagship of the Europe 2020 initiative, is centred around the role of ICT in overcoming barriers in the EU. Given that the demand for voice telephony has already been satisfied, ICT now targets primarily measures of expansion and development of broadband Internet and the common digital market of households and firms.

In the Czech Republic, the number of products and services directly tied to Internet access steadily increases. The coverage of the area of our country is therefore of utmost importance for future development of the Czech market.It is clear that the construction of and support for the infrastructure, which is one of the pillars of competitiveness, is also a challenge for research and development. That is why a great deal of attention is paid to energy, transport, their impact on the environment, or ICT research in the national priorities of oriented research and development until 2030 that were approved by the government in 2011.

A suitable solution is a long-term attainment of such energy mix that would combine many kinds of sources while prioritizing local sources, that would bring about an increase in energy self-sufficiency and that would ensure the energy safety of the Czech Republic. This requires a systematic approach to the development of the energy sector in the context of the European Union, particularly in the areas of renewable energy, nuclear and fossil sources of energy and suitable fuels for transport.

However, smart infrastructure is not just about the energy sector. We also need it for the safety of the society. *Since the Second World War, the population of the Czech Republic has never been subject to any major physical threat. This has changed during the two waves of floods in 1997 and 2002. The floods of 1997 damaged a large part of Moravia. Should something similar happen in Prague, half the centre would be under water, which* *seemed completely unimaginable. Yet, in 2002, the level of water reached the first floor of the office of the government, the whole subway system was flooded and the city centre could almost be reached by a boat. It became obvious that even the most essential infrastructures were not safe from such occurrences, that the early warning system was insufficient, and weather forecasts were not useful enough. In aftermath of the floods, the issue of the safety of essential infrastructures and resources was added to the priorities of oriented research.* The issue is tackled through two targets. The first one is the securing of the function of essential infrastructures, so that natural disasters and anthropogenic occurrences do not lead to catastrophic consequences. The second target is the creation of information systems that allow the modelling of interconnections between essential infrastructure systems and an earlier detection of threats stemming from these interconnections. This should contribute to more accurate and prompt predictions of the development of potential sources of adverse developments and a more timely reaction to them. *Using the case of flood, if we had known the dynamics of water in the Vltava river inflow, half of the city would not have ended up under water.* However, this is relevant not only for floods and water management but also for the energy sector, the food processing industry, agriculture, health care, transport, ICT, the financial system and many others. It is obvious that the infrastructure has many more uses than competitiveness and efficiency, and that it is also crucial in case something goes wrong.

Support of research and development of new technical and technological solutions is crucial for a smarter infrastructure and competitiveness.

Smart Cities – Concept of Horizontal Relations for Smart Infrastructure

There is also another concept, especially for regional and spatial development – smart cities, first described in the SET Plan (the European Strategic Energy Technology Plan, approved by the European Commission in 2007), represents one of the principal initiatives aimed at energy efficiency. The SET Plan pays a great deal of attention to the concept of smart cities, or cities that are built to ensure the well-being of their inhabitants.

The smart-cities concept was initiated in reaction to the fact that three quarters of the world population lived in the cities, and this would grow further to up to 80 % in 2020. Urban areas are characterized by large a consumption of energy and resources, high output of waste or high air pollution due to traffic and industry operations. This negatively impacts the quality of life of the inhabitants and their health, especially in the case of vulnerable population groups, such as the elderly and infants, who are prone to respiratory difficulties and allergies. However, the situation has been improving thanks to an increasing pressure on a higher efficiency of production and the growth of the share of green infrastructure. These two aspects are the cornerstones of the smart cities concept, and while originally aimed only at energy, the concept has become a part of many local initiatives.

The three pillars of the smart cities concept are: buildings; technological infrastructure encompassing mainly production, accumulation and distribution of energy, lighting, waste and water treatment; and transport. Another main component spanning across the three pillars is the level of control, information and communication, which is necessary for a sufficient management of the pillars. Finally, the development of cities is made possible by infrastructures, based on both technologies and communications/information.

The smart cities concept and its core issue of efficiency in the use of energy and resources and waste management was also employed in other important EU initiatives. In particular, in the Europe 2020 strategy, which contains several goals that are based on the smart cities concept.

Conclusions

The world we live in is getting not only more and more complex and interlinked but also more and more turbulent. Turbulences can be seen in the natural environment (climate change) as well as in the human society (financial markets). Recently, the global energy sector has been undergoing a “shale revolution”, which may bring about considerable geopolitical changes as the major world economy is changing from an energy importer to an energy exporter.

A tool that would allow for sustainable resilience under these turbulent conditions is a well-balanced dynamic mix of measures in relevant infrastructures, which should be able to react to sudden and often unexpected changes of conditions. Such a tool cannot be developed and managed without a robust research and development background.

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PART II

INSTITUTIONALISATION OF TECHNOLOGY ASSESSMENT

Articles from the PACITA 2013 Conference Sessions:

Institutionalisation of TA (I)
TA and Governance (II)
Evidence-Based Policy-Making (III)
Future-Oriented Technology Analyses (VII)
Integrated Assessments of Emerging Science (XVI)
Politicians and Researchers (P-II)

Making Cross-European Technology Assessment

Marianne Barland and Walter Peissl

Abstract

Europe is getting more closely connected, the European Union is growing and with the rapid technological development, there is a need for establishing networks and knowledge bases in a cross-European manner.

The PACITA project has identified the added value in doing cross-European technology assessment, and this paper discusses some of the factors that can help to increase and encourage these activities in the future. The paper derives its findings from several case studies of completed cross-European TA projects and its discussions from two workshops organized by the PACITA project in June and November 2012. Based on these, we will present a vision for "European TA 2020" showing how cross-European TA may continue to develop in the future.

Technology Assessment in Europe

The Office of Technology Assessment (OTA) advised the US Congress on questions related to the complex relationship between society, science and technology for 23 years (1972 – 1995). Some of the most evident heritage from the OTA is the huge inspiration it played when the field of TA developed in Europe.

In the 1970s, initiatives were started by the OECD, the European Commission and individual states to introduce technology assessment in Europe. Following this, offices for parliamentary technology assessment (P)TA were established in several European countries and regions. In 1990, Lord Kennet (POST) proposed to establish the European Parliamentary Technology Assessment (EPTA) network. Today, the EPTA network has 14 members and four associate members.[1] It aims to strengthen the links between offices for technology assessment throughout Europe and establish technology assessment as an integrated method when advising parliaments in their decision-making.

Besides the EPTA network, there is a specific institution dealing with TA at the European level. STOA,[2] which itself is a part of the EPTA network, serves the needs of the European

Parliament. STOA is, at the same time, an important actor because it commissions TA studies from a number of institutions. Since October 2005, the European Technology Assessment Group (ETAG) has served as one of the contractors to STOA.[3]

Despite the establishment of PTA institutions in many European countries and at the European level (STOA), cooperation between the different (P)TA institutions remains limited. Although there have been a number of joint projects in the EPTA framework as well as projects funded by the European Commission (see below), one cannot speak of regular cross-European TA cooperation. The whole of Europe is getting more closely connected, the EU is growing and the rapid technological developments have implications that go beyond national borders. In this respect, there is a need for establishing result-oriented European networks in the field of (P)TA, so that technological development can be considered in a global perspective, taking into account both national and European realities.

In the context of this paper, we define cross-European TA as TA (projects) done by a group of TA institutions across borders. It implies a common objective and cooperation but not necessarily the application of the same methods.

On several occasions, the EPTA network has conducted joint projects in which EPTA members cooperated and performed cross-European PTA activities. These projects are carried out as a part of the "Joint EPTA Project Framework" where three or more members can initiate a project, which is then open for participation by other EPTA members. The projects are adopted at either a Directors' Meeting or a Council Meeting. There are now EPTA reports on four such joint projects in existence from 2004 until 2012.[4] Investigated issues cover "ICT and privacy in Europe", "Genetically modified plants and food", "Energy transition" and "Preparing for the next wave", which dealt with synthetic biology.

In recent years, many TA institutions have also cooperated in project consortia funded by the European Union.[5] The EU research programmes are now reflecting the "new" and expanding Europe and many policy decisions are made across borders. The knowledge production financed by the EU needs to reflect this and encourage cross-European projects to have an impact on the processes that shape European policies.

Parliamentary technology assessment and TA methods have been seen as instruments for reviving the power of parliamentary bodies in Europe and broadening public discussion and awareness of technology's impacts on society (Vig and Paschen 1999). PACITA's work on cross-European TA aims to lower the threshold for cooperation between countries.

This paper discusses three topics that may help to reach this goal: (i) to identify the added value of cross-European work, (ii) to identify addressees and target groups of cross-European projects and (iii) to indicate how to deal with tensions between national/regional TA structures and the ambition to act European. In addition, a vision for cross-European TA 2020 has been formulated that illustrates, on a more general level, the values that will be important in the future of cross-European cooperation.

Why Cross-European TA?

The emerging technologies debated in different countries are more or less the same. But contexts and the timing of discussions, and the shaping of technologies will differ nationally. Thus, cross-European TA can contribute with agenda-setting and policy support at the European level and at the same time inform national science and technology discourse.

All European countries (whether EU members or not) relate to European regulation in some areas. These areas of regulation may be interesting subjects for cross-European TA. The projects could create a common platform between the partners and a connection between the national and the European spheres. If a European issue is important for policy-making on the national or regional level, it would probably be a suitable topic for a cross-European TA project.

There have been several research projects and reports documenting the activities and methods of (P)TA in Europe.[6] But few of these have discussed cross-European cooperation and how it can be done in the best possible way. A STOA study from 2012 describes collaboration between PTA institutions as limited (STOA 2007). Most (P)TA units have formed their roles around the specific needs of their national or regional parliaments and other national or regional target groups. Therefore, the report argues, it can be difficult to shift focus and create a new role for them in a European sphere.

Added Value in Participation

(P)TA institutions have their mandate mainly focused on the national and/or regional sphere. Some have an identified task to "watch trends in science and technology"[7] (both national and international), but none have participation in international projects as a formal task. Identifying and understanding the added value in cross-European projects may help to open up and stimulate more cooperation and at the same time justify international cooperation on the national level.

For institutions, the participation in cross-European projects itself can produce added value. Cooperation with other institutions provides for institutional learning and exchange of experience. The way one institution approaches a topic, the method it chooses and the framing of projects are highly contextual characteristics. Input from and discussions with other practitioners can be mutually beneficial. It broadens one's perspective and can shed light on new sides of an issue. Networks can also strengthen capacity, both in institutions and the (P)TA community as a whole: for (P)TA units with limited resources, the contact with other units can enhance their portfolio and broaden their field of expertise and range of methods.

Communication, Addressees and Target Groups

One of the main characteristics of many European PTA units is their strong connections to parliaments. This has often been institutionalized either by organizing the unit inside the parliament (the parliamentary committee or parliamentary office models (STOA 2012)) or by stating it in the terms of reference, which identified the parliament as the main addressee (independent institute model).[8] Many PTA units additionally communicate their results to a larger audience consisting of different target groups. These can be scientific communities, ministries or other governmental offices and the general public.

When the (P)TA activities move up to the European level, it will become more difficult to identify addressees and potential target groups.[9] In the national contexts there exists a defined public sphere; yet there is no clearly defined “European public”. Brussels serves as an important policy arena with many important EU target groups. But as (P)TA activities include institutions and countries that are not members of the EU, it is also important to identify target groups outside the Union. This presents a considerable challenge when conducting cross-European projects: to have an impact, one needs an addressee.

Knowing the importance of a clear addressee, there is a need to find the best ways to identify and communicate at the European level. First of all, it demands a thorough dissemination strategy for all projects. Every project has to identify its own public, both addressees and target groups, something that most likely will be quite different from project to project. The identification process has to start at the same time as the project itself and continue throughout the project. In this way, the project can identify recipients, get input from relevant communities and actors during the project, and know where to direct the message in the end.

Since the goal of (P)TA is to give input for knowledge-based decision-making, it might help to broaden the definition of who decision-makers really are. In national contexts, parliaments and governments stand out as the main decision-makers. In the European context, the European Commission and the European Parliament play important roles. But as Europe is multifaceted and consists not only of the European Union, national representatives on different levels have a say too. In addition to this, many others (lobbyists, NGOs, the media) also take part in decisions and hold power in important discussions.

An important target group that several projects may have in common is the TA community itself. The communication of results of well-conducted cross-European projects can be used both on the national level by institutions not involved in the specific project and also to encourage others to participate in future projects and enrich and communicate the value of these projects.

National versus European Focus

For many (P)TA units, there is a tension between doing national projects and participating in European projects. Easing this tension may be one of the factors that could lower the threshold for doing cross-European TA.

Tensions arise from the fact that PTA institutions mainly have a national focus in their mission. Thus, participating in European projects could take away both focus and resources from the national working programmes. Therefore, providing sufficient resources for cross-European activities can be one important factor in lowering the threshold for national bodies to engage in European activities. The increasing participation in EU-funded projects also supports this notion; when there are special funds available, institutions easily see the added value of joining a consortium.

However, there is a strong argument that cross-European TA could be stronger if there was structural financing for cross-European cooperation that was not limited to individual projects. It is easier to stay in a field if you know there will be more than a single project. The opportunity to really establish TA as a field and the availability of funding to maintain the work may make the European sphere more enticing. Long-term presence and more structural financing could be an incentive for more cross-European work.

For some institutions, their organizational set-up creates a barrier for participating in European projects. Mainly the institutions organized as parliamentary committees have restricted access to participation in European projects. The fact that they have national/regional parliaments as their sovereigns in budgetary matters means they cannot bind themselves by contracting with the European Commission. The same argument applies to parliamentary offices because of their closeness to the parliament. The more independent the (P)TA bodies are, the lower the barriers for seeking EU funding.

A Vision for European TA 2020

As a part of a Karlsruhe workshop, PACITA partners elaborated on a vision for European TA 2020 shaped by cross-European activities.[10] The vision consists of important cornerstones for cross-European TA, describing both the added value and the features of cross-European TA for the future.

Cross-European TA needs to be inclusive and diverse. Over the last couple of years, the field of (P)TA has changed. Several institutions have been transformed and one can see the need to broaden the scope of European TA from purely parliamentary TA (PTA) to other forms of TA involved in policy-making processes in different ways. Having an inclusive and diverse approach will broaden the TA landscape and include diversity in methods and approaches as well as institutional settings. Inclusiveness also implies that TA will spread to more countries in the coming years. The progress made during the first phase of PACITA has provided us with good signals, and one could envision a goal of covering all of Europe and even beyond.

Although this is a vision for European TA, the internationality factor is an important cornerstone. Technology assessment is a growing field all over the world, and the wide spread of TA in Europe makes it possible for things to happen elsewhere in the world as well. Acknowledging that others in the world face the same challenges but deal with them differently can give us insight and new perspectives.

An essential element in our vision for European TA is the notion of independence. This refers to the independence of TA institutions from stakeholders' interests and influence as well as independence from funders and policy-makers themselves. Independence is important in order to maintain the credibility of TA institutions, and it will strengthen the reputation of TA in Europe in general. Giving well-founded and independent advice is one of the main strengths of TA, compared to advice from NGOs and lobby groups, who have their own interests in mind.

One of the main targets of PACITA is to help institutionalize new (P)TA units. Processes like these can often be long and difficult, but a more permanent and stable presence of TA at the European level will provide important support for "TA startups" – both within the PACITA project and in the years to come.

A stronger and more stable TA structure will make promoting and lobbying for TA easier. Communication of project results, both national/regional and European, can help promote technology assessment as an important input for knowledge-based policy making.

Having TA institutions all over Europe will make the field of TA highly dynamic and create a catalytic effect. Issues will be dealt with together and common projects will enhance and thereby broaden the horizon of individual institutions and provide feedback for national and regional contexts. The knowledge sharing between institutions will be the real added value of a stronger TA community. PACITA has already developed a common platform – the TA Portal[11] – that guides interested actors to relevant resources like reports, publications and experts. This will also create a community that is more than the sum of its parts. Doing projects together and using the knowledge base of others will help create synergies and learning effects. The community will in itself create added value, both for the institutions and their addressees and target groups.

The most important overall goal of this vision and of TA in general is making an impact. This will be strengthened by all the arguments in this paper and the developments mentioned above. A growing TA community in Europe will demonstrate to relevant addressees that TA is important and make them seek advice from TA institutions.

Conclusions and Recommendations

There are many arguments that prove the added value of doing cross-European work in the field of technology assessment. But there are also some barriers; the difficulty in finding the right addressee and making an impact at the European level, and the tension that can arise between the national/regional structures and resources when participating in cross-European work. Lowering the threshold for doing (P)TA across borders depends on several factors: some structural, external factors, and some factors that the institutions involved can influence themselves.

Partners in the PACITA project have, following the two workshops on cross-European TA, taken the initiative to set up a working group that will look into the possibilities of establishing a European association for TA. This association will embrace the vision for European TA 2020 created by PACITA and continue the work on lowering the threshold for spreading cross-European TA. This will be an important work to ensure that TA will have an impact at the European level in the future.

Having an impact on decision-making and knowledge production in Europe should be the overall goal of European (P)TA institutions. This demands more activity by the institutions and a strong presence in the European arena. All (P)TA units have to deal with the same or similar technological trends in society. Even though political culture may vary in different countries and regions, institutions can learn from one another and provide input to policy-making processes in a cross-European manner as well.

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Expanding the TA Landscape

Barriers and Opportunities for Establishing Technology Assessment in Seven European Countries

Leonhard Hennen and Linda Nierling

Abstract

This paper explores socio-political opportunities and barriers for introducing Technology Assessment (TA) as a support for S&T policy-making in seven European countries, most of which have not had any significant TA activities or institutions so far. The explorative study clearly shows that any attempt to promote and establish TA has to take account of the particular situation in the countries explored, which differs in many respects from the situation in the 1980s and 1990s when the first wave of TA institutionalization in national parliaments took place in Europe. Elements of "civic epistemologies", such as a vivid public debate on S&T policies, are missing in some of the countries explored, and S&T policy-making is busy modernizing the R&D system in order to keep up with global competition. The paper discusses the implications of this environment for the adoption of TA as a concept of critical and independent policy advice.

Introduction

Technology Assessment has been established as a means of policy advice for governmental bodies and in particular for parliaments in many European countries for quite some time now. There are, however, many European countries, especially in the South of Europe and in Central and Eastern Europe, where the concept of TA is not well established or even known – neither in academia nor in S&T policy-making. It is the central purpose of the "Parliaments and Civil Society in Technology Assessment" (PACITA) project to explore the opportunity structures and barriers for strengthening the concept of TA in national political contexts in European countries where TA infrastructures are not yet in place – be it in national parliaments or elsewhere in policy-making and society. This paper presents the results and insights from an exploratory endeavour carried out within the framework of the PACITA project in seven European countries (Bulgaria, the Czech Republic, Hungary, Ireland, Lithuania, Portugal and Wallonia). The exploration aimed at shedding some light on existing needs and existing institutional preconditions for introducing TA as a concept in national processes of policy-making in the field of S&T.

The national exploration processes ran from February 2012 to March 2013 and focussed on national political and institutional contexts, existing capacities (actors, organizations, networks), demands and interests in TA-related activities and on barriers and opportunities in national/regional contexts. Research methods comprised document analysis (i.e. national research plans, TA-related studies), interviews and discussion rounds with relevant stakeholders in the countries explored. The exploration was not done in a detached analytical, "classic scientific" modus but by means meant to directly intervene in the existing S&T policy-making landscape, inducing networking activities with regard to a future establishment of a national TA community and TA capacities for policy advice. The cross-national comparison included in this paper draws mainly from the findings of the national country reports. The country studies were conducted by national authors supported by partners from established European TA institutions.

Setting Up TA Infrastructures in the 1970s and 1980s

The point of reference for any analysis of opportunities and barriers for new initiatives to incorporate TA as a support for S&T policy-making, or for a possible further expansion of the European TA landscape, is, without a doubt, the historical situation in the 1970s and 1980s that lead to the establishment of TA in the USA and Europe. Therefore, it is necessary to briefly outline our view on the opportunity structures prevalent at that time before presenting the results of our exploratory study. Notwithstanding existing peculiarities in the different TA countries, we regard the following features as having been pertinent in one way or another for the establishment of PTA in the 1970s and 1980s:

- First, there was a highly developed and differentiated R&D system with a strong and visible commitment from the governments to develop and fund national R&D performance in order to improve or foster international competitiveness of the national economies. This – among other developments – was reflected in the setting up of specific structures in governmental administration (Research Ministries), growing public funding for R&D and the increasing salience of R&D issues in standing committees of parliaments.
- Second, apart from a more generalized criticism against "industrialization" or "consumerism", citizen initiatives on every political level were demanding to have a say in planning decisions and R&D politics as these were thought to interfere with citizen rights. This was the reason for the salience of the issue of public participation in TA right from the inception of TA in the US and later on in Europe (Hennen 2013).
- Third, problem-oriented research and self-reflexive science gained importance in the academic sector, first in systems analysis and in the field of environmental politics, later in risk assessment, in the social sciences and in the ethics of S&T (environmental ethics

and bioethics). In addition to these activities, there was a visible and growing fraction of the academic sector advocating TA-like "hybrid-science" and policy-oriented research.

- Fourth, these factors affected a strong and explicit demand by policy-making for support by best available scientific knowledge as well as by methods for taking up or dealing with public concerns. This resulted in different forms of institutionalization of TA bodies in, or in relation to, parliaments and governments (see Ganzevles and van Est 2012; Vig and Paschen 2000b).

Our comparison of the different national settings of TA partly draws on previous analyses of national TA practices, especially with regard to the different forms of TA institutionalization (Delvenne 2011; Ganzevles and van Est 2012; Hennen and Ladikas 2009, Vig and Paschen 2000b). In contrast to these analyses, the exploratory processes presented in this report have very much a practical intent, i.e. initiating TA with a special focus on parliaments in Europe in the countries of Southern and Western Europe, as well as in new (Central and Eastern) member states. In other terms, the study focussed on the potential for the implementation of TA in new national contexts.

The Socio-Political Context for TA in Seven European Countries

The findings from the country studies carried out within the framework of PACITA (for details see Hennen/Nierling 2012a, 2013b) clearly show that today, the political, economic and societal context in these countries is, to a great degree, different from what was prevailing in the 1970s and 1980s.

In most of the countries explored, the main issue is not further development of a strong R&D system. Instead, it is about building new structures or a fundamental restructuring of existing structures in R&D. Any development towards a diverse, market-like and self-governing system of R&D structures is still seen as a challenge in Eastern and Central European countries. It is largely about setting up new funding structures (competitive funding instead of institutional funding) and new agencies for funding, promoting and evaluation of S&T. The R&D landscape is in transition, and the most important thing is not to reflect on "protecting" societal needs and values against the dynamics of S&T but to instigate dynamics to generate economic growth. Technology Assessment is thus expected to provide support by offering strategic thinking on robust R&D structures, options for innovation policies and evaluations of existing structures and practices. It is not by accident that while TA is often not very well known in the countries explored, "foresight activities" have been widely promoted in some of the countries.

There is apparently no open public discourse on the role of R&D structures for societal development. The process is restricted mainly to administration and experts. Accordingly, parliaments have a rather weak role in this context and with the exception of Wallonia and Portugal, parliaments are often not regarded as the appropriate places for TA activities by TA-interested actors. S&T-related parliamentary committees often mainly deal with scientific education and the development of universities – innovation policy and the shaping and regulating of the context of implementation is of marginal parliamentary relevance. A lack of democratic structures in S&T policies is often perceived, as is a lack of communication and cooperation between relevant actors (academia, government, parliament, CSOs) – TA then comes into perspective as a means of acquiring unbiased information for policy-making or as a platform for establishing a democratic (public) S&T discourse (independent of reflections on its institutional setting).

At least in the Eastern and Central European countries involved in the exploration, a vivid and well-connected scientific community active in problem-oriented research or reflexive S&T research is not visible. Single points of activity, such as chairs for science and technology studies at universities and academies of sciences, often appear to be isolated even in the academic sector, and a connection with politics, e.g., via advisory bodies or a public uptake of results is not visible. Thus, important TA entrepreneurs are missing in those countries. On the other hand, we see that the academic sector complains about not being sufficiently involved in S&T policy-making (especially in the on-going restructuring of the R&D sector), and “knowledge-based policy-making” is regarded as a promising concept for supporting more “rational” policy-making. These notions are often accompanied by “technocratic” connotations. Nevertheless, they are also coupled with a demand for more transparent, public and accountable processes of decision-making and might thus serve as door openers for TA.

Other than in the 1970s and 1980s in Western European countries, S&T does not involve vivid public discourse and activism of CSOs. In Western Europe, the present-day relatively low public engagement in S&T debates comes with an established system of professional and public authority bodies dealing with risk and ethical issues. Such structures are missing in the countries explored (with the exception of Wallonia). With regard to the examples of public controversies reported in the country studies (such as the debate about nuclear power in Lithuania), it is often noted that they are characterized by a lack of platforms for a constructive interchange of actors including CSOs and lay people: TA is expected to play a role in this respect. On the other hand, “the public” often comes into perspective with complaints about the lack of interest in and knowledge about S&T issues. As much as this might be in line with the well-known attitude of scientific elites and with the prevalence of the so-called deficit model of Public Understanding of Science, this might also indicate a specific problem connected to a lack of trust in democratic structures and a distance to the political process that goes beyond the usual disenchantment with politics.

Existing TA Structures and Possible Modes of TA Institutionalization

For the Central and Eastern European countries involved in the study, it can be stated that the concept of TA has been largely unknown so far – with a few exceptions, such as in the Czech Republic, where TA-like activities have been going on at the Academy of Sciences and the Technology Centre ASCR. It was a central feature of the exploration to first make relevant actors aware of the idea behind the concept of TA and its practical workings as a tool of policy advice in order to make them reflect on and discuss the possible relevance of the concept in their national academic and policy-making setting. This was done with considerable success at national workshops organized as a part of the exploratory research.

In Ireland, TA was perceived as something that in terms of strategic planning and evaluation of policy measure already exists. There is, however, a feeling that a need exists to open up existing structures of knowledge-based policy-making to stakeholder groups and an attentive general public. Portugal shares structural problems of the R&D system with the other countries as well as weak or inconsistent structures of democratic S&T policy-making. There is, however, a small but vivid network of academic TA researchers and despite (or probably due) to the rather weak role of the parliament in S&T policy-making, there already have been parliamentary initiatives to explore the need and options for adopting TA. Wallonia is an exception as there has already been a history of TA debate in the political system. There have been several initiatives for setting up TA capacities related to the government and the parliament, and just at the very moment when the research activities started, a decision to set up a TA institute was officially taken.

When it comes to policy options, especially with regard to the further development of a TA infrastructure, the country studies propose different paths, which are categorized in the following classification:

Supporters of the parliament (Ireland, Portugal, Wallonia)

In Wallonia, Ireland and Portugal, members of the parliament or parliamentary committees expressed their interest in TA, and thus the parliament was selected as the main addressee for TA activities in these countries. Ireland and Portugal are at the beginning of such a process as both parliaments expressed an interest in TA. In both countries, the parliaments have a rather weak political role. While in Ireland, TA is regarded as a possibility for strengthening the role of the parliament, in Portugal, the advantages of a TA unit in the parliament are seen as a possibility for supporting the "political, social and economic" development of the country.

The innovative explorers (Bulgaria, Lithuania)

The national recommendations developed for Bulgaria and Lithuania present a new model for a national TA landscape: the network model. In both countries, there were only a very few former experiences with TA or TA-like activities. However, during the research activities, TA was identified as "an unrecognized need" by some of the relevant decision-makers. The main function of such a network model is to raise awareness of S&T topics in society and provide information to decision-makers in relevant political fields. Both countries consider it helpful to start with some kind of pilot project (as was the case in the starting phase of some of the European TA institutions established in the 1980s and 1990s, ref. Ganzevlees and van Est 2012) in order to "prove" the national relevance and to increase the understanding of the concept of TA and its "products".

The institutional traditionalists (Czech Republic, Hungary)

The Czech Republic and Hungary make up a third group. Both countries have in common that their academies of science are decisive players in the field of S&T policy; furthermore, the national academies in both countries have been in contact with TA or TA-like activities (especially foresight and STS). Both evaluate the "system barriers" in the current political context as being quite strong and are thus pessimistic about the establishment of a TA unit in the future. The best chance, if any at all, for building a TA institution, is for TA to be integrated into already existing institutions, which act on the governmental level with responsibilities in monitoring and evaluation of S&T. Thus, the specific function of TA would be to support the development of national agendas and strategies for research and technology development.

Conclusions

Concluding from our findings we can say that TA in the countries explored has to define its role in relation to the following context features:

- On-going government activities, which tend to be rather poorly coordinated, for building or restructuring the R&D system. In this respect, TA is often explicitly expected to contribute to the strategic planning of the R&D landscape and to the evaluation of R&D capacities.
- In the context of globalization and the global economic crisis, innovation policies for improving competitiveness are central in the countries involved – "economy first". TA would have to position itself with respect to these activities by providing support for identifying socially sound and robust country-specific innovation pathways ("constructive TA") and for contributing to lower costs of trial and error learning.
- Democratic and transparent decision-making structures are often not well developed. A part of this is the low profile of parliaments in S&T policy-making as well as the lack of communication between relevant actors. TA could find a role here as an independent and unbiased player that would initiate communication on "democratic" structures in S&T policy-making among relevant actors.
- Apparently, "involving the public" is regarded as being a challenge by many actors in the countries explored. In this respect, motives of democratizing policy-making are often merged with "paternalistic" motives of "educating the public" (media, lay people). The latter may, nevertheless, indicate a real problem of broad public unawareness of the democratic relevance of S&T politics, and it has to be clarified to what extent can TA's mission of "stimulating public debate" adapt to that problem (without becoming "persuasive").

In all the countries explored, actors from different perspectives highlight problems, such as non-transparent decision-making, lack of trust in democratic structures, lack of competences of relevant actors, bounded rationalities of relevant actors or the lack of strategic long-term thinking. All of this results in an explicit demand for "knowledge-based policy-making" in the context of which the (not very well known) concept of TA is welcome as a means of underpinning decisions with the best available knowledge in an unbiased manner. It might well be that, in terms of institutional solutions, none of the models so far realized in Europe are appropriate. It is necessary to provide for the "independence from" and, at the same time, "connectedness to" the existing S&T policy-making landscape. In this respect, ideas, such as a TA network including different (governmental, scientific, societal) actors and bodies with more or less close relations to policy-making as well as an "NGO model" for TA, are discussed.

For future activities, it might be important to take account of the fact that TA can be supportive (and organized) on different levels of R&D policy-making activities. The explorative endeavour of the PACITA project was focussed on the "macro level" of national bodies and authorities of policy-making. Supporting activities could, further on – possibly in the frame of the EU "responsible research and innovation" initiative – also aim at the "meso level" of regional or local bodies or on the "micro level" of R&D strategies developed on the micro level: be it in industrial companies or individual research institutions.

On the other hand, "being responsive" to national expectations should not imply giving up a certain (normative) core of TA as a concept. TA – as it was argued by Arie Rip at the comparative project workshop held in Karlsruhe in November 2012 – might be in danger of becoming an "empty signifier" when responding to any demand for "rational" decision-making and planning that is expressed by policy-making bodies and authorities. TA, as a concept, implies the role of a critical observer of R&D policy-making activities that necessarily asks for some institutional independence in order to provide space for reflection beyond short-sighted political agendas and openness for a broad spectrum of perspectives being applied in assessment processes.

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Institutional Interpretation of Parliamentary TA

A Framework for Studying the Danish Board of Technology

Rasmus Øjvind Nielsen

Abstract

This article discusses why and how the history and the current state of participatory technology assessment (referred to as pTA; not to be confused with PTA, which stands for parliamentary TA), especially in Denmark, may be understood in terms of institutionalization. The core argument is that while pTA has emerged as a practice within institutions for parliamentary technology assessment (referred to as PTA), the local logic of structuring PTA institutions does not necessarily explain the institutional role of pTA practices. To grasp these practices appropriately, a broader framework may be needed. The aim of the article is thus to relate the challenges of establishing and continuing pTA as a societal practice to the question of societal institutions and their logic. Towards this aim, the paper draws on a number of different theoretical directions within New Institutionalism and attempts to build a generic conceptual framework, which may relevantly add to the understanding of the multiple institutional logics at play in and around pTA practices. The usefulness of this generic framework will first and foremost be to function as a platform for empirical research in the field. An overarching goal of developing the framework, however, will be to serve as a conceptual resource for the long-term strategic outlooks of organizational entrepreneurs working to establish or continue pTA practices within STI policy-making.

Introduction

As a part of a larger budget settlement for the Danish STI policy, a decision was made in November 2011 to abolish the DBT. With the Board having stood as a one of the leading figures in the development and practice of participatory methods for technology assessment and policy development, this decision was met by protests from a wide range of different actors at national and international level (see also Paldam Folker et. al. 2012). Partly on the basis of these protests, but mostly on the basis of efforts by central institutional entrepreneurs, the DBT was transferred to a non-profit foundation and given a grace period to establish itself as an independent economic entity able to carry on the work of the DBT.

In the Danish institutional tradition, the current state of existence of the DBT is something of a non-sequitor. With a few exceptions, Denmark does not have the same strong tradition of advisory organizations funded by private foundations with the purpose of shaping societal development as, for example, Germany, the UK or the US,. The continued existence of the DBT after the abolition of a public advisory institution therefore makes very little sense, and the DBT has moved into an unknown territory. Should the organization be viewed as a consultancy, a think-tank, a research institute or something altogether different? Where will its operational resources come from? How can it maintain legitimacy? What new horizons open up? In this situation, organizational survival naturally comes into focus. But the DBT as a concrete organization only has meaning as long as it exists to continue TA as a societal institution.

To navigate this conceptually gray area, adopting an institutional perspective is helpful. Institutional analysis has a deconstructive element to it (Peters 2012), which allows for the discovery of overseen chains of causation within long-term evolutionary developments. It also makes it possible to import conceptual resources from other institutional areas to view the situation in a new light. Analyzing the situation using the resources of institutional theory may thus open up overseen opportunities for institutional innovation and strategic re-orientation.

Institutionalization of PTA in Denmark

The institutionalization of PTA in Europe has been given great attention in a number of core studies containing both comprehensive overviews and comparisons between PTA institutions in different countries as well as thorough case studies of the DBT (Vig and Paschen 2000; Decker and Ladikas 2004; Hennen and Ladikas 2009; Enzing 2012; Ganzevles and Van EST 2012). On the basis of this literature, it is possible to see the DBT and its current situation as a limit-case for the institutionalization of PTA. Within the PTA literature, three types of PTA institutions have been identified (Enzing et. al. 2012:ii), the DBT falling into the "independent institutions" category, which is populated by PTA institutions formally placed outside the Parliament and mandated for self-governance. But it has also been shown that individual PTA organizations must continually adapt to national circumstances in continuing processes of institutional bricolage, which takes both an entrepreneurial spirit and a great deal of creativity. As such, these works inspire a view of the current situation as transitory; an obstacle that others have met before and that may be overcome.

These existing studies focus squarely on institutionalization within national parliamentary contexts. From this perspective, the drama of the DBT and its evolutionary path easily boils down to this question: How much independence can the independent institutional model bear? What comes into focus are the internal contradictions within the logic of the institutional establishment. As stated in the PACITA case study of the DBT: "the DBT is in fact more than a TA institution" (op. cit.: 64, my emphasis). With its focus on activities that aim to involve citizens in decision-making and to establish dialogue processes between stakeholders in the Danish society, the DBT's activities have evolved beyond the arena of parliamentary debate, even to the point where assessment projects only involve the Parliament if and when it is a relevant actor in the situation under scrutiny (op. cit.). The DBT has thus evolved out of a role strictly defined by its relation to parliament towards a broader mission of "policy-oriented TA" – a development which applies, to a degree, to the entire field of PTA (Bütchi 2013).

The evolutionary path traced by the DBT thus makes it relevant to adopt a broader perspective with regard to institutionalization. For what would the emergence of this "more than" imply for our understanding of the strategic space currently inhabited by the DBT? Firstly, Paldam-Folker et. al. (2012) make it clear that the evolution of the institution is not a shift away from the politicization of technology and innovation – on the contrary, it is an expansionary movement driven by a broadening understanding of the political will to embrace notions of network democracy and participatory governance. Secondly, Klüver (2000) provides the understanding that this expansion of activities towards a broader audience cannot meaningfully be construed as a case of mission creep. The development away from a parliament-centric approach to TA may paradoxically be seen as a mission-driven development unfolding out of the original mandate of the DBT. On the one hand, the mandate designated Parliament as "the most important target group", while on the other hand, the mandate included the tasks of facilitating "dialogue between experts and lay people" and the freedom to select target groups "with regard to the topic treated" whether or not this would lead to the inclusion of the Parliament (op. cit.). The formal relationship to the Parliament was thus always marked by inner contradiction and made it predictable that tensions would arise between the need to stay relevant to the Parliament and the mission to involve broader segments of society.

How to analyze this development? Taking the existing literature as sole reference and extrapolating from it might lead to an analysis in which the abolishment of the DBT happened because one element of the institutional logic behind it – the logic of independence from the Parliament – wins out against the opposing element, namely subjection to the Parliament. Going on the accounts already given of the institutionalization process, the limits of independence would seem to be that an advisory institution cannot allow its independence to trump its reliance on its institutional base of support, which supplies it with institutional legitimacy and the resources to operate. To carry out an in-depth analysis of the situation would therefore mean to scrutinize the relationship between the DBT and the Parliament for direct causes of the abolition. And by default, the question of re-institutionalization would be posed as one of reestablishing formal ties with the Parliament.

Such an explanation would, however, fail to capture the gist of the DBT's situation on a number of accounts. Firstly, it would fail to take into account the significance for the abolition decision within broader developments in the governance of it STI, such as European integration, increased privatization and globalization. Secondly, it would fail to explain the apparent base of support for the institution found outside the Parliament allowing the institution to survive the abolition. And thirdly, because it would equate institutionalization with formal relations to the Parliament, it would fail to produce options for institutional re-orientation reliant on other sources of legitimacy and support. Consequently, this triple failure looms because the analytical frameworks employed so far in the PTA institutionalization literature have not yet been able to fully explain the dialectical dynamics between TA as a broader political project and concrete PTA institutionalization processes. Furthermore, we do not yet have the necessary frameworks for mapping and following the interactions between PTA institutions and other institutions in the STI policy field. At this stage of the literature's development, we still need ways to capture the interaction between the three layers of institutionalization: the micro-level on which we can follow historically the struggles for institutionalization of the DBT as a concrete organization within the Danish-European STI governance system; the macro-level on which the creation of PTA organizations must be seen as one among a number of different projects for establishing forms of interaction and coordination between science, society, policy and markets; and the practice level on which participatory methods in TA may be seen as taking on an institutional character of their own, i.e. becoming established through repetition as an institution within political life.

Towards a Multi-Level Institutional Analysis

On the micro-level, the existing in-depth analysis of the formal setup underpinning an institution and the struggles among stakeholders to formulate them must remain as one of the core elements of our understanding. This is the perspective from which the major life events of an institution and their relation to the ecosystem of political institutions – initial establishment, growth and evolution, changes and tensions – can best be identified and described. This is the perspective taken by most of the existing institutionalization literature, and the theoretical resources applicable within this perspective are the notions of path-dependency and change. Typically, change and continuity in institutions can be explained through the mechanisms of diffusion of institutional forms, adaptation to national contexts and continuing reconfiguration of institutional elements through bricolage and translation (Campbell 2004: 63-89). Remaining on the micro-level, however, we need to broaden our understanding of the breadth of strategic options available to institutional entrepreneurs. In the tension between the internal logic of an institution and the pressures affecting it from the outside, adaptation is only one of a number of identifiably successful strategies. Oliver (1991, cited in Mac 2005) identifies an entire range of overall strategies and tactics on a scale from acceptance and adjustment to external forces to strategies for manipulating the external environment. Such strategies and tactics must be a part of our vocabulary when studying concrete cases of institutionalization.

Macro-level analysis must complement such micro-level strategies and tactics in order for them to be anchored in a firm understanding of the bigger picture, i.e. of societal changes affecting institutions. Friedland and Alford (1991) famously argued for "bringing society back in" to the analysis of micro-level institutional change. Without a firm rooting of micro-level analysis in an understanding of the macro-level interaction between multiple logics of different societal institutions (i.e. 'grand politics' and historical trends), the success or failure of institutionalization would remain inexplicable (op. cit.:244). They argue that the macro-level of society is as "real" as any other level, all levels being socially constructed (op.cit. 242). The specific mode of existence of the macro-level, however, is that of the ideas held by actors about the macro-level and the actions through which these ideas are enacted. Campbell (2004:101) divides the social reality of such ideas into background (paradigms and public sentiments) and foreground phenomena (political/administrative programmes and the frames produced by hype, spin and campaigns). Each of these phenomena articulates a general view of societal development and seeks to advance one or more logics of development. As such, they link individual actions on a micro-level to overall visions of society and thus bestow a larger meaning on concrete efforts, which would otherwise be reduced to expressions of self-interests (op.cit. 91). Establishing links between micro-level institutional analysis of strategies and tactics and macro-level analysis of clashes between ideas would provide us with a view of the progress of TA as a political project in itself. We would be able to put meat on the bone of the core image of TA as a bridge-builder between science, society and policy (Decker and Ladikas 2004). Which are the concrete chasms needing to be bridged; where do different sectors misunderstand each other, disconnect, de-couple? Where are the concrete potentials to contribute to societal development through knowledge brokering and participatory methods? When and how do PTA institutions succeed or fail in establishing their relevance and legitimacy, step by step, in the broader system of STI governance institutions?

Strategies	Tactics
Acquiesce	Habit, Imitate, Comply
Compromise	Balance, Pacify, Bargain
Avoid	Conceal, Buffer, Escape
Defy	Dismiss, Challenge, Attack
Manipulate	Co-opt, Influence, Control

Table 4: Strategies and tactics of institutional entrepreneurs (Oliver 1991, cited in Mac 2005)

Ultimately, this leads to the necessity of including TA practice as a subject for institutional analysis. March and Olsen (1989) argued that institutions do not only derive legitimacy from their formal placement within existing systems, such as governments or parliaments. Of equal importance is the informal legitimacy gained through repetition of actions through which certain practices grow to become an expected part of the way things work, i.e. "institutionalized". Institutionalization in this sense is a broader concept with more unpredictable empirical expressions. Our understanding of such informal institutionalization cannot rest on written sources and formal frameworks, but must be rooted in the concrete experiences of actors, whether practitioners or audiences. And we cannot a priori equate the institution of TA as perceived by societal actors with the PTA organization itself. Perceived according to logics entirely separate from the internal institutional logic of PTA itself, the recurrence of events, projects and public statements from PTA organizations may, over time, serve to create a permanent reference point in the public sphere – a place to delegate problems having to do with the science-society relationship. In the case of the DBT, the "institution" may in fact be the continued practices of participatory events within the STI field – with all the different perceptions and expectations from different actors in the field, which become attached to those practices over time. This will be especially relevant in the study of the DBT for which the direct interaction with and between actors plays such a key role in the process of technology assessment.

Conclusions

On the micro-level, we find formal statutes embodying political decisions to establish, consolidate and abolish PTA institutions; on the macro-level, mediated through the ideas of individuals and organizations, we find competing political projects for defining the direction of societal development, a field of contestation in which TA evolves as a project in itself; and finally, on the intermediate level of practice, we find pTA events and projects established over time as a reference point within the landscape of debate and decision-making, one small piece of the puzzle of how society works. Each level of analysis must be woven together to create an organic understanding at any given time of the stage of the institutional and strategic situation of a PTA organization carrying out pTA. Through such multi-level analysis, we will be better placed to understand the dialectical interaction between formal and informal processes of institutionalization. Specifically, this will enable a better understanding of the role that participatory methods may play in the struggle between different actors regarding the institutionalization or de-institutionalization of PTA organizations.

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Disputed Evidence and Robust Decision-Making

The Case for Cross-Disciplinary Expert Groups in TA

Jon Fixdal

Abstract

A cross-disciplinary expert group is a TA method used regularly at the Norwegian Board of Technology. Such a group has 5-8 members and meets 4-8 times during a project. The experts bring different perspectives to the discussions, and they typically serve as "counter expertise" for each other. Therefore, the discussions between the experts help the project manager to span out and structure the topic, to pinpoint issues that have a particular role for the interests at stake and to formulate relevant policy advice. In summary, this has shown experts groups to be a powerful tool in handling complex, cross-disciplinary and often controversial TA issues.

Introduction

Doing TA requires craftsmanship. The TA institution and the TA practitioner need a thorough understanding of the topic and the interests at stake. The TA process should help them achieve the necessary insights, identify the most interesting policy issues and formulate relevant policy advice. There exists no panacea to these challenges. A given topic can be framed in numerous ways. Multiple methods and process designs can be applied (see, for example, Tran and Daim 2008; Fixdal 2003; Vig and Paschen 2000; Rowe and Frewer 2000;). A cross-disciplinary expert group is a TA method used regularly at the Norwegian Board of Technology (NBT). It has proven very suitable in many TA projects (NBT 2011; NBT 2012). Such a group typically has 5-8 members and meets 4-8 times during a period of 6 to 12 months.

I will start with a brief description of what I consider to be the three core characteristics of TA projects, and the challenges these represent for TA practitioners. I will then discuss how expert groups used at the NBT have played a key role in producing good project outputs. Finally, I will identify some possible limitations and objections to the use of expert groups.

My perspective is first and foremost a practical one; that is how expert groups have proven to be a valuable tool for the NBT. But as my discussions hopefully will show, they have connections to several other principal/academic debates about the use of expertise, the question of how to handle complex issues in an increasingly complex world and about the greater purpose of TA institutions.

Three Characteristics of Typical TA Topics

TA projects at the NBT have three important characteristics:

- *They address complex, cross-disciplinary issues.*
- *They include assessments where empirical "evidence"/data are central.*
- *They address topics in which there are controversies about data, desired developments, the values at stake etc..*

Let me start with complexity. Most TA topics can be divided into different sub-topics from numerous topical areas. A project may typically deal with, for example, the potential of different technologies to help solve a given problem, the economics of different solutions (whether technological or political), existing and possible new regulations and normative issues about interest at stake and desired developments.

The NBT project on the future of salmon-farming provides an example: The project assessed to what extent could closed containment systems help reduce the problems of sea-lice (a parasite) and salmon escaped from traditional open-net pen systems. To do so, the project needed to discuss such topics as what factors influence the costs of salmon-farming, what types of materials may be used in a closed containment system, the distribution of sea-lice and other parasites at various sea depths, the extent to which escaped farmed salmon may interbreed with wild salmon and threaten the survival of the wild populations and how different causes for escapes from farming facilities may be reduced.

A TA project typically faces the dilemma that it can never cover all issues that can be related to the topic, while at the same the projects needs to demonstrate that it has made sound judgments of which topics to include and which to leave aside. This will require a combination of different types of expertise. No TA practitioner can be expected to know sufficiently about all of them to do a proper analysis by themselves.

Secondly, empirical data play a key role in almost all TA projects. Understanding the relevant data is the key to a thorough analysis and to the credibility of the project in the public sphere. An example is the above-mentioned distribution of parasites throughout the water column. This topic has been extensively researched in Norway. Proponents of closed systems claim that using water from debts of 20-30 meters will eliminate the problem of sea lice, since these live in the first 5-10 meters below the surface. But are there other parasites at greater depths? Will a closed system simply replace one parasite problem with another?

Finally, we have the contentiousness of TA topics. Different actors have different views on, for example, what the key issues at stake are, how various challenges ought to be dealt with, what the relevant empirical data are, how uncertainties should be interpreted and what the proper policy measures could be. The quality of advice from a TA project depends on how complexity, empirical data and controversial issues are handled.

On the Terms "Expert" and "Robust Decision-Making"

At the NBT, an expert is a person with some specialized knowledge about a particular topic. Experts may be academic researchers or scientists, employees in private companies or in the public sector, they may work in NGOs or as consultants. An academic education is not a prerequisite. The following were the members of two different expert groups:

- Project on "Regulating online gambling" (NBT 2007): One lawyer, one psychologist, one expert on Internet payment and one on data filtering, and finally the head of "Norwegian poker association" (an NGO).
- Project on "The future of salmon farming" (NBT 2012): Representatives from two large salmon-farming companies, representative from two NGOs, CEO of the largest Norwegian supplier of salmon-farming technology, two researchers (experts on aquaculture and fish-farming), and one project manager from a large oil and gas engineering company.

I will relate the term "robust decision making" to the three above-mentioned challenges for TA. Thus, a robust decision should first and foremost be based on a thorough analysis of the various aspects of the policy issue, including an assessment of the empirical issues that pertain to the topic.

Secondly, the decision should be based on a process as a part of which the main actors have been heard. This does not mean representation in a numerical way, but that the main "positions" have had an opportunity to contribute to the process. Since no TA practitioner can be expected to know everything about an issue, hearing a sufficiently broad variety of actors is of great value in identifying what topics the TA project should cover. Furthermore, a process that allows affected parties to be heard may reduce the risk that affected parties try to discredit the process, the information basis or the assessments.

The Value of Expert Groups

Why do expert groups help manage the three challenges? I will first show the more obvious benefit of bringing together people from different areas of expertise. Thereafter, I will emphasize the importance of the dynamics between the experts throughout the process.

Experts Help Structure the Topic and Focus Assessments

The first benefit of expert groups is that they help span out and structure the topic. Experts with different areas of expertise bring different perspectives to discussions. Thus, the fact that expert groups have members from different fields of expertise is of great value to most TA projects.

The intersections between different fields of expertise help us understand how different aspects of a topic relate to each other. This is not only instrumental in understanding the topic but also for communication to policy-makers and other parties. The more complex a topic is, the more important it is to be able to break it down into sub-topics and structure it properly. Working with an expert group can make this meticulous work a lot easier.

Furthermore, different experts often point to different sources of data. For many contemporary policy issues, there exist numerous studies and reports from research institutions, NGOs, international organizations, governmental agencies and industry. It is important to identify these and to find out which are the most relevant and reliable. The dialogue between the experts can be very instrumental in this respect.

Robust Advice through "Experts as Counter Expertise"

In cross-disciplinary expert groups, the experts typically serve as "counter expertise" for each other. An expert will be contradicted by other experts if she or he makes statements that other members of the group disagree with. Thus, we can say that all expert-group members have to expose themselves to "the risk of information" (Daele 1994). Consequently, the discussions between experts help the project manager pinpoint issues that have a particular role for the interests at stake. As the work with an expert group progresses, the experts often reach agreements on a majority of the different topics, while a few issues remain contested. Experience has shown us that these disputed issues often represent a politically very interesting "core" of the broader TA topic.

Let me give an example. The salmon-farming industry believes it can solve its environmental challenges by improvements within the existing technological paradigm. Here, open-net pens are the very core of the production (one such net pen may have a circumference of 160 meters, a depth of 40 meters and contain 200 000 fish). There are NGOs that do not share this view. They believe closed containment systems may be necessary to ensure sustainable salmon-farming. But representatives from the farming companies point out that none of the attempts that have been made with closed systems have succeeded. Still, after some meetings in the expert group, the members agreed that (NBT 2012):

- The salmon-farming industry cannot prove that they will be able to meet environmental requirements within the existing technological paradigm.
- The salmon-farming industry has no "Plan B", i.e. what to do if their preferred approach fails.
- The NGOs cannot prove that closed containment systems will have satisfactory operational safety, acceptable cost levels and animal welfare.
- We need more thorough tests and reliable data to make sound judgments about the potential of closed systems.

The agreement on these points provided a firm basis for formulating policy advice that took into account the knowledge status, the maturity of different technologies and the challenges of the industry.

Group Dynamics and Robustness of Advice

Group dynamics in an expert group is important. In the public sphere, it is not unusual for experts to make controversial statements without being contradicted by other experts. In an expert group, however, experts risk hurting their credibility if they make too many "false claims" to knowledge. If you want the other experts to listen to you and if you want your knowledge to contribute to the process, you need to maintain a certain level of "soberness" in the discussions.

Also, the process makes it difficult for experts to "blindly" pursue whatever interests they might have because it may discredit them in the eyes of the other group members. And if an expert does pursue his or her interests, then he or she has to acknowledge that other members have the same right to pursue their interests. Then it is unlikely that the group will be able to agree on any assessments or recommendations. Thereby they will lose this opportunity to help contribute to policy discussions that are likely to also affect their own areas of competence.

Key Factors for a Successful Expert-Group Process

Establishing an expert group does not guarantee a thorough process and a politically relevant outcome. The following factors have proven important when establishing and running expert groups at the NBT:

First, the experts should have the possibility to influence the framing of the topic. The experts may contribute to a more precise framing and thus to more relevant discussions and interesting outcomes. Taking part in the framing of the topic may also increase the experts' identification with the process and the final product, and thus stimulate them to actively engage in the discussions.

Searching for a consensus is a good starting point. The experts do not have to agree on all assessments and recommendations, but it is our experience that policy-makers are interested in knowing what a diverse group of experts can agree upon. Any disagreement should bring some value to the discussions. It is, for example, not so useful to know that an environmental NGO and a salmon-farming company may disagree on the environmental impacts of salmon farming. But it can be interesting to know why they disagree on whether or not the ongoing efforts of the salmon-farming industry can secure sustainable salmon-farming.

Process facilitation is key. Although group dynamics may contribute to focussed discussions, heated debates should be expected. They are often an indication of a high level of dedication to the topic. The project manager needs to know when to let the discussion be heated, and when to try to calm them down. Experience is the only way to learn this.

An expert group should not have more than eight members. A group works best when all members engage actively in the discussion. If the group has too many members, it will be difficult for all of them to take part on an equal footing and for the process facilitator to involve all members in the discussions.

The independence of the organizing institution is crucial. All expert groups have members that have different and conflicting interests. In order to make the experts work together, the TA institution should have no interest in which policies are developed. The interest should lie in the thoroughness of the process and the quality of the assessments and recommendations.

The NBT process manager does the writing of the report, while the experts comment upon drafts. This lowers the threshold for potential expert group candidates to participate, and increases the likelihood that we can recruit the most relevant candidates. Should the experts be the ones to do the writing, it would increase their workload significantly. It would also increase the risk that conflicts between the group members would slow down the writing process and thus the project progress.

Discussion and Conclusions

There exist, of course, objections against the use of experts groups. I will highlight two of them. First, a group of five to eight persons can never represent all experts, views or insights on a topic. Nevertheless, an expert group can cover a broad range of relevant views. In addition, we often combine expert groups with open, public hearings, typically with 10 to 30 participants, allowing an increased number of persons and institutions to express their views and assessments.

Secondly, organizers of expert groups can be criticized for composing groups that provide advice that the organizer "prefers". One way to counter this objection is through the assessments and recommendations that result from the processes. If these stand the critical scrutiny of the public eye, it can be considered a strong indication that the process has not been biased in any systematical way. Furthermore, transparency throughout the entire process is crucial. There should be no secrets about how and why experts have been recruited, or how the process has been run.

These objections should be taken into account when planning and organizing cross-disciplinary expert groups and their use in TA projects.

Cross-disciplinary experts groups have proven to be powerful tools for assessing complex and controversial policy issues. The experts bring different insights to the process and they help structure the topic, thereby also helping the TA practitioner manage complexity. Furthermore, the experts act as "counter expertise" to each other and thereby they provide quality insurance of the knowledge claims made throughout the process. This helps the TA practitioner formulate advice that is "robust" in the public sphere. This does not mean that policy decisions will correspond to the advice, but it may reduce the likelihood that different parties try to discredit the advice or use it selectively for their own benefit.

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From Shared Knowledge to Collective Action

The Strategy Process of the "Spitzen"-Cluster MicroTEC Südwest

Günter Clar and Björn Sautter

Abstract

A participative Technology-Assessment (TA) approach – integrated in a broader Strategic Policy Intelligence context – can better cope with complexity and uncertainty in technology development, reduce negative impacts of subsequent applications, address conflicting interests and rationales, and increase consensus. Given the potential of emerging technologies for deeply affecting individuals as well as societies, it is even more important to balance inputs from and perspectives of specialized technology experts, policy representatives, potential investors, and regional stakeholders. The results of the strategy process of the German "Spitzen"-Cluster MicroTEC Südwest show how a solid base can be developed for pursuing longer-term STI-related goals in a large, heterogeneous consortium. Financially high-risk investments were prioritized in Microsystems Technologies, a general purpose technology for tailored, intelligent, resource- and cost-saving applications in practically all industrial sectors.

Introduction: New Innovation Governance Approaches and the Role of Participative Foresight/TA

The turn of the millennium was often used to call attention of the broader public to upcoming grand societal challenges (cf. the Great Transition Initiative, e.g. Raskin et al. 2002). Against this backdrop, longer-term investments and joint efforts in next generation science, technology and innovation (STI) have been identified by multiple governments as a measure for enabling and facilitating necessary great transitions. The expectation is that an RTDI policy (Research, Technology Development and Innovation) effectively addressing societies' "grand challenges", such as climate change, healthy ageing, scarce resources etc., on a global level will also lead to economic competitiveness and social prosperity on the local and territorial level (cf. BMBF 2010, or European Commission 2011a/2011b for the Horizon 2020 framework programme for research and innovation).

Since 2006, the High-Tech Strategy for Germany has focussed on effectively facilitating the great transitions using a broad range of implementation support measures. Its objectives are to combine scientific findings and technological know-how and to incentivize collective actions, which are strategically aligned with a broad spectrum of RTDI-related policies. In line with a more systemic understanding of innovation support governance, a need is felt for more intelligent ‘third-generation innovation policies’ (cf. OECD 2005) that involve multiple public and private decision-makers, balance policy rationales, and develop appropriate knowledge bases that allow for the development of joint visions, agendas and priorities. By implication, this also requires new non-technological capabilities on the side of public and private decision-makers, in particular when it comes to longer-term and high-risk RTDI investments.

One approach to knowledge creation is to support highly-competitive world-class clusters in their dimension as local nodes of global knowledge flows and as ‘innovative hot-spots’ in globalized value chains (cf. Bathelt et al. 2004). They provide a promising base for developing technological answers to societal problems and also for producing strategic knowledge for cutting-edge and trans-regionally aligned RTDI programming (cf. Sautter/Clar 2008; Sautter 2012).

Against this background, we show how a participative Foresight/TA approach was used to support strategic decision-making in a German “Spitzen”-Cluster with excellent competences in the general-purpose technology of Microsystems Technologies (MST) with the aim of jointly tackling global challenges and enabling great transitions. In the following chapter, we introduce the “Spitzen”-Cluster” MicroTEC Südwest as a large regional RTDI consortium that plays an important role both in its territory as well as internationally in its trans-territorial ‘sector’ innovation system with its manifold global value chains. Following a summary of the MicroTEC Südwest’s strategy process, we then present the methodology of the STRATCLU project as a participative Foresight/TA approach integrated in a broader Strategic Policy Intelligence (SPI) context for jointly thinking and debating futures. Finally, we highlight some major results of this strategy process and conclude with reflecting about the relevance of such approaches for tackling grand challenges and facilitating great transitions.

The “Spitzen”-Cluster MicroTEC Südwest: Top-Level Local Know-How for Globally Relevant Solutions

The MicroTEC Südwest ”Spitzen”-Cluster consortium in Germany’s south-western state of Baden-Württemberg, which is closely linked with related agglomerations in the neighbouring parts of France and Switzerland, involves more than 300 actors with all competences needed to cover key value chains in the field of ‘intelligent’ and miniaturized systems:

- ***A scientifically excellent knowledge base***, in universities, research centres and companies, e.g. in nano-, micro-, bio-technologies
- ***Technological know-how*** for designing and producing advanced Microsystems, provided by many specialized suppliers, e.g. specialized technology-transfer systems, university spin-offs or research centres
- ***Industrial know-how & market expertise*** for integrating those advanced Microsystems in 'intelligent' products (e.g. driver-assistance systems in cars or point-of-care diagnostic systems in the health sector) and for achieving success with them on international markets, e.g. through global players like Bosch or Roche Diagnostics

Internationally acknowledged for the development and commercialization of first generation microsystems, MicroTEC Südwest has the potential to contribute considerably with its next-generation smart solutions to addressing grand societal challenges like healthy ageing, energy saving, resource efficiency, secure societies and infrastructures etc. The related projects of the consortium are funded by national and regional ministries and by the cluster actors themselves. The approx. 90 million EUR (50 % public – 50 % private) for 5 years are allocated mostly to RTDI projects, with long-term cooperation and competitiveness strengthened by 'structural' projects.

STRATCLU, one of the structural projects coordinated by the authors, has been set up with the aim of advancing the "Spitzen"-Cluster strategy and ensuring sustainable and successful cluster development in the long run by broadening and consolidating participatory decision-making in the cluster through strategic capacity building. The overall risk of longer-term RTDI investments in the cluster could be reduced significantly by enabling the cluster's public and private decision-makers to systematically develop future strategies together, to assess them and to develop actor-specific, synergistic approaches to successful implementation. This can then lead to optimized and higher allocation of resources and contribute to sustainable growth and jobs.

A Participative Foresight/TA Approach in a Broader Strategic Policy Intelligence (SPI) Context: Sharing Knowledge with the Aim of Taking Collective Action

Investments in future technology R&I carry high risks due to high complexity and uncertainty regarding the technology results. In addition, given their potential to fundamentally affect individuals as well as societies as a whole, they are associated with conflicting interests and values and diverging rationales between public and private stakeholders. Technology Assessment can help to better cope with complexity, uncertainty and ambiguity and to facilitate consensual investment prioritization processes when integrated in a broader 'forward-looking' decision-making context supported by Strategic Policy Intelligence (SPI). SPI can be defined as "set of actions to search, process, diffuse and protect information in order to make it available to the right person at the right time in order to make the right decisions" (Tübke et al. 2001, p. V). TA can play its strengths to the full when the process is implemented with a view to balance inputs from and perspectives of specialized S&T experts, policy representatives, regional stakeholders as well as current 'internal' and potential future 'external' investors ('outward-looking').

Such a participative forward- and outward-looking approach can help to systematically 'translate' knowledge between various domains, e.g. between science, industry and policy in 'triple-helix' innovation systems (Etzkowitz and Leydesdorff 2000). Jointly developed long-term visions and priorities facilitate, for example, the identification of market opportunities arising from politically emphasized grand societal challenges. RTDI roadmaps developed on this basis incentivize entrepreneurs to develop new business cases. It supports the specification of requirements and solutions needed for realizing these business models, and thus enables researchers to create the pre-requisite S&T know-how for the creation of value through innovative products and services. Vice versa, this approach also assists scientists in showing the market potential of new S&T developments as well as their potential for addressing grand societal challenges and attracting investors to new research activities. If these "communication and translation processes" take into account the varying policy, economic and scientific rationales, objectives and preferences, they can also contribute to revealing and addressing conflicting interests and to reducing negative impacts of the technology applications.

For the strategy of the "Spitzen"-Cluster MicroTEC Südwest, a participatory decision-making process (as described below) was developed and implemented, involving a broad spectrum of public and private stakeholders with the objective to:

- Integrate their specific know-how, as well as relevant strategic knowledge from global sources, which had been prepared for them by the strategy team
- Use it as a basis for elaborating on their optimized and preferred development paths, and thus
- Create synergies between their different specific activities and forge a commitment in the stakeholder group for also implementing future common activities

In operational terms, stakeholder groups with key players from industry, academia and the administration were established, with different foci (e.g. the cluster board for general oversight, the strategy panel for overall cluster strategy, working groups for different application areas). A combination of SPI tools was applied – systematically integrating foresight and technology & innovation assessment with international benchmarking and road-mapping activities (cf. Clar et al. 2008) – in a 'strategic learning cycle' with the following steps:

1. ***Stock-taking***: auditing for 'inward-looking' and international benchmarking for 'outward-looking' activities to assess the current cluster position in the global context.
2. ***Forward-looking*** with foresight and innovation-assessment elements to identify, out of the vast spectrum of global scientific, economic, societal and political developments,

the strategically most relevant ones for the cluster actors, and develop, on the cluster level, a common vision, joint action lines and priority fields for developing advanced microsystem-based solutions successful on tomorrow's markets.

3. ***Action-planning*** with road-mapping activities on multiple levels, e.g. to concretize in prioritized application areas like Smart Health or Smart Production specific RTDI activities towards promising innovation opportunities and to harmonize and complement the individual activities on the cluster level in order to arrive at a cluster roadmap.
4. ***Action-Taking***, e.g. with 'agenda-setting' activities in order to mobilize the necessary RTDI resources under global competition. These activities are supported by the STRATCLU-related project "Futures International" funded by the Ministry of Science, Research & the Arts of Baden-Württemberg and also co-ordinated by the authors.

The STRATCLU "Strategic Learning Cycle", which envisages future activities, was implemented in parallel to the implementation of the already approved RTDI projects. Therefore, an "Operational Learning Cycle" was put in place simultaneously to monitor the results of the on-going projects and to ensure that appropriate conclusions were drawn from both, the strategic considerations and the operational findings.

Focussing Actions:
Joint Investment Priorities for Applications Facilitating Great Transitions

Based on detailed science and market analyses, investigation and discussion of global trends and on an assessment of their specific impacts along the strategic learning cycle, the MicroTEC Südwest strategy panel developed a joint AGENDA 2020+. Considering all important elements of the 'knowledge triangle', this agenda addresses the three dimensions: "research & development (R&D)", "education & training" and "venture & innovation" with specific priority fields.

Considering the national priorities set by the High-Tech Strategy 2020 for Germany and the microsystems-technology-related strengths in Baden-Wuerttemberg, the first application fields for smart and miniaturized systems were selected for breakthroughs in the health-care sector to ensure the quality of citizens' lives and in the production sector to enable more resource and cost-efficient manufacturing processes. Tailored microsystem-based solutions comprise:

- For ***Smart Health***: personalized & economic health-care solutions, such as point-of-care and companion diagnostics as well as intelligent implants, medical devices and instruments and
- For ***Smart Production:*** networked & efficient manufacturing solutions, such as intelligent work pieces and machines for flexible, adaptive and efficient production processes as well as safe human-robot collaboration

In the next phase, five major “research and society” cross-cutting fields for microsystem-based solutions will be concretized, so that they address fundamental aspects of the next-generation smart systems, and thus with a potential of leveraging synergies across a broad range of key areas of future applications:

- Human-Technology Interaction (=> ***functional*** systems)
- System-of-Systems (=> ***cross-linked*** systems)
- Micro-Energy (=> ***self-sustaining*** systems)
- Cradle-to-Cradle (=> ***sustainable*** systems)
- Prosumer2.0 (=> ***affordable mass-customized*** systems)

Conclusions

Focus and outline of the research fields prioritized by the MicroTEC Südwest consortium show that it has addressed considerable technological challenges, such as “How could self-sustaining microsystems be designed with wireless data transmission in harsh environments, e.g. at very high temperatures or in biological systems?” The relevance goes beyond the consortium as the need arises to also assess impacts on societal questions, values and structures, e.g. “How do people want to live in future ‘technologically charged’ surroundings? Do they accept, and if yes, in what way, the need to interact with more and more ‘intelligent’ technologies? How could macro-economic gains be balanced with potential negative impacts on individual self-determination? And how could then accepted future production, consumption, and societal interaction patterns be discussed and designed?”

Regarding the importance for TA and future research needs, one can conclude that these go far beyond the whole range of societally and politically relevant research questions that emerged throughout the STRATCLU strategy process. It also became evident that new approaches to a thorough integration of technological and societal research and related policies have to be developed to effectively facilitate great transitions in society.

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Using Corporate Foresight Results Effectively

A Case Study from Poland

Anna Sacio-Szymańska, Adam Mazurkiewicz, Beata Poteralska and Joanna Łabędzka

Abstract

Systematic, in-depth analyses of technological development trends and the anticipation of their impact on society, environment and economy in short- and long-term perspective are of crucial importance to a country's sustainable economic and social development. Foresight is one of the most important means in reaching this objective. A successful implementation of foresight depends, among other things, on the applied methodology. This paper presents a methodology for the generation of future research priorities and technologies, which was designed and tested on a pilot scale at the Institute for Sustainable Technologies – National Research Institute based in Radom, Poland. The authors' focus is on the main outcome of the institute's foresight, that is: the Strategic R&D Programme entitled 'Innovative Systems of Technical Support for Sustainable Development of Economy'.

Introduction

New product and process technologies, which enable the introduction of innovative, internationally competitive products onto the market whose wide commercialization is the main factor of civilization progress, are the drivers of development of every economy.

However, in light of the sustainable development strategy, economic growth needs to be integrated with the environmental dimension, which should allow for a harmonious development of societies in the long-term. The main environmental factors of sustainable development include: energy efficiency, raw materials saving, technical safety and protection of the environment from industrial activities. A realistic development agenda, be it on a local, regional, national or supranational level, requires the undertaking of novel basic and pre-competitive applied research in the fields of: material engineering, advanced mechatronic, diagnostic and monitoring systems, as well as the design and improvement of specialized research and test apparatus, which enables the development of innovative, commercial products on the one hand and a precise control of possible side-effects of their applications on the market on the other hand.

The implementation of the principle of sustainable development has been the core objective of international (Millenium Declaration 2000), European (A Sustainable Europe..2001, Europe 2020..2010) and national (Long-Term Strategy…2000) documents. The principle was also of key importance to the National Foresight Programme "Poland 2020" (NPF "Poland 2020") realized in the 2007–2009 period. The outcomes of the programme included: R&D priorities in the three main research areas: "Information and Telecommunication Technologies", "Safety" and "Sustainable Development of Poland" (Mazurkiewicz, Poteralska 2009; Sacio-Szymańska, Kuciński 2009).

The acceptance of the principle of sustainable development in the National Foresight Programme "Poland 2020" acknowledges the fact that the two concepts are connected: foresight helps to create long-term R&D strategies with a view to enabling and accelerating progress towards sustainable development.

"Foresight and sustainable development have been interlinked since the beginning of the 1970s. Despite their differences, these two concepts have at least three characteristics in common: they address long-term future and offer alternative solutions, they call for a systemic analysis of complex systems by practicing interdisciplinarity and by drawing upon the theory and practice of modeling; they are action-oriented, integrating a strategic will to advocate a change (Destatte, 2010, p. 1576)."

The strong relation between sustainable development and foresight and the fact that the R&D priorities determined in the National Foresight Programme "Poland 2020" were too broad to enable scientific-research institutions to effectively identify, sort and prioritize detailed research projects or to allow companies to make investment decisions concerning particular innovative technological solutions – in accordance with the principle of sustainable development – were the reasons to undertake research aimed at the generation of key research priorities addressing the policy of sustainable development of the economy through the initiation of research programmes that build upon the results of foresight conducted in strategic research institutes.

Theoretical Background

Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations (Our Common Future…1987).

Foresight is a methodologically systemized process in which social, technological, economic and environmental trends are analyzed in order to create alternative, long-term visions (future scenarios) of the development of a country, region, sector or an organization that support the taking of effective strategic and operational decisions and thus better preparing for the future. (Sacio-Szymańska 2010)

As “the ultimate aim of foresight is sustainable development in a changing world” (Destatte 2010, p. 1575), the results of foresight activities help decision-makers to direct public and private R&D funding to the most important national, regional or organizational R&D priorities, which will assure the sustainable development of a country.

Foresight projects are classified (Ruff 2004) according to their main source of financing, that is public or private. The first category involves projects sponsored by international, national, regional or local administrations (e.g. EU directorates, national ministries, governmental agencies etc.), whereas the second group includes foresight activities executed in private companies (Rohrbeck 2010).

A specific type of corporate foresight is foresight implemented in strategic research institutes. A strategic research institute[1] is defined as a legally, economically and organizationally distinguished national organizational unit set up in order to carry out basic and applied research activities the outcomes of which should be successfully transferred to the commercial sector for public benefit. The institutes select priority areas of major relevance to countries in which they operate and undertake research to foster their development. In short: they help to create and implement national innovation strategies.

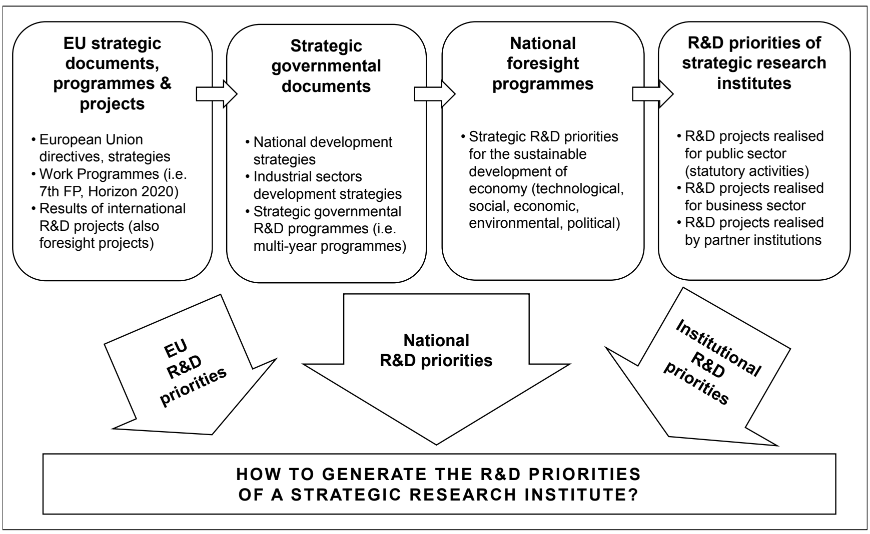

Figure 2: Rationale of determining priority research directions (Mazurkiewicz et al 2009, p. 234)

Taking into account the position of such institutes in national and European innovation systems and the vocation of such institutes, which is the conduct of research in areas of priority importance for the sustainable development of a given country, the main research problem the scientific entities have to deal with is the design of an effective way to identify and select long-term research priorities (Figure 2).

The main aims of the undertaken research were:

1. To develop a foresight methodology for determining research priorities as well as identifying incremental[2] and emerging[3] technologies in a given strategic research institute that carries out basic and applied research the results of which are implemented in the manufacturing industry
2. To verify the developed foresight methodology at the Institute for Sustainable Technologies – National Research Institute (ITeE – PIB)
3. To design a research programme that would make it possible to put the results of the institute's foresight into practice

The Methodology of Foresight

The research process aimed at developing a foresight methodology involved two main phases: (1) an analysis of methods and models used in foresight projects, (2) an examination of foresight activities undertaken in selected companies[4] and European research institutes[5] with the use of a multiple case-study research method.[6] The outcomes of the aforementioned analyses (described in detail in: Sacio-Szymańska et al 2011) played a crucial role in building the methodology of the institute's foresight process.

The main phases of the designed foresight process included (Figure 3):

- Analysis of an institute's research potential
- Prioritization of R&D priorities and a selection of key development directions
- Creation of alternative scenarios of the institute's R&D development
- Elaboration of an operational plan for the implementation of the preferred R&D scenario
- Monitoring and updating of the selected R&D priorities

Each phase of the foresight methodology is described in detail in terms of research methods used and sources of information needed to obtain the expected results. On the whole, the authors recommend ten main research methods to be used in the designed foresight methodology. These are: benchmarking, SWOT, STEEP, scenario building, key technologies, technology roadmapping, structural analysis, weak signal analysis, bibliometrics and patent analyses. Additional methods include: expert panels, workshops, questionnaire surveys and brainstorming. Apart from these methods, main operational models of research were proposed, that is: the combination of Collecting Post, Observatory and Think-tank modes (Becker 2003).

The designed methodology was used for the generation and selection of priority research directions as well as more detailed incremental and emerging technologies of the Institute for Sustainable Technologies – National Research Institute in Radom, Poland (ITeE – PIB). The process of the generation and selection of the promising R&D priorities and technologies was incorporated into the framework of a pilot corporate foresight project and a sectoral foresight, "Advanced industrial and ecological technologies for the sustainable development of Poland",[7] coordinated by the Institute within the Innovative Economy Operational Programme. Altogether, 74 technologies were generated by internal experts representing ITeE-PIB and external experts representing science, industry and the federal administration sector. The R&D priorities and technologies were grouped in five main research fields:

1. Specialized research and test apparatus
2. Mechatronic technologies and control systems for the support of manufacturing and maintenance processes
3. Advanced material technologies and nanotechnologies and technical systems supporting their design and application
4. Environmental technologies, rationalization of the use of raw materials, resources and renewable energy sources
5. Technologies of technical and environmental safety

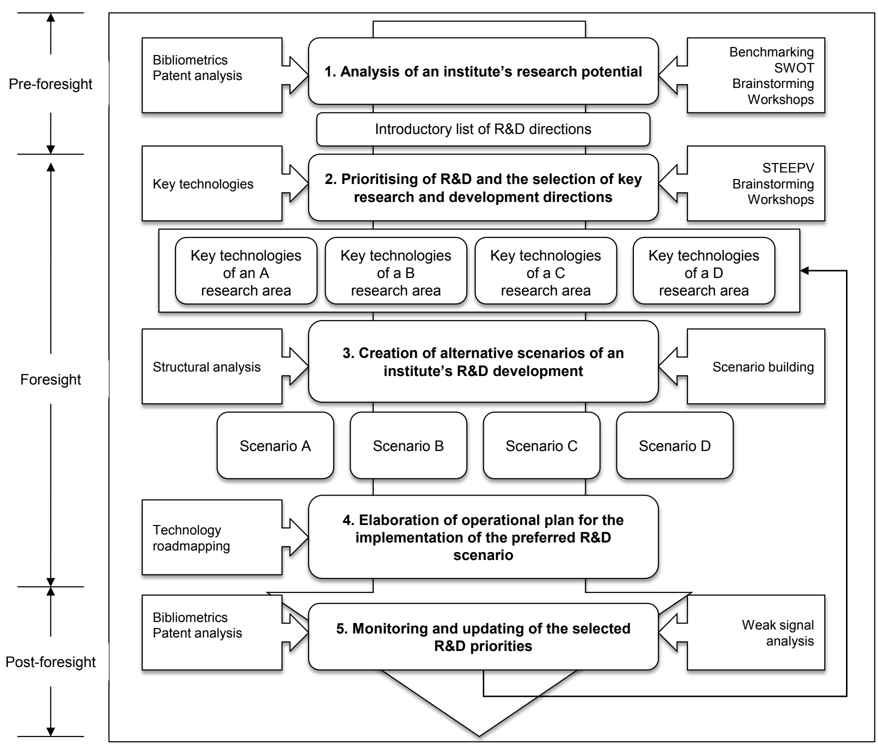

Figure 3: General foresight methodology dedicated to strategic research institutes

The theoretical foundations and the results of the application of the developed methodology were described in detail in (Sacio-Szymańska et al 2011, Mazurkiewicz et al 2012), whereas this paper focuses on the main outcome of the institute's foresight, that is the Strategic R&D Programme entitled 'Innovative Systems of Technical Support for Sustainable Development of Economy'.[8]

Main Outcome of Foresight

The final phase of the foresight methodology verification at the ITeE-PIB involved the design of a strategic research programme, which was meant to be launched using national or EU structural funds that would provide financial assistance for pursuing research in the five aforementioned fields. Such a programme has been developed and is being jointly realized by the ITeE-PIB and Polish R&D institutions and enterprises as a part of the Innovative Economy Operational Programme (co-financed from the EU structural funds) in the 2010–2014 period.

The 'Innovative Systems of Technical Support for Sustainable Development of Economy' Strategic Programme aims at the development of advanced product and process solutions ready for practical industrial implementation in the area of manufacturing and maintenance of technical objects and system solutions supporting their application. The scope of research of the developed strategic research programme resembles the R&D priorities determined in the corporate and sectoral foresight projects undertaken by the Institute for Sustainable Technologies – National Research Institute. The R&D matters revolve around four main technological areas concerning advanced technologies facilitating manufacturing and maintenance processes: methods and systems of rational waste utilization, systems for the safe maintenance of technical objects and a test apparatus and unique technological devices.

The outcomes of the Strategic Programme will include over 160 new technological devices and 90 non-material solutions, including: evaluation methodologies and procedures of commercialization of innovations. So far, 60 material and approx. 50 non-material solutions have been developed, and several dozen have been practically utilized.

An effective execution of the Strategic Programme requires close interactions and connections between its research tasks aimed at the development of innovative technologies and system support in the area of knowledge transformation and technology transfer, as well as activities for organizational support in the form of organizational and informational platforms aiming at the development and dissemination of innovative solutions (Figure 4).

Tasks in the area of improving the efficiency of knowledge transformation and technology transfer processes undertaken within the Strategic Programme include the following interrelated issues:

- The determination of future research directions
- The evaluation of the Strategic Programmes and its detailed R&D projects, Complex technology assessment

- A search for effective mechanisms and structures for innovation deployment and
- The creation of organizational and informational platforms facilitating cooperation and dissemination of innovative solutions

It is assumed that each technology (or a product and process solution) developed in the course of the programme will be evaluated for its impact on society, environment and economic performance. The practical implementation of the products and processes developed within the strategic programme in the Polish economy (companies) will answer the question whether the foresight results were efficient, effective and in line with the principle of sustainable development.

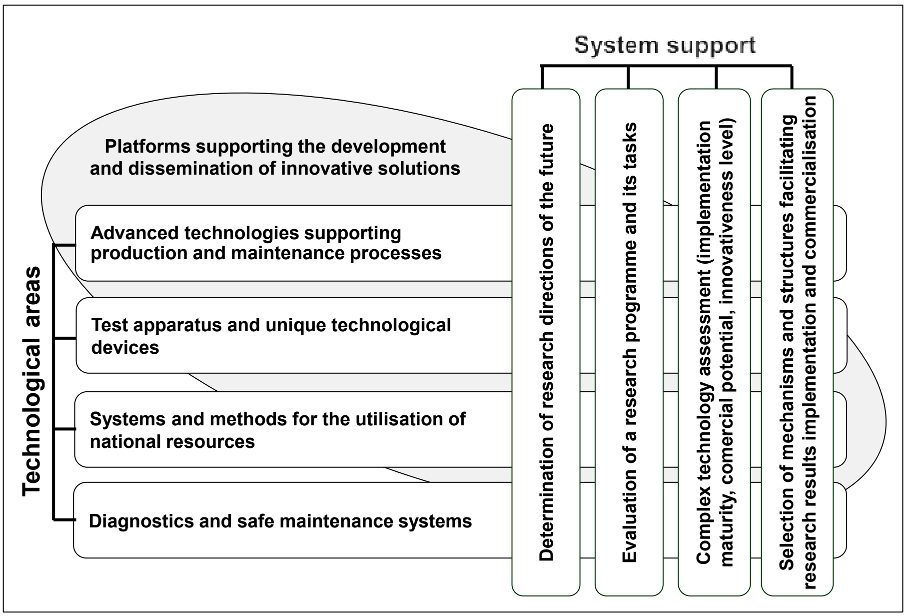

Figure 4: Correlation of research tasks of technological nature with activities providing system support in the area of knowledge transformation and technology transfer and organizational support

Conclusions: Summary and Follow-up Research

It can be stated that the success in acquiring EU funding for the realization of the strategic programme points to the fact that the research areas, R&D priorities and more detailed incremental and emerging technologies set as a result of foresight initiatives realized at the Institute for Sustainable Technologies – National Research Institute are in line with the priorities of national innovation and technological policies and therefore serve as an evidence that the verification of foresight methodology has been designed and executed in a correct manner.

However, the proposed methodology is not free from methodological shortcomings (it is based on rather traditional foresight methods), but as foresight research at the ITeE-PIB continues, some improvements have already been suggested. The modifications take into account (1) the introduction of a new method into the developed methodology, that is: the Intellectual Capital measurement technique and (2) the application of bibliometrics. The latter of the two was proposed in the methodology, but so far it has not been verified in practice at the ITeE-PIB.

Following Popper (2008) who claimed to "consider less frequently used foresight methods" in the forthcoming foresight project, the authors propose to assess the strengths and weaknesses of the institute using the Intelectual Capital measurement methods instead of the widely applied SWOT. The IC measurement methods are commonly used in the context of corporate business management (Sveiby 1997, Sullivan 2000) and increasingly by universities (Leitner 2002, FH IC Joanneum Report). The method does not appear in the comprehensive list of foresight techniques presented by Popper (2008) and Magruk (2011). Additionally, the authors of this paper have found only one example of the use of the IC methods by a strategic research institute in order to prepare its IC Report: the Austrian Institute of Technology (Leitner, Warden 2004), but this activity was not connected to foresight. The authors are of the opinion that measuring IC of a strategic research institute would help to (1) better assess the institute's strengths and weaknesses by estimating the real value of the institute's IC assets, and (2) better manage their improvement with a view to effectively implementing foresight results.

The second methodological improvement relates to the application of bibliometrics in the foresight methodology. Although included in the methodology, it was not applied due to the time-consuming nature of bibliometrical analyses and time restrictions of the investigated foresight projects. In the forthcoming foresight project, it has been envisaged to use bibliometrics in the mapping of promising R&D fields, identification and analysis of emerging research topics (Glänzel, Thijs 2012) and determining whether a particular research field has moved beyond the early, conceptual phase towards a more applied, practical phase or determining whether a research field is more 'technological' or more 'scientific' in nature (Thomas et al 2013 p. 899). The results of these analyses are expected to help strategic research institutes to better assess the coming S&T challenges and provide guidance on how to best address them, for instance, by the inclusion of the identified S&T challenges in the long-term R&D strategies and programmes of such institutes.

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Some Problems of Great Transitions in a Small Central European Country

Ivan Dvořák

Abstract

Exploitation of R&D results and the introduction of innovations are our hope for cushioning negative impacts of the coming Great Transitions. In addition to problems of the whole Europe, there are special problems endangering a small country in the middle of Europe, such as the Czech Republic. Some of them are difficult to address, but an inadequate structure of the decision-making process in the field of innovation can and should be tackled. Four questions are addressed in the paper: (i) formulation of competitiveness strategy, (ii) collaboration in RDI within the EU, (iii) responsibility for financing RDI, (iv) role of public and private entities in implementing innovations. Various measures have been proposed for improving the current situation. However, more new ideas, methods and approaches should be introduced and experimented with, Technology Assessment being undoubtedly one of them.

Introduction

There is growing consensus within European society and its political representation that an intensive implementation of results of R&D and a massive deployment of innovations are our only a tool for cushioning the negative impacts of coming Great Transitions caused by the demographical, sociological, technological and economic development of the western civilization and its partnering civilizations around the globe.

Leaving aside problems of the whole Europe, which are well-known (ageing population, impact of global climatic changes, financial and economic crisis – to name just three seemingly the most important at the moment), there are special problems that endanger a small country in the middle of Europe, such as the Czech Republic:

- Strong influence of external (EU-wide and international) factors on local economic and social development
- Limited financial resources, which have been further tightened by the impact of the global economic crisis

- Social mind-set of the population, which stem from welfare-state expectations fed by a large portion of the political elite
- Inadequate structure of the decision-making process in the field of innovation and competitiveness support, which reflects rather historical than rational reasoning

As a result of our attempts, which have been largely unsuccessful, to cope with these problems, competitiveness of the Czech Republic (measured by various competitiveness score-cards) slowly but steadily decreases (cf. GII – see Dutta/Lanvin, 2013), namely in comparison with the so-called new economies (China, India, Brazil, Indonesia etc.).

While the first three items listed are a sort of historical, geographical and political constants that cannot be changed fast, the last one may and should be tackled, and the changes needed should be discussed in the context of the current situation in the Czech Republic. The aim of this contribution is to discuss some ideas circulating and to introduce some new ones. We focus on four important questions:

1. Formulation of a competitiveness strategy
2. Collaboration in RDI within the EU and worldwide
3. Responsibility for financing research, development and innovations
4. Role of public and private entities in implementing and promoting innovations

Formulation of True Competitiveness Strategy

To formulate an RDI strategy for a superpower is not an easy task, but it is a well-defined one – by definition, it must cover all fields of science and technology. For a small country, such as the Czech Republic, it is much harder to formulate a strategy that specifies "what to do and what not to do", but it is an inevitable precondition of any reasonable and efficient allocation of financial resources.

Strategy Priorities 2030 (Priority 2030, 2013), prepared by group of chosen experts, seems to be a step in the right direction, even though it is criticized by many. Currently (end of 2013), efforts of the Czech and regional governments are focussed on developing this strategy further according to S3 principles set forth by the European Commission (Smart Specialization Strategy, 2013). Its aim is to supplement the "macrostrategy in RDI" through local microstrategies for regions. Though it is surely a step in the right direction, and some positive examples (cf. South Moravia – see RIS3, 2013) can be already pointed out, too often these strategies tend to be too formal and very little interconnected – prepared as an ex-post confirmation of already formulated plans instead of being understood as a necessary ex-ante step from which the plans should follow as intended by the EC. Also, the strategies are usually not worked on further to the level of municipalities and even particular universities and research institutes.

Though full information on the outcome of this effort is not available at the moment, it can be concluded from what is already known that the strategies developed may generally exhibit two serious omissions:

- They do not fully reflect new approaches coined by the EC – cf. social innovation (SI – see Social Innovation, 2013) or open innovation approach (OI – see Open Innovation, 2013).
- They are too focussed to historical classification of industries and research areas and neglect (to a large extent) cross-discipline research and cross-pollination of ideas from various branches of industries.

It will not be easy to compensate for this deficiency, and it surely will not be achieved by entrusting strategy development into the hands of small groups of "proven experienced experts" who only formally open a nearly finished version of a strategy for general discussion. In the future, wider discussion, encompassing not only scientists, innovation experts and politicians but also entrepreneurs, NGO representatives and public communities is desirable. Ideally, the overall strategy should by based on detailed TA analyses made beforehand and then approved by the parliament.

Collaboration in RDI within the EU

For a small country like the Czech Republic, international collaboration is essential. Unfortunately, participation of the Czech Republic in the ERA and international cooperation on enhancing innovations in general is still lower by far then what is possible and desirable (see Albrecht/Vaněček, 2009). To improve this situation, international, and especially EU-wide, collaboration in RDI should by stressed as the most important factor in any evaluation of RDI institutions funded from public money.

EU-wide and international collaboration in RDI cannot be left in the hands of scientists and innovators only. The state has an irreplaceable role here: to promote the mobility of students and teachers, young scientist and professors, as well as fund the development of RDI infrastructures focussed on excellent research, development and implementing of innovations. Six centres of excellence and related regional centres of excellence funded toward the end of the financing period are a step in the right direction (though great problems with their sustainability are still looming).

The Czech political representation also needs to extend more effort to secure the placement of pan-European facilities in the Czech Republic. Surely, the establishment of the headquarters of the Galileo Agency (European GNSS Agency, 2013) may serve as a beacon of hope, but many more such institutions are desirable in Prague and elsewhere in the CR.

Financing RDI

The Czech Republic did not meet the 3 % criterion of the Lisbon strategy (2000 – 2010), repeated also in the Horizon 2020 strategy, and it does not look as if it was about to meet it in the near future (many other EU countries also do not meet the criterion). Even in this situation, a lot can be done. The following are just some already devised plans as well as some fresh thoughts that should be discussed:

- Concentration of the public funding of RDI, which is too scattered over many fields, institutions and branches, only on the most promising domains and institutions; the RDI strategy is a necessary starting point for this. Though very much needed, it naturally arouses great resistance from those who feel as would-be losers.
- Reform of the way High Education Facilities and Public Research Organizations are funded (see Zákon č. 130/2002) in a similar way as the Bayh-Dole Act did in the US in eighties. Though not traditional in Europe, this step would unleash the enormous potential of the know-how accumulated here.
- New means for the induction of private investments in RDI – zero-tax on revenues from IP utilization should be developed and experimented with.

Role of Public and Private Entities in Implementing and Promoting Innovations

Possibly the greatest problems in RDI promotion and enhancement in the Czech Republic are encountered in the decision-making processes.

First, the historically developed division into an “academic sphere” and an “application sphere” represents a great obstacle to an intensive and efficient flow of knowledge and technologies through innovations to routine applications on the market.

Second, there are many different bodies with overlapping competencies interacting, competing and even fighting in the field.

Third, procedures adopted for public funding and decision-making in RDI in general are becoming ever more complex (partly with good intentions – to prevent and avoid corruption). As a result, they are becoming so cumbersome that they make effective management of projects funded from public resources practically impossible! In combination with (unfortunately) often insufficient qualifications of the officials involved, it makes for an explosive mixture that endangers further successful development of the whole RDI process.

A lot can be improved in the public domain if there is a political will. The truth is that in recent years, this will was either simply missing or governments have been so weak that they have not been able to exercise any will at all (if there was any). There is not much time left. Some steps that should be considered basic if any effort to improve the decision-making process in the public domain is to be taken seriously are listed below:

- The number of public bodies involved should be drastically reduced, which would also bring about a reduction of the number of officials involved. The best of them should be kept and trained.
- Decision-making procedures should be made much simpler and friendlier to applicants for public funding. Emphasis in evaluations of applications for funding should be shifted from assessing formal attributes to factual ones: "what will be achieved and for how much?".
- Greater freedom for recipients of public grants should be combined with greater responsibility: do what you can (within the limits of the law) but assume personal responsibility for the results!

Implementation of these simple rules would not be easy and surely will not be achieved overnight. The greatest obstacle will surely be the general bureaucratic mind set that prevails in many institutions, which is in direct contradiction with the flexible and open approach that is necessary for effective support of implementation of innovations.

In this respect, methods of Technology Assessment should be mentioned. Their broad application on all levels (not only the highest ones) should considerably improve the quality of the decision-making process and prevent any confusion with regard to real and perceived goals of any attempted efforts, which we still witness very often.

The private sector should react accordingly to these proposed changes: new types of (both for-profit and non-profit) entities may appear that would aim at organizing the RDI process. The primary goal of these bodies should be to elaborate and further develop the "RDI microstrategies" for application in practice in order to find and fill the gaps in which skills and expertise could be applied most effectively with the intention of using our limited financial resources for crossing borders of the originally separate scientific disciplines and giving rise to non-traditional and commercially viable innovations.

Conclusions

The implementation of the proposed measures does not present a complete solution to the aforementioned problems (general improvements of the business environment is another important topic in the CR that should be mentioned), but it would surely and significantly contribute to an amelioration of the still worsening situation. Reactions of the political representation and the state bureaucracy to the aforementioned dangers has not been very conclusive so far. But there is a growing consensus that something must be done. Responsibility finally lies in the hands of the political representation, but this should not be an excuse for all others. New ideas, methods and approaches should be created, introduced, studied and compared with those that come from larger and more advanced countries. Every crisis is also an opportunity, so we all should think hard how to make use of it.

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National Priorities of Oriented Research, Development and Innovation in the Czech Republic

Ondřej Valenta

Abstract

Institutionalization of technology assessment within the RDI system in the Czech Republic faces significant obstacles, especially in terms of the rather insufficient development of communication between researchers, political representatives and the general public, as well as a low evaluation culture. However, certain partial activities have been taking place, which are thought to lay the groundwork upon which a technology assessment system can be developed. One of the major initiatives of such kind was the identification of national priorities of oriented research, development and innovation in the Czech Republic in 2011, which were subsequently approved by the Czech government in July 2012. The main benefit of the priorities with regard to technology assessment is their problem orientation and close relevance to broader social, economic and environmental needs of the Czech Republic.

Introduction

The Czech Republic is one of the countries in which the system of technology assessment (TA) is in the phase of being introduced into the state administration. Thus, it has no institutional tradition and its basic premises, including the ability to connect the political representation, S&T community and the general public on issues of relationships of technologies vis-à-vis society, has not taken root yet. Mutual relations between S&T experts and researchers or the general public and the political representation are thus not sufficiently developed.

One of the most significant prerequisites for introducing a TA system into the Czech Republic is a critical level of evaluation-culture development. However, it has to be stated that evaluation culture has not yet reached the state that would provide a solid background for the system of technology assessment to flourish. As a result, there is no TA institution that would bring forward issues of relationships between the broader public and emerging technologies within the wider S&T development (Pokorný, Hebáková, Michalek 2012).

Nevertheless, a positive feature, which could be a supportive factor in the subsequent introduction of TA in the Czech Republic, is the relatively long tradition of the utilization of the forward-looking approach, especially within the processes of the identification of national priorities of research, development and innovation. The forward-looking approach has generally gained a broad acclaim and in the area of research, technology and innovation, it has been adopted on a large scale to orientate science, technology and innovation (STI) policies in a number of countries.

In the Czech Republic, the forward-looking approach (foresight) was first used as a part of the process of the identification of thematic priorities of applied research, development and innovation in 2001. Since then, priorities of research, development and innovation (RDI) have been identified during several national exercises utilizing foresight methods (Ministry 2013). However, the resulting set of RDI priorities had a few drawbacks; the priorities were set up as broad fields of science or industry, covering nearly the whole spectrum of scientific as well as industrial activities. The wide range of the priorities did not allow for targeted financing of priority RDI directions (Government 2011). Moreover, these priorities were only very loosely linked to wider social, economic and environmental aspects, and thus did not form an institutional basis upon which TA could develop.

In 2011, another process started, adopting a novel approach, which led to the identification of "genuine" priorities of applied research, development and innovation, based on different principles, with the aim to avoid the shortcomings connected with the previous set of RDI priorities. The main method, through which the priorities were identified, was again foresight. This new set of RDI priorities has also brought about a tighter link between wider social, economic and environmental aspects and research and development activities. This short article is focused on the description of methods and processes that resulted in the strategic orientation of RDI activities towards broader, non-research aspects and thus created a framework for a subsequent utilization of technology assessment tools and methods.

Framing the Process

Policy Framing

In the Czech Republic, priorities of applied research, development and innovation are usually defined by a national strategy for research, development and innovation. The current strategy, the National Policy of Research, Development and Innovation of the Czech Republic for 2009 – 2015, adopted by the Czech government in 2009, presents a major RDI policy document at the national level in the Czech Republic. The strategy proposed a reformulation of the current priorities of applied research, development and innovation, so that a higher effectiveness of targeted support for RDI is achieved; at the same time, the aim was to link public support for RDI to broader needs of sustainable development.

Methodological Framing

The identification process was managed by the Research and Development Council, an advisory body to the Government of the Czech Republic. However, in order to secure a broader acceptance of the results, the major outputs of the process were approved by the Czech government. Of these the most important was the document describing the principles (approved as the Government Resolution no. 244 from the 6th of April 2011), upon which the RDI priorities were to be based. The principles were as follows (Government 2011):

- *Problem-orientation*; RDI priorities were seen as a means to address current and anticipated social, economic and environmental challenges and needs of the Czech Republic.
- *Future-orientatio*n; the anticipatory and forward-looking character of the RDI priorities was related to the strategic horizon of 2030.
- *Priorities as targets*; the new RDI priorities were no longer to have a form of RDI directions. Instead, the new RDI priorities were to be constituted as long-term targets.
- *Sustainability*; the long-term targets were to promote sustainable development of the Czech Republic in social, economic and environmental aspects.
- *Feasibility*; the long-term targets were to be achievable through Czech RDI; in other words, adequate RDI capacities (e.g. in terms of human resources, infrastructure and excellence, and with regard to the potential of the Czech industry to absorb the results of the RDI activities) had to exist within Czech RDI in order to achieve the targets.
- *Consensuality*; the RDI priorities were to be the result of a broad consensus of representatives of various fields of science, industry and the public administration.
- *Fluidity*; the relevance of the RDI priorities in the context of social, economic, political and also technological development was to be reassessed in 2020 in order to ensure that the RDI priorities still addressed relevant issues.

The principles consequently formed the basis of the methodological design of the process leading to the identification of the RDI priorities. The principles also challenged the traditional division of research into basic (or curiosity-driven) and applied. Instead, a novel concept of “oriented” research was established, encompassing – in addition to the applied research – also the so-called “oriented basic research”, which was to be carried out with the expectation of yielding new information, which would in turn provide a broad knowledge base for addressing current or anticipated challenges through the utilization of current or anticipated opportunities, and thus providing a knowledge basis for applied research, which is always considered to be oriented.

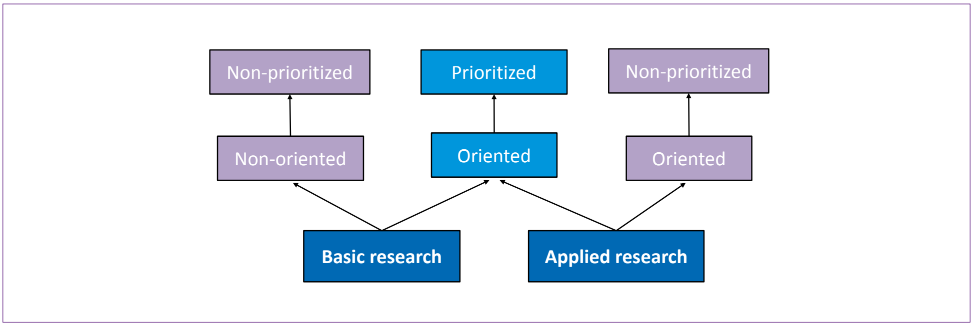

Figure 5: Oriented vs. non-oriented research

The RDI priorities were considered to identify preferential topics of public support for RDI, a minor part of basic research and a considerable part of applied research, development and innovation. Indeed, space was left within applied research for non-oriented applied research, allowing for independent activities of RDI performers and for preferences of providers of RDI support. This shift in the approach to understanding research is also reflected in the official name of the RDI priorities, that is "National Priorities of Oriented Research, Experimental Development and Innovation" (Government 2011).

Organizational Framing

As stated above, the main body responsible for the process and its outcomes was the RDI Council, the main authority for drawing up national RDI strategies and policies, as well as for managing the financial aspects of the RDI system in the Czech Republic.

Within the process itself, the Coordination Expert Council (CEC) was established as the main coordination and management body. It was composed of 15 highly respected individuals from the R&D community, state administration and industry. The head of the CEC was a reporter to the RDI Council. The members of the CEC were heads of the six scientific expert panels, each consisting of approx. 15 selected representatives of the R&D community, industry as well as the state administration and non-governmental organizations.

The entities responsible for methodological and administrative issues were the Technology Centre ASCR and also the Office of the Government, serving as a secretary of the RDI Council as well as the CEC and expert panels. The organizational scheme is presented in Figure 6.

The establishment of expert panels and of the main coordination and management body (Coordination Expert Council) also served another purpose; that is the achievement of broad acceptance of the identified priorities. Altogether, almost 120 respected individuals from the scientific community, industry and the state administration participated in this process.

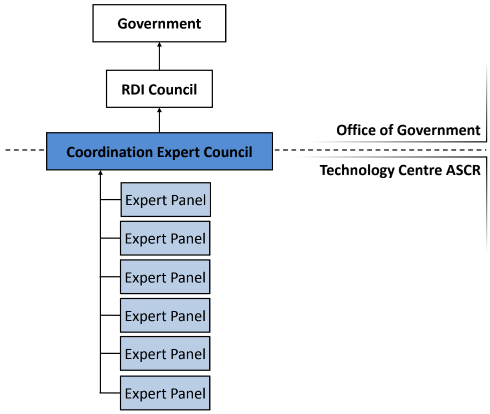

Figure 6: Organizational scheme of the process

Description and Methodology

The overall approach to the identification of national priorities of oriented RDI is shown in Figure 7. The scheme suggests that the methodology was based on several combinations of approaches, penetrating the whole process of the identification of the RDI priorities:

- Backward vs. forward-looking approach
- Top-down vs. bottom-up approach
- Expertise vs. participatory approach

As a part of the backward-looking approach, background studies and papers were prepared with the aim of providing expert bodies with necessary knowledge. Competencies and capacities of Czech RDI were assessed by in-depth analyses, surveys and questionnaires about the various aspects of Czech RDI, and the so-called Map of R&D and Application Potential of the Czech Republic was created. The Map consisted of the following thematic blocks:

- Performance of R&D
- Evaluation of application potential
- Human resources in RDI
- Governmental expenditures on RDI (GBAORD)
- R&D infrastructure
- International cooperation in R&D

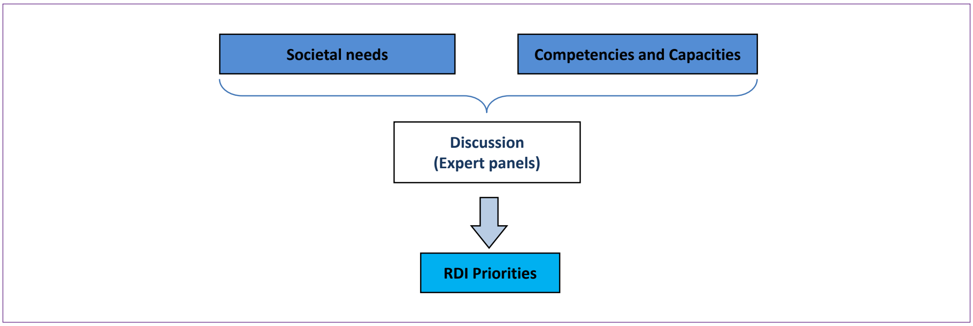

Figure 7: Approach to the identification of RDI priorities

The idea behind the creation of the Map was to assess the current state of Czech RDI, and the findings were consequently used in later stages of the process.

Participatory foresight methods were utilized in order to anticipate possible future societal needs in the time-horizon of 2030. At first, foresight was used as a tool to anticipate the likely future development of the Czech Republic. In this sense, an exploratory approach was applied, which resulted in the identification of significant external and internal trends and their anticipated future development. In the second step, a set of the most plausible and significant needs, opportunities and challenges was identified.

Based on the findings, the Coordination Expert Council proposed strategic socio-economic targets of the Czech Republic in the time horizon of 2030, which would be based on two general criteria: quality of life and sustainable development. The outcomes were then grouped into six complex priority areas, which were as follows (Government 2012):

1. Competitive economy based on knowledge, dealing with competitiveness, reacting to changes in the area of the Czech Republic's competitiveness on a global scale. The priority area focuses on ways to increase the productivity and efficiency of business and public sector activities and their functioning, and to increase the quality, flexibility and attractiveness of their products (i.e. both commercial products and services and public services) within the broader aim of strengthening the sustainability of economic development and growth.

2. Sustainability of energetics and resources is a priority area that, to a great extent, reflects the thematic focus of the European SET plan. It focuses on energetics and material resources and reacts to the current situation in the world and in Europe. The main challenge for the Czech Republic is ensuring long-term affordability of energy for the population in the current and future unstable situation.

3. Environment for quality life includes a wide array of themes particularly from the area of environment and ecology, in its complexity and relations to number of human activities and society.

4. Social and cultural challenges; this priority area deals with cultural and social challenges of the current, modern society. These are issues of life-long learning, social inclusion and demographic changes in the society, especially ageing. Another great challenge is the development of the population's age structure and its relation to the labour market, satisfaction with social services and the country's competitiveness.
5. Healthy population considers a healthy population to be the cornerstone of an economically, socially and humanly successful society. It includes topics concerned not only with medical research but also with sociology, population psychology, demography etc.
6. Safe society focuses on the necessity of the adaptation of the Czech security system to new threats and risks. This includes natural and man-caused catastrophes as well as issues of the protection of critical infrastructures, energetic security and the suppression of organized crime.

Since the priority areas are of a complex nature, inevitable thematic overlaps appeared. This was especially true in the case of the first three areas (relationships between issues of economy, energetics and environment are particularly tight). The priority areas, although distinct in their thematic orientation, had some common features (Government 2012):

- *Problem-orientation*. The priority areas represented a set of the most significant challenges and needs in a given thematic area.
- *Thematic scope*. Despite the prevailing thematic orientation, the priority areas were defined in a complex manner.
- *Forward-looking orientation*. The forward-looking character was inherent to the methodology used to constitute the priority areas.
- *Disconnection with R&D*. The priority areas were defined in a rather general and complex manner, with no connection to research, development and innovation.

An expert panel was established for each of the priority areas. Their aim was to identify RDI targets, so that they would contribute to the broader socio-economic and environmental targets defined within each priority area. Additionally, the expert panels proposed a set of policy measures that would further facilitate the achievement of the set targets. The activities of the expert panels thus represented the core activity within which the RDI priorities were identified. This was done in the several steps described below:

- In the first step, the expert panels divided the given priority area into more specific problem-oriented thematic blocks (so-called Areas and Sub-areas, Figure 8); using this process, the expert panels implicitly made a selection of the most significant challenges and thus performed an initial prioritization; this break-down of the priority areas consisted of two levels in each expert panel. For each sub-area, a principal target was formulated – a description of a desired state of the given sub-area in the time-horizon of 2030.

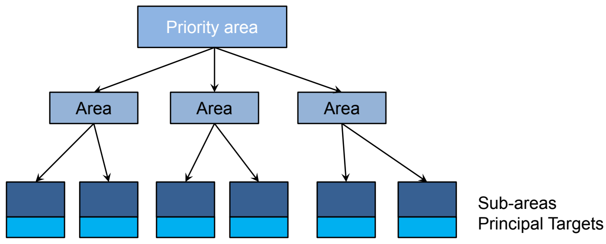

Figure 8: Breakdown of a priority area

- In the second step, the expert panels proposed a set of targets for RDI that would contribute to the fulfilment of the principal target. For the most part, targets for RDI were defined for a closer time-horizon (e.g. 2020) and, if prioritized, were thought to form the basis of the subsequent orientation of the thematic R&D programmes.
- Each expert panel prioritized its set of the defined RDI targets; this constituted the selection of RDI priorities. Initially, the RDI targets were evaluated in terms of their importance (e.g. economic, social, environmental), and feasibility for Czech RDI). Based on the evaluation procedure, the RDI targets were positioned in a two-dimensional graph; members of the expert panels then selected the priority RDI targets; usually the most significant and feasible ones at the same time (Figure 9).
- The final set of the RDI priorities was, by each expert panel, accompanied by proposals of policy measures that were thought to facilitate and assist the general environment in the Czech Republic as well as the R&D activities with achieving the defined targets.

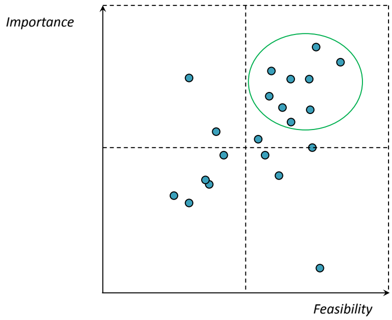

Figure 9: Principle of selection of RDI priorities

The reports from the expert panels were submitted to the CEC, which prepared a Summary report and a proposal for the RDI Council. The RDI Council subsequently approved the national RDI priorities and so did the Czech government in June 2012 (Government Resolution no. 552 from 19 July 2012).

Conclusions

The current set of RDI priorities was put together with the help of lessons and experience acquired during previous attempts to identify national RDI priorities. The priorities consist of specific objectives and targets that are of public and private interest, form a combination of long-term goals and multidisciplinary focus, are desirable and applicable society-wide, are feasible with regard to the Czech Republic's material and personal resources and achievable in the long-term and, last but not least, attainable via R&D activities. The RDI priorities are the result of the work of dozens of national experts from various sectors and fields. The process was based on forward-looking studies and analyses focused on the identification of the main current and future issues.

We can recognize a couple of positives that could be used as the basis for the development of TA in the Czech Republic in the near future. First, the RDI Priorities and their strategic orientation (especially of applied research, but also of basic) of the national R&D into areas that will help to deal with fundamental current and expected future problems and challenges in the Czech Republic and will enable us to use potential opportunities for a balanced development of the Czech Republic. R&D activities have thus gained a tighter link to broader issues, and vice versa.

The second positive is linked to a further development of the evaluation culture in the Czech Republic. When approving the RDI Priorities (July 2012), the Czech government tasked the RDI Council with establishing a general framework for a systematic and coordinated implementation of the RDI priorities in R&D programmes in cooperation with major providers of public support for RDI. The implementation system also included general requirements related to the evaluation system both at the level of RDI programmes and at the level of the RDI priorities themselves. It is expected that the allocation of financial means on the basis of these priorities will be launched in 2014.

The identified RDI priorities, which establish a firmer link between research and wider social, economic and environmental aspects and issues, by no means form a sufficient basis for the subsequent introduction of a system of technology assessment into the Czech RDI system. This initiative, however, is a promising start in this respect. Nevertheless, more needs to be done within the RDI system of the Czech Republic, so that a formal institutionalization of TA within the system is achieved.

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Creating a Hub for ELSI/TA Education, Research and Implementation in Japan

Tatsuhiro Kamisato and Mitsuaki Hosono

Abstract

As the relationship between science, technology and society deepens, it is increasingly emphasized that science, technology and innovation (STI) policy should be directed toward "the society and the public" by obtaining public understanding and trust and at the same time by fostering public participation. Within this context, in 2012, Osaka University and Kyoto University have jointly started a "Program for Education and Research on Science and Technology in the Public Sphere (STiPS)" funded by the Japanese government. This is the first case of an innovative educational and research programme taking account of ELSI (Ethical, Legal and Social Issues) in Japan that includes TA (Technology Assessment) and PE (Public Engagement). Therefore, we will outline STiPS. It is expected that STiPS will contribute to recovering public trust in expertise in the Japanese society, which was lost as a result of the 2011 nuclear accident.

Introduction

With the deepening relationship between science, technology and society, there is an increasing consensus that science, technology and innovation (STI) policy needs to foster and obtain public understanding, trust and participation. This consensus rests on several points: that it is necessary to understand the influence and impact of STI policy on society and to make it visible to the public; that the policy-making process must be rationalized to make it more objective and evidence-based; and that this will lead to improved accountability for STI policy makers to the public.

Within this context, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), has been promoting the "Science for Redesigning Science, Technology, and Innovation Policy (SciREX)" programme since 2011, which aims to prepare a system and a foundation for the realization of evidence-based policy formation through 1) a proposal of policies effective in addressing different challenges, 2) multifaceted analyses and 3) assessments of social and economic impacts from STI policy (MEXT 2013a). The MEXT planned this SciREX programme by taking the "SciSIP" programme as a model, that is the "Science of Science and Innovation Policy" in the US. The SciSIP programme was established in 2005 by the National Science Foundation in response to a call for a systematic study of the social science of science policy by John Marburger, the director of the Office of Science and Technology Policy at the time (Rosenbloom 2013).

Currently, the SciREX consists of four sub-programmes: mission-oriented research on STI policy, research funding, data and information infrastructure, and the "Fundamental Research and Human Resource Development Program" for STI policy (MEXT 2013a).

During the fiscal year of 2011, several hub institutions for the "Fundamental Research and Human Resource Development Program" were selected by the MEXT. They consisted of the National Graduate Institute for Policy Studies (GRIPS), the University of Tokyo, Hitotsubashi University, Kyushu University, Osaka University and Kyoto University. Although each institution has its own focus area, the STiPS programme at Osaka University and Kyoto University had a minor specialization with a focus on ethical, legal and social issues (ELSI) in science and technology (MEXT 2013b). In this paper, we will mainly discuss this STiPS programme.

Outline of the STiPS Programme

Role and Position of STiPS in the SciREX

First we will take a look at the concept and role of STiPS in the SciREX programme. The missing perspective in the traditional STI policy in Japan is an understanding of what people in society expect, their concerns with regard to science, technology and public policy, and their vision for the world they want to live in.

To address this viewpoint, a process of participation, engagement and deliberation that includes a wide variety of people, organizations and groups, not only researchers, industry specialists or policy makers but also citizens, is needed. In this process, the participants, both directly and indirectly, engage in discussions to deepen our thoughts and to elicit and share our expectations and concerns.

Although the Japanese government has recently begun to work on a new policy for innovation in order to get over these problems (METI 2007), it has not yet made any discernible progress.

STiPS is strongly committed to the development of personnel who can contribute to the process of policy-making by creating links between various academic fields, as well as between academia, policy and society. This will be achieved by those who can carry out the practice and analysis of public engagement activities, and who can promote these activities based on the study of ELSI in science and technology. Naturally, these activities would include TA.

Three Functions of STiPS

STiPS has three functions.

1. First, it is “a hub for education”. Through education and by utilizing the opportunity to become involved in the field of public engagement in science and technology, we aim to develop individuals who can cross over the boundaries of their specializations, understand a wide range of issues related to science, technology and society from various angles and contribute to the process of policy-making by acting as a link between academia, policy and society.
2. Second, it is “a hub for research”. Osaka University and Kyoto University will jointly engage in research on the ELSI associated with science and technology. This process will incorporate trends in research, in science and technology and in laboratories and research institutions, so as to continuously improve the effectiveness of practice and analyses of public engagement in the policy-making process. Building this research into ELSI, both theoretical and practical skills in the field of public engagement will be fostered in individuals through their participation in, and by an analysis of, public engagement activities, such as technology assessment.
3. Lastly, it is “a hub for practical application”. In this programme, hands-on experience in social collaboration with academic and social knowledge, and the opportunity for students to take the initiative in that collaboration, will be offered. Both Osaka University and Kyoto University have strong ties with the business sector and the local government in the Kansai region,[1] and they have frequently collaborated and exchanged information in the realm of science and technology. In addition, by promoting the participation of civil society, the general public and NGOs and NPOs in public-engagement activities, STiPS contributes to the development of STI policies. It also helps draft and plan research and development that truly reflects the needs, unique circumstances and issues of the local society.

Educational Goal

A minor specialization programme by STiPS began in April 2013 as a part of the existing master programme. In the first year, 15 students from a variety of fields, including engineering, science, literature, law and others, were enrolled in this programme.

In this minor programme, we expected to foster two types of personnel who could act as links between various fields.

1. One is “type A” personnel, who could act as a link between various fields, that is various academic fields, many companies or citizens. This personnel type is a specialist or intermediary in our society. They should be leaders in ELSI, PE and TA. We hope to establish a new major doctoral course for type A in the future.

2. The other is “type B” personnel: people in their own professional fields who can also act as a link between their own field and another field. A typical target person here would be someone who has a Master of Science or Master of Engineering degree. We can expect to send our students into society with knowledge acquired through this minor programme.

Several career paths stemming from this programme can be envisioned.

1. The first is a professional researcher at a university, at a research institute or in the laboratory of a private company. They would work mainly in their specialized field, having a similar viewpoint or way of thinking as ELSI, TA and PE.
2. The second is a government official, policy secretary or a staff member working for the management and the research policy at a university or in an institute. They would work directly based on the education provided in the STiPS programme.
3. The last is an experts for public relations and risk communication. They could work in central government, local government and in industry.

Category	Faculty	Subject Name	Unit	Semester
Core Subject	CSCD	Introduction to Science, Technology and Innovation Policy	2	1
		Workshop on Science, Technology and Innovation Policy	2	Intensive course
		Research Project	2	All Year
Elective Subject (At least 4 subjects should be selected)	CSCD	Science, Technology and Communication	2	1-2
		Science, Technology and Society (STS) Studies	2	1
		Advanced Seminar on Science, Technology and Innovation Policy	2	Intensive course
		Hot Issues in Science, Technology and Society	2	2
	Medicine	Ethics in Life Science and Public Policy	2	Intensive course
	Engineering Science	Social Engagement on Nanotechnology A	1	Intensive course
	Engineering	Enviromental Management for Sustainable Industrial Systems	2	1
	International Public Policy	Development and Environment (L)	2	2
		Development and Environment (S)	2	2
		Environmental Law (L)	2	1
		Environmental Law (S)	2	1
		Personnel Micro-Data Analysis (L)	2	All Year
		Personnel Micro-Data Analysis (S)	2	All Year
		Public Policy I	2	2
	Human Sciences	Science and Technology in Society	2	2
		Methods in Fieldwork	2	1
	Law	Bioethics and Law 1	2	2
		Bioethics and Law 1	2	2

Table 5: The list of the new curriculum of the minor specialization in STiPS

Curriculum of the New Minor Specialization in STiPS

Above is a list of the new curriculum of the minor specialization in STiPS. It comprises three core and eighteen elective subjects from various disciplines, such as engineering, public policy, law, medicine and STS. We are planning to add more to the curriculum next semester. Students in the minor specialization have to obtain all the credits of the core subjects and at least four elective subjects in order to complete the certificate.

Other STiPS Activities

Thus far, we have mainly discussed the educational programme. Finally, we touch upon the other activities of STiPS. Since members of STiPS actively participate in many activities, it is difficult to talk about them all. Therefore, we will briefly look at only two cases.

1. Research on public engagement. In 2012, one of the core members of STiPS, Tatsuhiro KAMISATO, was asked to contribute an article to a review journal on the web, "Nippon Dot Com", which was produced by the Nippon Communications Foundation. It promoted understanding of Japan through web-based publishing and other activities (Nippon.Com 2013). This article is about the issue of public engagement in strategic energy policy in Japan after the Fukushima Daiichi Nuclear Plant accident. As is well known, the energy policy in Japan is still unclear. This article deals with the issue of how to formulate a strategy for energy supply (Kamisato 2012). The readers of this website are not only academics but also businesspeople, policy makers and so on. As one of the missions of STiPS is to intermediate between academic and political communities, members contribute this kind of media, which has a wide range of readers.
2. Another activity is to facilitate social events concerning science and technology, arts and culture, policy and so on. One of the many events hosted by STiPS is the "Labo Café", which is an interactive programme in which participants have wide-ranging discussions on a variety of topics. The programme aims to turn the concourse of the subway station into a communication space for the arts and academia by addressing various themes. In addition, we have a series of public seminars, which are intended for deliberating about science and technology in the public sphere with citizens but also for forming networks among researchers, practitioners and citizens in the "Kansai" region. The themes we have picked include "regulatory science", "innovation and the role of the university", "environmental innovation", "universal design" and so on.

Conclusions

As observed above, we have taken a look at the background and outline of the STiPS programme. This has been the first educational and research programme for innovation putting great value on ELSI, TA and PE. Fortunately, the programme has met with positive public response. For example, it received glowing coverage in certain sections of the media

(Yomiuri 2013) and also received inquiries from some government and university staff. Above all, the most important thing is that STiPS is appreciated by students enrolled in it.

On the other hand, in order to stably maintain this program, there must be enough job opportunities in which the knowledge and skills of TA and PE can be applied. Honestly speaking, there had been only a few such jobs, at least in Japan. Recently, however, we have been able to see a slight shift, which would be due to the effect of the Fukushima nuclear accident in 2011.

Although SciREX, including STiPS, was not necessarily established to cope with the situation brought on by the accident, some people in Japan now pay more attention than before to TA or ELSI in science and technology because they have lost trust not only in the safety of nuclear power but also in the expertise of the government with regard to science and technology in general. In fact, before the accident, most Japanese were not very familiar with ELSI, PE or TA.

In the autumn 2011, the "National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission" was formed. Before the accident, this type of a commission on the national diet had never been formed in Japan (NAIIC 2012). Although this commission has already been dissolved, we should hope that this experience will be an opportunity to form the first TA organization on the Japanese Diet. It would mean turning the tragedy into a constructive opportunity. It is hoped that efforts will be made for further advancement in this area.

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PART III

PARTICIPATION IN TECHNOLOGY ASSESSMENT

Articles from the PACITA 2013 Conference Sessions:

TA Methods and Tools (IV)
Participation within the Field of Climate Change (V)
Participatory Methods (XII)
Participation: Practical Cases (XVIII)
CSOs in Research (P-I)

Tangible Meets Fictional – Shaping the Future, a Participatory Methodology

Michael Rehberg, Kora Kimpel, Martin Kim Luge and Martina Schraudner

Abstract

Participatory and need-centric innovation lies at the core of a sustainable and, more importantly, socially appreciated research agenda. Until now, relatively little progress has been made toward creating a systematic method that will orient innovation toward the lay perspective and will foster social and technological co-evolution.

Drawing on the approaches of participatory design, Fraunhofer's Shaping Future has developed an original methodology that is intended to enable the "experts in everyday" to co-shape research trajectories. The methodology was continuously refined in six workshops with 125 participants. This paper presents the approach and a selection of developed methods.

Shaping the Future – Participation as Opportunity

The growing public demand for participation stems from its increasing awareness of the discrepancy between its expectations for technological development and the results of the conventional method of innovation practiced by research and industrial organizations. To address such concerns, the scientific community will need to re-arrange its priorities and re-envision the role of public input (e.g. Mejlgaard/ Bloch 2012). By investing in participation, societies can achieve "transformative innovation" (e.g. Steward 2012) and master the challenges of the future.

By enabling the public to co-shape research trajectories prior to setting any research agenda, participation fosters viable visions of the future (e.g. Owen et al. 2012). When compared to conventional feasibility-centric developments, user-directed innovations – defined as directed both toward and by prospective users – satisfy a much vaster range of needs and equally benefit society, industry and the scientific community. Applicability, marketability and social appreciation are incorporated into the research agenda ab initio – as opposed to traditional approach where these are addressed post factum (e.g. Hippel 2006; Oudshoorn/ Pinch 2003; Smits 2002).

In this regard, participation requires a systematic method that will foster knowledge-centric interaction and preference reflection. By prioritizing public input and matching technological advances to social developments, such methods will promote socially responsible innovation (e.g. Anichini/ Cheveigné 2012; Stilgoe 2013).

Participatory Foresight and Design Research

The need for transformative innovation reveals the growing significance of orienting technological advances toward the preferences of prospective users and of engaging the latter in "consumption-oriented socio-technical" networks (e.g. Steward 2012). Utilizing a collective interdisciplinary perspective, these networks are characterized by an outcome-oriented approach to problem-solving (e.g. Gibbons et al. 1994). Due to this orientation toward application, collaborative-learning processes require new methods that can enable both experts and decision-makers from research, business and political organizations to interact on equal terms. By enabling articulation of the lay perspective and by expanding the boundaries of conventional research and development to include laypersons, participatory methods promote a knowledge-centric culture and orient innovation toward public preferences (e.g. Owen et al. 2012; Turnhout et al. 2013; Edler 2007; Edler/ Georghiou 2007; Edler 2010).

Participatory Foresight

Foresight is based on the concept of social and technological co-evolution (e.g. Hekkert et al. 2007, Jørgensen et al. 2009). Primary participants of foresight, however, have traditionally been experts and decision-makers from research, business and political organizations (e.g. BMBF 2008). Between 2007 and 2009, the German Ministry of Research and Education, BMBF, used this approach to define seven interdisciplinary areas of prospective research as being particularly promising with regard to innovation (e.g. Cuhls et al. 2009). Successful development of these areas, however, requires an orientation toward users and their diverse perspectives which could be achieved by systematic social discourse (e.g. Cuhls et al. 2009; Erikson/ Weber 2008; Loveridge/ Saritas 2009). Participatory elements promote an iterative learning process that enables both the public and the scientific community to refine their understanding of the particular needs of laypersons (e.g. Boon et al. 2011). This approach to innovation is closely related to the "social shaping" approach to technological foresight (e.g. Jørgensen et al. 2009).

Methods of participatory innovation are currently in different stages of development (e.g. Boon et al. 2011; Owen et al. 2012; Warnke et al. 2008) and have included scenarios, creativity techniques and surveys, such as panel studies and Delphi polls (e.g. Cuhls 2008). Due to their flexibility, creativity methods have been found to be particularly effective in assessing the lay perspective and in promoting interactive forms of preference reflection (e.g. Cuhls 2008; Popper 2008). Results of such interaction can also serve to assess the social acceptance of research agendas.

Drawing from these approaches and remaining mindful of the "dilemmas of participation" (Helm 2007), Shaping Future has engaged a wide range of non-specialists – people who participated non-professionally – in its exploration of the following question:

- Which methods, formats and settings might foster participatory foresight and innovation?

Design Research

Within the context of innovation research, participatory methods still appear to be in the initial stages of development. In the field of design research, however, co-creation has its traditional roots in movements such as German Bauhaus and Scandinavian Nordic Design of the 1920s and 30s, which regarded design not as an independent but as a collective act always embedded within particular social and political contexts (e.g. Ehn/ Badham 2002; Mareis 2011). The role of "co-creation" and "participatory design" in applied and scientific design research continues to grow (e.g. Mareis et al. 2010), and the focus of design practice continues to shift from "user as subject" toward "user as partner" (e.g. Sanders/ Stappers 2008).

In the digital age, traditional modes of ideation, such as "mere" verbalization, are being supplemented with an ever-widening variety of innovative formats that engage multiple senses; in particular, these include "rapid prototypes", "provotypes" and "design placebos" (e.g. Dunne/ Raby 2001; Mogensen 1992). By focussing on physical objects and the sense of touch (e.g. Martin/ Hanington 2012), such formats help access implicit knowledge (e.g. Polanyi 1966) and enable its transformation into symbols that are simultaneously visual and tangible. By helping to overcome potential terminology barriers among participants from diverse backgrounds, this can foster preference reflection early in the innovation process.

Combing approaches from "participatory design" (e.g. Sanders/ Stappers 2008) and "actor network theory" (e.g. Callon 1986; Latour 1986), Fraunhofer's Shaping Future has developed an original participatory methodology that is intended:

- To promote collective ideation
- To provide interactive and multi-sensual formats for preference reflection
- To enable the public to anticipate its key preferences in a decade's time from now and beyond
- And to foster shared insights into prospective social and technological co-developments

Shaping Future, a Participatory Methodology

The methodology was developed in cooperation with the Berlin University of the Arts through a qualitative exploratory case study (e.g. Popp 2006). Of the seven strategic areas determined by the BMBF, "human-machine-cooperation" (e.g. Cuhls et al. 2009) was selected as particularly suitable for anticipating emerging public expectations (e.g. Rasmussen et al. 2007, Spennemann 2007) because technological devices implicate varying degrees of a physical connection or proximity to the user (e.g. Dahlin 2012).

The methodology is centred on an iterative co-ideational process. From March through October 2012, 125 participants co-ideated in six workshops. Each group of participants was diversified based on age, gender, education etc. Each workshop included scientists and/or engineers in order to give participants an opportunity to discuss the conventional, solely professional method of innovation (e.g. Hennen 2012).

Developing the methodology was prioritized over designing the study to meet the criteria of representativeness and generalizability. One key characteristic of the methodology was that it continued to evolve throughout the entire project. Joint reflection in workshops' follow-up sessions contributed to this continuous learning process. Approaches from design research thus undergirded both the methodology and its development.

The following sections present three of the developed methods – enabling spaces, user-directed storytelling and speculative prototyping – and the results of their utilization over the course of the project.

Enabling Spaces

"Enabling spaces" are transformable along a number of both physical and psychic dimensions including social, cognitive and emotional (e.g. Peschl 2007; Peschl/ Wiltschnig 2008). The co-ideational process can be realized through a joint exploration and shaping of such a space. The interplay between the act of co-shaping and the effects that the emerging space has upon the participants provides an inspiring environment that fosters new forms of collaborative knowledge, interaction and creation.

Over the course of the project, five thematically different enabling spaces were co-shaped. The interdisciplinary team provided objects, materials, interaction formats and creativity-fostering techniques. Developed ideas and discussion records were entered into a database and conditioned for evaluation and presentation.

There are a number of ways in which the collected data can be conditioned. One such way involves grouping together established preferences or suggested applications. Another is word clouds, where the size of the font is set proportionally to the number of times a particular term was used within a particular context in order to help establish the terms' relative significance; the fact that an anticipated term was not used is also relevant.

User-Directed Storytelling

The purpose of "user-directed storytelling" is to jointly develop narratives that enable shared insights into prospective social and technological co-developments. Four parameters provide the basis for each narrative:

- Who – name, age, background etc.
- When and where – time, place, conditions etc.
- What – a certain need, conflict etc., which concerns a certain range of people
- How – a general idea for a potential innovation and/or an application.

A range of cards provides each parameter. Participants are divided into groups and each group randomly chooses four cards and develops a narrative about a hypothetical socio-technological situation; this is repeated a number of times within a relatively short time. The developed narratives are then "compressed" and channelled into a range of scenarios.

The developed scenarios map socio-technological trends, explore their potential impacts and articulate shared expectations toward prospective innovations.

Speculative Prototyping

The purpose of "speculative prototyping" is to explore hypothetical socio-technological situations through tangible objects – "design prototypes". These prototypes are neither supposed to function as real devices nor to serve as their models. Instead, their sole purpose is to explore potential functionality without reference to practical limitations.

To this end, participants jointly develop socio-technological hypotheticals and, out of everyday materials, construct respective prototypes. Through user-directed storytelling, they role-play their potential applications and functionality. Through such "tangible fiction", participants articulate their preferences for hypothetical innovations – with regard to materials used, functionality and the social contexts that surround them.

Conclusions

Fraunhofer's Shaping Future pursued a participatory methodology that could enable the public to co-shape research trajectories prior to setting any research agenda. Rather than limit itself to potential innovations per se, the project focussed on participation formats that could enable laypersons to "grasp" the future and to articulate their expected preferences.

Suitable techniques from design research were adapted and used to augment foresight methods. An iterative co-ideational process constituted the method's core. In six workshops, 125 participants jointly explored the chosen domain of human-machine-cooperation resulting in a range of "tangible fictions" – hypothetical socio-technological situations and/or design prototypes.

Specialists from a variety of fields visually and qualitatively evaluated, conditioned and re-utilized the collected data throughout the entire project. In particular, they projected the hypotheticals into a “Participatory Technology Roadmap” (e.g. Kimpel et al. 2013; Schraudner et al. 2013) by estimating when such developments could become technologically feasible and by arranging them on a timeline based on these estimates. These roadmaps can serve to identify future research trajectories.

Participation formats were consistently evaluated and refined throughout the entire project. Their visual and, particularly, tangible aspects combined with the interview approach proved to foster preference reflection and both concise and original visions of the future. The developed methodology can be easily adapted to the specifics of particular research fields or industry sectors and, in combination with the collected data, support future participatory practice.

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Civil Society Organisations in Research Governance

Initial Observations from the CONSIDER Project

Simon Pfersdorf, Martine Revel, Bernd Stahl and Kutoma Wakunuma

Abstract

The idea of bringing public interest to the core of research projects strengthens the role of civil society for science. However, the involvement of such organizations in research poses problems and challenges to the governance and structure of science projects. It is the nature of research projects (particularly European ones) to be complex both on the content side and on the social side, especially if you involve interdisciplinary groups from different cultural backgrounds. This paper introduces the current state of the CONSIDER (Civil Society Organisations in Designing Research Governance, www.consider-project.eu) European research project. The first section shows insights from a quantitative study on FP7 research experience with CSOs. Section 2 presents three examples of CSO participation and synthesizes main drivers influencing the governance of research projects. From this we can draw preliminary recommendations for CSOs, researchers and funders for improving the conditions of CSO participation in research. Our findings from the FP7 surveys and the initial case studies support the different motivations for using CSOs in research to varying degrees. The argument that they can improve scientific efficiency seems to be strongly reflected. This is achieved by using the knowledge of the CSOs for improving research design, methodology and analysis.

Introduction[1]

The growing social relevance of research and innovation that affect all aspects of personal and public life has led to a debate about research governance that explores novel ways of ensuring that the outcomes of such activities are acceptable and desirable for society. In Europe, this discussion currently focusses on the concept of responsible research and innovation (RRI) (Owen Richard et al. 2013; Schomberg 2011). One crucial aspect of this debate is the assumption that broader societal engagement with research and innovation will lead to scientifically superior and societally desirable outcomes. An additional hope is that such engagement will lead to an increased level of legitimacy for both research processes and research outcomes.

The typical Technology-Assessment (TA) experience with social engagement is lay participation and with it a consensus conference, scenario workshops, world café or focus groups. These engagement experiences share common factors in that they are organized by scientists following a predefined method. The participants are randomly selected citizens who do not have any function in politics, economics or science. At the end of such events, the results are symbolically passed to responsible politicians and representatives of the relevant administration, science and the economy. However, most studies show that these procedures rarely affect political decision-making or scientific projects (Bogner 2010). The idea of bringing public interest to the core of research projects strengthens the role of civil society for science (Stirling 2006). Including Civil Society Organizations (CSOs) is one approach to make this happen. For the purpose of our empirical work, we found the following definition: CSOs are not-for-profit organizations that do not represent commercial or governmental interests and pursue a purpose in the public interest (for example NGOs, cooperatives, associations, grass-roots, mutuals, foundations, think tanks and umbrella organizations).[2] However, the involvement of such organizations in research poses problems and challenges to the governance and structure of scientific projects. It is the nature of research projects (particularly European ones) to be complex both on the content side and on the social side, especially if you involve interdisciplinary groups from different cultural backgrounds. Adding non-scientific groups to a research project further increases the complexity. Then you have to bring together groups orienting their work at disciplinary scientific discourses as well as others who are guided by social or policy debates. What we know so far from literature is that the complexity of CSO participation is reduced if research projects are structured by one of four main social functions. These are (1) influencing the scientific efficiency in research projects, (2) solving CSO-related problems, (3) providing social legitimacy to projects and outcomes and (4) improving development in technology:

1. In his famous study, Steven Epstein found out how patient organizations influenced the course of HIV research. These organizations mainly consisted of gay men who, before HIV was discovered, were fighting for their social recognition and identity. Beyond protests and demonstrations for cures and therapies, the groups gained credibility among experts in HIV research by participating in scientific discussions. Having gained scientific credibility and having been acknowledged politically, the patient organizations could participate in the expert talk. They were able to contribute to scientific discussions on the construction of research problems, to the setting of research agendas, to the application or non-application of specific research methods and the evaluation of results (Epstein 1995).[3]
2. Science shops embody another functional type of the interaction between science and civil society. They work as intermediary organizations that pass CSOs' problems to scientists. In exchange between the scientist and the organization questions, methods and efforts might need to be adapted. This research process results in reports contributing to

current policy discourses, public-relation strategies or instructions for the application of the produced knowledge so as to solve an existing real-life problem (Farkas, 1999, p. 44).[4]

3. If CSOs participate in a research project, then this could also have political implications. In science and technology, it is deemed necessary to make the complicated research fields accessible to others. Therefore, workshops at the end of research projects present research results. On the one hand, CSOs do not play any role in the production of new scientific knowledge but become engaged in the dissemination of project results. On the other hand, researchers can claim that CSOs have participated in their project as an attempt to increase the project's social legitimacy (Saretzki 2003).

4. Similarly, but in another societal field, CSOs can become engaged within the innovation process. Projects driven by industrial needs are known to profit from the participation of end-consumer groups. Experiences have been made with assistive technologies for disabled people. Concepts like Design for All, Universal Design, User-centred Design or Inclusive Design offer solutions. Their common approach is that either a product is adapted in cooperation with other users after it has been developed or the product is developed bottom-up (Hippel 2006; Plos et al. 2012).

While we are aware of these recognized functions of CSO participation, it is still unclear what influences the institutional embedding of CSOs in research projects, and how these projects are governed.

This paper introduces the current state of the European research project CONSIDER (Civil Society Organisations in Designing Research Governance, www.consider-project.eu), which is working on closing these knowledge gaps. The following section shows insights from a quantitative study on the FP7 research experience with CSOs. Section 2 presents three examples of CSO participation and synthesizes main drivers influencing the governance of a research project. From this we can draw preliminary recommendations for CSOs, researchers and funders for improving the conditions of CSO participation in research. At the end of the paper, we draw a conclusion from our current empirical insights with regard to good practices of CSO involvement and its notable problems.

The Meaning of CSO Participation in FP7

As shown above, CSO participation in research can take varying forms and functions. Each participatory or research practice might lead to governance problems. In order to explore the field and identify the main patterns of CSOs participation, CONSIDER ran two surveys on the 14 000 existing FP7 projects. The first one was very short (up to five questions) and was sent to all of the 14 000 FP7-project coordinators. A second more detailed questionnaire was given to project coordinators who acknowledged CSOs participation in their research project. Further CSOs that we were introduced to projects also received the second questionnaire.[5]

The Concept of CSOs

Considering the personal reactions of the survey respondents and their answers, it is clear that the concept of CSOs lends itself to a number of different interpretations. Public research institutes or universities often described themselves as CSOs because they reasoned that they were not for profit organizations. However, they did not recognize the fact that they were scientific and public entities largely funded by the government. In addition, some private research institutes considered themselves to be a part of Civil Society. Furthermore, the survey results show a difference among cultural settings. In the south of Europe, where democratic regimes are well established and combined with a centralized vision of the state – e.g. Greece, France, Italy, Spain – CSOs are typically seen as a counter power. By contrast, in Nordic countries, where a federalist vision of the state is more dominant, CSOs are mostly seen in a communitarian tradition.

CSOs' Roles Inside Research Projects

The share of CSO projects in the sample, according to the project coordinators' responses, is at least 22 %. The first two questions of our questionnaire were the following: are there any CSOs included in research? And: What roles were dedicated to CSOs participating in research projects?

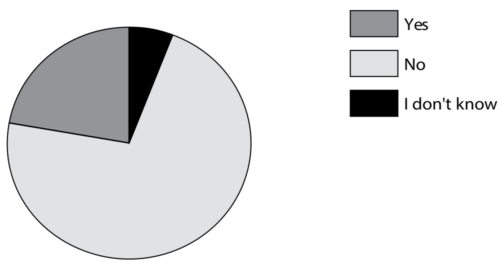

Figure 10: Consider Survey 1 CERAPS, Lille 2 University: "Was there any CSO participation in your research project?"

The roles of CSOs in projects are diverse, according to responses to the initial survey (multiple choices answer), as figure 2 shows. Their main functions are to provide expertise, to be a member of the team, to discuss results or to contribute to publications. According to the responses by project coordinators (questionnaire 2), CSO roles are more focussed on knowledge activities (local knowledge, facilitating information, contribution to publications) than in the more participative research projects. The second questionnaire gives further insights about the role of CSOs.

The multiple-choice question clearly shows that CSO roles are perceived as being fundamental when they give their expertise, and when they disseminate project results and guidelines. In the case of CSOs, expertise does not come from lay people. As underlined in our sample description, the CSO members who answered our questionnaire were well educated and skilled in research projects. The value added by CSO members seems to help research projects to get more context-relevant for policy needs or for the needs of other beneficiaries (patient, children etc.).

The traditional model of role distribution between researchers and stakeholders usually implies that CSOs should disseminate project results. CSOs are perceived as intermediaries who are going to translate and pass on the produced knowledge or test the results of R&D.

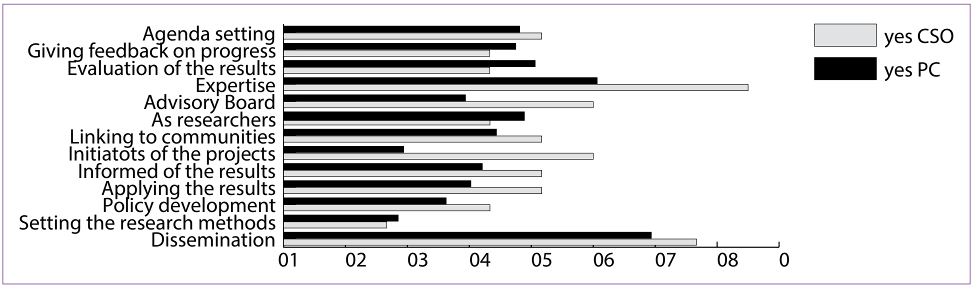

Figure 11: Consider Survey 1 CERAPS, Lille 2 University: Role definition of participation

Most interestingly, the representation of CSO roles differs when considering CSO involvement in projects. According to CSO members' responses, CSOs are the initiators of projects more often than what PCs acknowledge (50 % / 19 % responses), and CSO members also claim to be advisory board members more often than PCs mention they are (50 % / 29 %). This tends to indicate a tendency for project coordinators to assign a more passive role in projects to CSOs members, which does not seem to suit CSO members' perspective. These different perceptions of CSO involvement in research activities may indicate a normative framing conflict about what ought to be the CSO role inside the research team.

This conflict is not about their skills; we refer to the fact that the first role attributed to CSO members is their expertise. They also seem to be seen as researchers (39 % of PCs agreed with that / 33 % of CSOs). The tasks reserved for other members of the team, according to both categories of respondents, are: setting the research method and policy development. This is more of a governance conception discussion: should the project coordinator take the leadership, or should the project governance be more participative? The CSO-role attribution also indicates that CSOs are scarcely able to discuss research project designs from the start. Only 30 % of project coordinators indicate that CSOs are involved from the start of the project. The majority report that they are involved at the planning stage only, which is confirmed by CSOs member responses to the questionnaire.

First Appraisal of the Governance of CSO Participation

The standard model of science is dominant in the responses we received in survey 1. It is "a traditional top-down approach, which is based on the knowledge of experts. With this approach, normativity comes from the knowledge and opinions of the experts involved in decision-making" (Rainey, Goujon, 2012). CSOs involvement in research is still embedded in a rather classical normative setting of research when considering their role and attribution. FP7 projects have certain characteristics (length, international collaboration, funding scheme, evaluation etc) that frame the working and communication context of each research team. The CSOs here are very specific CSOs whose members hold PhDs and have research experience. CSOs do not bring in lay people's views, and they also do not always represent public interest. They are more policy-oriented. Project coordinators seem to see CSOs more as end-user representatives than as equal partners. CSOs scarcely define the research method and agenda and are perceived as experts. There might be a norm-construction process here about what a CSO's role and a researcher's role ought to be, and what implicit power relations should exist. CSOs are valued for their expertise and their networks, which will facilitate the dissemination of results as well as the testing of developments. Researchers usually master project-research methodology and agenda setting of the particular research problem. Project governance is mostly a functional one: task division and specialization among partners, which is supported by an implicit definition of science. Interactions between partners are more aggregative than deliberative.

Patterns of CSO Participation on the Project Level

This section describes the initial steps and preliminary findings of the in-depth case studies undertaken as a part of the second major empirical step of the project. The idea behind the case studies was that a deeper understanding of the factors that influence the success or failure of CSO engagement in research would require an in-depth investigation of research in real projects. The consortium therefore decided to undertake 30 detailed case studies, which were selected on the basis of hypotheses concerning the role of CSOs in research. A part of the sample of research projects was determined on the basis of the outcomes of the survey of FP 7 projects which led the consortium to choose some of the FP7 projects that took part in the survey. Given the structured and very specific frame of the European Framework Programme, it was decided that a number of non-FP7 projects should be included as well. The consortium developed a case-study protocol that determined the data requirements and analysis structure of the research. This paper does not offer the space to describe the methodology of the case studies in any detail. The focus of this section is less on describing the approach and more on outlining some of the initial findings. We therefore highlight some of the main aspects that emerged from the grounded analysis of the initial set of case studies undertaken by the four partners involved in the empirical research.

Before we come to the more detailed discussion of the initial cases, it is important to stress that the snapshot provided in this paper represents provisional findings that require further discussion and reflection within the consortium, and that they may be superseded by findings arising from further research. The consortium decided that the analysis, following the principles of grounded theory, would initially be done on a case by case basis. Each case is to be written up following a template that reflects research interests and the hypotheses

	DMU Case C	KIT Case J
Consortium size and membership	Partners from 4 countries, of which were • 2 universities • 2 companies • 1 research organization • 1 NGO • 1 not-for-profit hospital	• Participatory research unit of a research organization • Social Science Institute as the interface between the project and the CSOs as well as participating disabled people • Research Institute for electronics • Private Hospital • Company experienced in services for disabled people • Software company
Funding source	EU FP7 ICT	German governmental fund
Budget	€3M, Funding €2.3M	Unknown
Duration	3 years	3 years
Disciplines	ICT, neuroscience, assistive technologies	Product Design, Economics, Electrical Engineering, Informatics, Medicine
Content	Brain and Neural Computer Interfaces	Product Development, Methodological knowledge on user participation in product development
Basic / applied research	Application oriented, but not yet close to market	Applied
Beneficiaries	Severely disabled users	Disabled users/ Companies /Research
Project management structure	• Own organizational unit within a research organization as the coordinator / Regular General Assemblies consisting of all partners as the main decision-making body • Meetings twice a year and regular telephone conferences	• Own organizational unit within a research organization as the coordinator / Regular General Assemblies consisting of all partners as the main decision-making body • Telephone conferences if necessary
Dissemination and communication	• Project website • Academic publications • Public project deliverables • Press releases • Project videos	• Research publication on methodological outcomes • Media coverage of the project • Technological results and applications/ maybe patents
Conflict resolution	• Formal conflict-resolution mechanisms in line with FP7 project expectations • Informal project management as experienced approach to disagreements	• Mutual agreement or consent when it comes to general decisions on the project • Specific questions of product development need to be answered by CSOs • external project participants alone or in cooperation with the scientific /technical developer at the different steps of the development
Ethics	• Shared view that project is ethically positive because it aims to facilitate autonomy for disabled users. • Project raised human-research ethics issues. The technology was classed as a medical device which triggered a full national ethics review. The CSO members were able to partner up with a local university, which was not a part of the consortium, to use their experience and facilities to gain ethics approval. This proved to be a major effort for the CSO that they were unlikely to have been successful in if they had not had the support of the local university.	• Strict interpretation of personality rights • Double check of media and PR by relevant CSO(s) • The university partner served as the main organizational link to the disabled. Its staff was experienced in their treatment and was aware of their needs and limits.

Table 6: Overview of two initial CONSIDER case studies

that motivated the choice of case studies. The following table gives an insight into the cases that inform the present document.

As was to be expected, the findings arising from the case studies were rich and provided interesting insights into current practices of CSO participation. During further progress of the project, this data will provide the basis for the development of models that represent important aspects of CSO participation in research. As the present paper does not provide the space to go into any detail, we can only present some of the highlights of the findings.

In order to understand the governance of CSO participation in research projects, the data analysis paid particular attention to the questions of the development of research projects and their consortia and of the different expectations of different types of partners and various enablers of CSO participation as perceived by those involved in the projects. The CONSIDER project has committed itself to developing guidelines and recommendations. As there are evidently a number of stakeholders that CONSIDER has revealed during data collection, the intended guidelines and recommendations will be tailored to the different stakeholders who include CSOs, researchers and policy-makers. In order to ground such guidelines in empirical reality, the respondents in the cases were asked to suggest ways of improving participation.

Development of Research Projects and Consortia

The case studies show that the development of research questions and the composition of research-project consortia crucially depend on a number of factors. Not surprisingly, funding requirements are dominant in this area. In several cases, the primary reason for the inclusion of CSOs was that this was mandated by the funder. However, another strong reason for the inclusion of CSOs was a research aim that targeted the needs of stakeholders represented by CSOs, such as patients that were to benefit from the research outcomes, which, among others, included some technical innovations. A further key aspect of CSO collaboration that also influenced the degree to which CSOs were integrated in proposal development and practical project management (e.g. work-package leadership or deliverable ownership) was the history of prior collaboration. Personal relationships between CSOs and other partners who had previously collaborated proved to be a strong factor with regard to the success of collaboration.

Stakeholder Expectations and Expectation Management

The expectations of different stakeholders and partners in projects often diverged in several aspects. A recurring theme was that CSO members were hoping for direct benefits for their constituents to be accrued as a result of the project. Such expectations could sometimes be linked to the promises made by research proposals but could prove disappointing because of the slow pace of the research process or over-ambitious expectations. A further recurring theme was that the emphasis of researchers was on publications which, in turn, were of relatively little interest to CSOs. Whether such diverging expectations led to problems, was strongly influenced by the degree to which the different partners were familiar with each other's ways of operating. A long history of collaboration could mitigate misunderstandings. A frequently named factor of exacerbation was that of different cultures, which could refer to a number of aspects, ranging from accounting practices to work routines and areas of expertise.

Barriers and Enablers of CSO participation

There were a large number of barriers and enablers that affected the CSO involvement in the projects under investigation. Some highlights were:

Barriers	Enablers
• Different cultures of different partners and resulting problems in communication and conflict management • Lack of prior history of collaboration as a deficit for trustful interaction • Different language and vocabulary • Different expectations, notably the academic focus on publications • Existing network of cooperation as a barrier for adaptability and creative problem-solving • The technology itself, insofar as its technical maturity does not permit the fulfilling of initial expectations • Bad past experience of interaction with science or scientists • Restriction of publication for scientists	• History of successful collaboration • Shared vision of research outcome and its social relevance • Adaptive problem definition • Existing networks • Hope for a scientific or technological solution of non-scientific problems • Internal organizational differentiation supporting participation (e.g. science shop of a university) • Project partner cooperation

Table 7: Barriers and enablers of CSO participation

For CSOs	For funders	For scientists
• Create partnerships with science • Create own research organizations • Professionalize your organizations	• Involve CSOs in advisory and steering committees • Make participation a popular topic • Fund/support CSOs being able to participate • Realize that participatory projects need more time • Make projects more flexible towards shifts in perspectives and research action	• Create organizational units focussed on CSOs/participation • Invest in personal competences • Invest more time in participation activities • Generate methodological knowledge • Adapt scientific jargon

Table 8: Recommendations for CSOs, funders and scientists

Recommendations

During the case-study research, our respondents came up with a set of interesting recommendations for a range of stakeholders that would overcome or at least alleviate some of the barriers to participation and strengthen the enablers.

Conclusions: Embedding CSOs in Research Projects

Our findings from the FP7 surveys and the initial case studies support the different motivations for using CSOs in research to varying degrees. The argument that they can improve scientific efficiency seems to be reflected strongly. This is achieved by using the CSOs' knowledge for improving research design, methodology and analysis. Furthermore, more than a half of the CSO members have a scientific background and hold a PhD. So they are accustomed to scientific thinking and experienced in managing scientific expectations.

Some CSOs, who represent particular constituent sets, such as patients with specific diseases, can establish contact with such patients and strengthen the research. In this sense, CSO involvement also improves the process and outcomes of technology development. A caveat to these observations was that in some cases, the CSOs did not think that the technical development aims were realistic and therefore struggled with their role in the projects.

In the projects we have investigated so far, there is little emphasis on solving CSO-related problems. The involvement of CSOs indicates that the research problem is relevant to the CSOs in question. At the same time, the project agenda is often shaped by researchers or research funders. In particular, FP7 projects are clearly pre-structured. New insights or unforeseen turns in the project, which might result from the on-going interactions between scientists and researchers, can cause problems for any consortium. However, this may be different for projects where CSOs have a funding role, which will be investigated in the CONSIDER project.

There is a clear divide between projects in which CSOs are only given a dissemination or end users role and those where the discussion surrounding the research agenda and methodology involves the CSOs. The last case seems more frequent when CSOs are in a position where their withdrawal from the project would lead it to collapse.

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Regional Climates: Participation and Collective Experiments on a Local Level

Stefan Böschen

Abstract

Sociological research on climate change faces a basic problem: instrumental knowledge, not democratic culture, defines the respective paths; therefore, further development of democracy is important. But the different levels of political and social coordination are confronted with the "tragedy of the commons": one single actor does not dispose of the necessary resources to force a change, and the global level is characterized by a lack of consensus as climate change effects are mostly observable on a regional or local level. But the meso-level has specific problem-solving capacities that have not yet been sufficiently taken into account: communities offer chances for social coordination and are the place to experience global climate change. The communal level also offers the chance to study socio-cultural transformations as a basis for collective experimentation.

Introduction: Climate Change on Different Levels

Sociological research on climate change is confronted with a fundamental dilemma: researchers act in a field that is predefined by natural scientists and therefore also pre-structured in a specific way. In many cases, sociological research on climate change thus takes the shape of an applied science and evaluates options for action and problem-solving that are defined by findings of natural scientific climate research and often seen as "without any alternative". In short, instrumental knowledge, not democratic culture, defines and decides the technological and societal paths and developments, though this conflict often remains unseen. Pointing in the same direction, yet from an opposite viewpoint, some scientists insist that the knowledge necessary for problem-solving and decision-making is principally available, but that the democratic structure of societies is, in fact, the problem. As suggested by James Lovelock, "it may be necessary to put democracy on hold for a while" (quoted from Hulme 2012, p. 2). With respect to the fundamental quality of change addressed by the climate-change problem, this situation is not sufficient. Moreover, the climate-change issue is calling into question some basic coordinates, such as the economy of growth, and therefore further development of democracy is of paramount importance to enable modern societies to decide upon such crucial issues in a democratic, not technocratic, way.

This argument directs the focus on the different levels of political and social coordination. These levels are confronted with the so called "tragedy of the commons" (Hardin 1968): individuals are highly restricted in their options to face climate change (as one single person evidently does not possess the means necessary), and the level of transnational cooperation is marked by structural divergences and rivalries of power (so that there is hardly any agreement about the means and measures to be undertaken). Thus, these levels are blocked in many ways with regard to mitigation measures. The same picture can be drawn with regard to the set-up of adaption activities. Again, one single actor does not have the necessary resources at his or her disposal, and the global level lacks practical starting points because climate change mostly affects regional or local levels. Against this background, two arguments can be put forward. First, the climate-change issue exceeds the established patterns of problem-solving and therefore calls for the creation of new pathways to analyse the core of the problem and to deal with its main outcomes. Second, there seem to be specific problem-solving capacities at the meso-level that are not sufficiently taken into account. In particular, communities offer specific chances for social coordination through participation; communities are the place to experience vulnerability: floods, changes in the usability of nature; and finally, communities often have to deal with developmental conflicts relating the local economy. The thesis of this paper is that the communal level not only constitutes an important space for coping with climate change but also offers the chance to study socio-cultural transformations as a basis for collective experiments to deal with the climate-change issue.

Accordingly, the "Regional Climates" project (www.regional-climates.com) directs its focus on the variety of regional potential for action, which is performed and balanced to counter climate change and its consequences. The core of this social-science project are the local perceptions of climate change in the Alpine communities of Bavaria (periphery: Achental, Bernried; centre: Munich) and South Tyrol (periphery: Lüsen, Moos; centre: Bolzano), and the measures that are being undertaken in this regard. The following questions instruct our research: do stakeholders in politics, business or civil society perceive climate change as a sufficient reason to strategically adjust future plans with regard to this topic, and if they do, how do they accomplish this? What cultural practices, narratives, interpretations and types of knowledge play a role in the organization of climate-relevant action? What are the outcomes of politics between top-down and bottom-up strategies in communities? Answering these questions, we learn about the importance and benefits of participation as well as its limits for collective problem-solving and hence get hints for the further development of a democratic culture.

The Concept of Collective Experiments

Climate change is (mostly) addressed as a severe problem that is or should be – as many observers state – accompanied by dramatic changes in the structure of societies (cf. Leggewie/Welzer 2009; Welzer et al. 2010). Against this background, I would like to propose to conceptualize these changes as a process of collective experimentation. The underlying assumption is that a concept that is describing the collective formation of social reality as an experiment gains important insights into the boundary conditions and forms of constructing realities (e.g. Dewey 1927/1996). How are "realities"' reproduced and transformed in the course of cognitive learning and institutional change? "Reality" is not a fixed or unchangeably established entity but gets its specific form through experimenting realities and constructing social boundary conditions. In this context, well-established hierarchies of problem definitions are very influential. The concept of collective experimentation draws a picture by reconstructing these hierarchies to ask which details are highlighted by whom, what is missing in the picture and which aspects are kept latent. Such latent aspects can be brought into play by other actors not yet involved. In this way, the concept of collective experimenting offers a "fresh look" and breaks established orders of interpretation to uncover new options. This normative ideal is supported by a huge amount of empirical findings, which indicate that collective "trial-and-error" processes often take the form of experiments. These processes proceed outside established patterns of constructing realities and therefore offer chances for a socio-ecological transformation. Thus, not only the epistemological aspect of problems can be addressed but also the forms of social conflicts and the forms of their solving.

With the concept of collective experimenting, we are able to address phenomena of change that are largely depending on different or conflicting knowledge resources and therefore linked to specific conflicts. For a first (and tentative) definition of collective experimenting, it can be described as social processes of "trial and error" in which not only solutions for concrete problems are found but also new settings of perceptions and forms of knowledge are created to enhance the problem-solution processes and new social forms of cooperation and conflict solving are being tested. This perspective seems to be useful with regard to problems that are highly contested in the political arena and fuelled by different sources of knowledge which renders it problematic to fall back on established routines of problem-solving. An important distinction in this context is the one between social change and social innovation. Social change can be characterized as a rule-oriented, but not necessarily determined, modification of social and/or cultural structures and routines of a society; it is typically observed ex post (like the process of modernization). By contrast, social innovations can be described as intentional processes of collective experimenting under specific social, substantial, temporal and spatial boundary conditions.

Regarding the conceptual idea of looking at processes of collective experimentation, a set of instructive dimensions is needed to address such processes more concretely. In this context, it is crucial to focus on processes of collective problem-solving, processes that are driven by the need to reconfigure modes of perception and to create new forms of knowledge while changing the social modes of problem-solving. Three dimensions seem to be especially important for the next conceptual steps:

1. ***Processes of problem-solving.*** What processes of problem-solving are observable in the cases of the communities analysed? Communities are confronted with a huge variety of very different problems – and the ones induced by climate change might only be a small part. The climate-change problem has to be seen in the context of more pressing questions to be solved in the specific environment of a community, and it might be the case that the climate-change problem is not addressed at all. It is thus essential to investigate and understand the specific local setting. Which local problem horizon is present? What are the perspectives seen as relevant for collective learning processes? In what ways is the topic of climate change embedded in other topics – if at all? Other important aspects are the expected vulnerability and the anticipated resilience. It might also be important to specify: in what ways are diagnoses of problems transformed into political action programmes? Are there any forms of local, experimental learning for the future, beneath the well-established ways of top-down adoption of action programmes? Is there an active positioning of communities in the tension between top-down structures and bottom-up incidents?
2. ***Perception and forms of knowledge.*** Change can be interpreted as collective experiments only in case that perception and knowledge as well as their enhancement are seen as decisive for the success of the process. In the course of such experiments, the above-mentioned aspects of experienced vulnerability and anticipated resilience are specified and contextualized. With regard to such processes of experimentation in communities, the following aspects are important to be explored: what learning strategies are used to concretize the chosen anchor points? Learning processes are normally highly connected to specific anchor points; they provide a starting point and a structure for collective experimenting. Which (locally available) sorts of knowledge and perceptions are taken into consideration for problem-solving activities – and which are not? Are there any dominant and overarching expert views?
3. ***Actor networks and new forms of community-building.*** Communities are basically characterized by the coordination mechanism of gemeinschaft ("community"; as elaborated by Ferdinand Tönnies). The questions in this dimension address the forms and mechanisms of social action and their changing related to societal problem-solving. Regarding local efforts to face the climate-change problem: are there any mobilizations in the existing networks? And besides the existing networks: do new problems need to be handled by new forms of collective action and the building-up of gemeinschaft? Are there any reflexive forms of gemeinschaft to be observed? In this dimension, the focus lies on the social forces or social-change agents connected with the climate-change issue in communities.

These dimensions are to be seen as heuristic-explorative ones. Regarding the present state of reflections on the forms of processes of collective experimenting (cf. Böschen 2013), the main goal has to be the exploration of the most important dimensions and indicators of local social change linked to global climate change. In this sense, the highlighted dimensions are mainly a scheme to guide research and analysis of the climate-related changes in communities.

Some Insights from Fieldwork

As a result of the field studies in our project, I want to summarize some aspects which can be generalized as the first hints to regional processes of experimenting with climate change.

1. ***Dimension of problem-solving processes.*** Most importantly, our field work showed that the observed communities address quite different problems as the most pressing ones. For example, demographic change: some communities are facing a dramatic drain of young inhabitants, whereas others (like Munich) are confronted with an increasing number of inhabitants. Or with regard to financial resources: most of the smaller communities are short of cash, and therefore the so-called "Energiewende" in Germany ("energy transition"; i.e. the political decision to replace German nuclear power with renewable sources of energy) offers the opportunity to rebuild the local system of energy production by transforming the energy production system towards renewable energies. In this context, new forms of housing like climate-friendly housing are also a part of the transformation. But there are also other perspectives and strategies of problem-solving, especially with regard to transforming regional economic cycles and, for example, creating forms of climate-friendly tourism. Generally, if the politics in communities are oriented towards climate-change issues, they also have to take the national legislation into consideration. Regarding the analysed centres (Munich, Bolzano), there are specialized bureaucracies which are, for example, able to connect climate-related measures with an impetus to stir processes of economic growth. On the peripheries, climate-related strategies are picked up by central players to conserve regional attractiveness, create chances to manage the economic situation from an outskirts position or handle the devastating processes of demographic change. Such changes are mostly given a push by visionary individuals ("leadership") who are trained in roles and positions of administration or civil society and embedded in the respective networks. These visionary individuals depend on the flexibility of administrations and supporting structures ("institutional entrepreneurship"). In metropolitan areas, specialized bureaucracies and their staff with functional expertise are prepared for the elaboration of climate-change-related measures.
2. ***Dimension of perception and knowledge.*** For this dimension, it can be stated that the climate-change issue is not addressed directly – but through a variety of proxies: weather, changes in agriculture and so on. The population in both peripheries and metropolitan areas do not prioritize the issue of climate change, but rather see it as a long-term imperative for action. In this sense, the climate change issue does not stand alone as an issue in itself on the level of communal politics, but as a part of

regional and cross-political strategies of problem-solving. Another important role is connected to narratives. Narratives of evolution that are shared by a bigger part of the population open up room for transformation while allowing social coherence. Therefore, such narratives combine different motives and contexts and reconfigure these elements to a coherent story. In narratives about the future development, the motives of preserving the particular and historic character or beauty of a village as well as the motives of autonomy and maintenance of local structures in the economic value chain play an important role. In many cases, the quest for mitigation and adaption is not in the foreground but combined with narratives of evolution when seen as an add-on argument. In the German case, the so called "Energiewende" opens a window of opportunity for thinking about climate-change-related measures and directs this thinking towards technical questions about the energy-production system. In South Tyrol, changes towards a renewable energy-production system and the so called "KlimaLand" (i.e. the name for South Tyrol's political campaign to become most climate-friendly) are pointing in the same direction. Many climate-related measures profit from specific funding resources and from information systems specialized in the Alps. There is a huge amount of expertise (provided by organizations specialized in the Alps and organizations located in the local metropolitan areas) and a high willingness of political actors to address the necessary questions for a sustainable development in the Alps (this can be seen as a specific, symbolic capital of the Alps).

3. ***Actor networks and new forms of community-building.*** In this dimension, the social capital (networks, routines of self-organization) is decisive. What are the routines of cooperative problem-solving that can be found? A proactive notion of climate-related action is to be observed in communities where existing networks are picking up this theme or where narratives about the future are not highly contested. By contrast, climate-change measures fail when no shared narratives are evolving or no routinized coalitions are supporting the development of such measures. Economic actors are getting active in case of related interests; agriculture and tourism often depend on the conservation and cultivation of landscape conditions. Therefore, businessmen in these areas are often involved in strategies for a further development of the region, and they also face the climate-change issue. External investors with their goal to create crosstown benefits on the ground of local structures are explicitly excluded. Regarding the individual level, it is important to notice that material circumstances (low income, compact settlement structure) are more influential to climate-related behaviour than climate-change awareness or educational levels.

Conclusions: Experimenting with Climate on a Regional Level

The notion of climate change bears a certain significance as a "resourceful idea" (Hulme 2010), but to learn about it, it is crucial to show how the different communities of knowledge are linked and which narratives of communal development can be employed to solve the coordination problem arising from cultural disagreements about climate change. Without such narratives, it is nearly impossible to form a coalition of different actors and to bring together all available knowledge resources necessary for the definition and resolution of climate-related problems. This is why climate change is not a significant theme in itself on the local level: its symbolic character is quite low, for example in contrast to a highly symbolic incident like the meltdown in Fukushima. Therefore, climate change issues are always addressed within the context of other important themes or problems to be solved. In this sense, climate change is both a powerful and fragile concept.

As we observed in the course of our study, the setting of climate-change-related perception, forms of knowledge and structures is multifaceted. Experiences of vulnerability, strategies for enhancing resilience, the strengthening of local strategies for development, environment-friendly forms of action, bottom-up against top-down strategies – these are some of the keywords to describe the situation in respect to communities. Indeed, the notion of climate change often works as a sort of an "add-on" explanation for endeavours to change social structures towards a sustainable development. Nevertheless, much attention is paid to activities to change the social forms of collective experimenting with regard to climate change.

Therefore, the tension between instrumental knowledge and democratic culture seems to be less severe than often assumed. Firstly, in the context of scientific research, it is limited by the combination of different research methodologies, which leads to a contextualization of one's own findings in the research process. Secondly, this tension is not a primary problem in such communities; instead, we find a vital culture to explore options of communal development collectively.

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E-Participation in Local Climate Initiatives

Participants' Assessments of Process and Impacts

Georg Aichholzer

Abstract

The collaborative European "e2democracy" research project has been studying citizen participation in local climate policies, particularly the use and effects of e-participation, in seven cities and regions in Austria, Germany and Spain. Citizen panels collaborated with local governments on CO_2 reduction, including bi-monthly individual consumption monitoring and feedback of CO_2 balances via a carbon calculator for a period of up to two years. The main results are: (1) Panel profiles show significantly higher levels of issue interest and knowledge than those of the local population. (2) Participation enhanced individual empowerment, increased attention to climate-relevant behaviour and climate-friendly behavioural changes in everyday life. (3) Offering media choice in participation is crucial though e-participation is preferred but not more effective.

Introduction

With the growing pressure to find effective responses to the challenge of climate change, various forms of engaging the wider public in climate policies are spreading. Among the earliest approaches were programmes on energy saving targeting individual citizens with information and awareness-raising campaigns (Wilson/Hawkins 2011). Other methods addressing individuals as citizens or customers are social marketing (Barr 2008) and residential feedback programmes (Ehrhardt-Martinez et al. 2010). More recently, the spectrum has been extended towards collective exercises. Examples include citizens' assemblies and consultations at the national level (Carson 2010; Bechtold et al. 2012), deliberative government, industry and community forums at the regional level (Edwards et al. 2008) and low carbon communities at local, sectoral or virtual levels (Heiskanen et al. 2010).

Along with this evolution, the use of information and communication technologies for public engagement in climate governance plays an increasing role. Up until to now, there have only been a few systematic efforts to explore the effects of this support of citizen participation by various electronic means known as electronic or e-participation (e.g. Pratchett et al. 2009; Kubicek et al. 2011). The European collaborative research project, “e2democracy” (environmental electronic democracy), contributes to closing this gap. It has been studying citizen participation in local climate policies, particularly the use and effects of e-participation, in seven cities and regions in Austria, Germany and Spain over two years. This contribution summarizes some of its results with a focus on participant profiles, their views of the participation process and their assessments of impacts.

Local Climate Governance and Citizen Participation

Despite the early coining of the concept “environmental democracy” (Hazen 1997), it is a more recent development that governments are beginning to discover citizen participation, supported by new media, as a specific strategy for climate-change mitigation. Along with pure dialogue processes, collaboration and co-production programmes are becoming popular (Bovaird et al. 2009). Rationales behind citizen participation in climate governance are varied: to mobilize individual motivation and commitment, to overcome social dilemmas through collective action (when individual efforts are perceived as useless unless others participate), to allow for community experience, social learning and individual empowerment, to initiate effective change processes, to unlock new ideas and local knowledge, to rebuild trust in political institutions and to revive democracy.

The Internet has brought an increasing number of new possibilities, which can facilitate participation in climate initiatives, such as instant access to structured information, new forms of communication and interactions, increased flexibility, speed and connectivity. Interactive elements of participation processes (discussion fora, feedback devices, polls, checklists, questionnaires, surveys) can be offered and used more efficiently online. Particular examples are carbon calculators (Aichholzer et al. 2012) and deliberations in fora (Talpin/Wojcik 2010). Increased outreach and speed of communication can reduce transaction costs of mobilization and coordination tasks. Hence, e-participation holds great potential for information sharing, awareness raising and the mobilization of the collective effort in collaborating on climate targets and enhanced problem solving.

Theoretical Background

Sustainable consumption and behaviour change have become the special focus in policy programmes (especially in the UK and USA) and key topics in debates on an effective response to climate change (Warde/Southerton 2012, Jackson 2005). New concepts, such as “sustainable citizenship”, which involves “an understanding of citizenship as a total practice of responsibility between individuals and their political, social, economic and natural environment" (Micheletti/Stolle 2012), reinforce the focus on the individual citizen. At the same time, critical voices warn against the tendency towards a "privatization" of the responsibility for sustainability (Grunwald 2010). In the theoretical underpinning of this discourse, a divide between individualistic and more systemic approaches becomes visible. While approaches of the former type focus on individual responsibility, choice and behaviour change, their critics consider social practices, system transition and wider social change crucial.

From the individualistic perspective, a key to behaviour change is addressing attitudes and values and seeking to reinforce pro- and modify anti-environmental dispositions by information, education and persuasion. Related policy concepts regard awareness raising, information and education campaigns as suitable means. Rational-choice-oriented models see the key in appropriate incentives to stimulate shifts towards pro-environmental behaviours. Social marketing approaches focus on tailor-made strategies for identified segments of the population, aiming at a "mainstreaming" of sustainable lifestyles (cf. Barr 2008). The effects of these policies have been modest, and the changing of lifestyles turned out to be a more complex challenge.

Critics object that behaviour change involves deeply rooted consumption patterns hardened by habits and often constrained by external barriers. The alternative, more systemic approach focuses on "social practices" and intends to recognize the complexity of social change involved in transitions towards sustainability (Shove 2010; Shove et al. 2012). The social-practice perspective claims to open up a more realistic view on social change and the conditions of changing individual behaviour by taking account of the fact that individual behaviours are deeply embedded in social, institutional and material contexts. This implies that climate-friendly or -harming behaviour is also a part of social practices and means that it is not only guided by one's own choice but also by relations to others around us and by established patterns of living and consumption (e.g. conventions of hygiene, of travelling, holidaymaking, etc.). This view throws light on the limits of "consumer sovereignty" and can prove fruitful for pointing out constraints to changing practices as well as, to some extent, ways to make subtle shifts towards climate-friendly elements of social practices.

A perspective that directly addresses the stimulation of behaviour change towards more sustainable practices builds on "gentle nudges" by offering a suitable "choice architecture" (Thaler/Sunstein 2008). The assumption is that it is important to anticipate the context in which people make decisions as well as the nature of decisions and then to offer adequate decision support that influences the choice of actions towards a desired direction, such as towards climate-friendly behaviour. Thaler and Sunstein regard those decisions as the most difficult, which have uncertain or delayed effects, provide little feedback or are ambiguously related to practical experience, a situation typically encountered in the context of energy consumption. Offering information to households on their consumption in previous weeks and on average consumption of energy in the neighbourhood, together with positive and negative emoticons (as the authors did in a study among households in California) showed positive effects but also an unintended "boomerang effect". Households consuming above average decreased their consumption level, but below-average consumers increased their energy use significantly. Overall, the feedback of information and the opportunity for making comparisons seem to have served as a positive nudge. Meta-reviews of studies on the effectiveness of feedback information showed savings of up to 15 % (Ehrhardt-Martinez et al. 2010, Darby 2006).

Research Questions, Research Design and Data Sources

This contribution explores the potential role of citizen participation, e-participation in particular, in achieving climate targets at the local level based on our research in the "e2democracy" project. The key questions are:

- Does participation in citizen panels, combined with eco-feedback, help to change individual attitudes, behaviour and social practices in favour of climate protection?
- What are the impacts in terms of CO_2 reduction?
- Does e-participation (compared to participation with traditional media) make a difference?

Our project allowed us to study a set of similar forms of citizen participation in climate policies at the local government level in seven cities and regions in three countries: the Bregenz and Mariazell regions in Austria; the Bremen, Bremerhaven and Wennigsen regions in Germany and the Zaragoza and Pamplona regions in Spain. Depending on local agendas, the participation processes started at different points in time and took place in the period from spring 2010 until autumn 2012. Common core elements allowed for a quasi-experimental field study and comparative assessment: at each site, the local government, companies and citizens agreed to a target of CO_2 emission levels reduction by at least 2 % per year; the participation format was citizen panels working with local governments on achieving or exceeding this target; the processes lasted between one and two years; a common carbon calculator was used for individual CO_2 balancing as a key tool; participants had free choice of the mode of participation – via traditional means (in person, via mail, telephone etc.) or via e-participation. Before the start, large-scale information measures via local media and kick-off events spread invitations to all citizens and local telephone surveys raised awareness of the participation opportunity.

Three types of interactions constituted the participation process:

1. The provision of information offering guidance on climate-friendly behaviour (regular newsletters, project website etc.)
2. Bimonthly reporting of individual consumption data (via an online carbon calculator generating individual CO_2 balances or via a personal CO_2 household accounts book on

paper with a subsequent reporting via telephone and a calculation and transmission of CO_2 balances by mail, supported by project staff)

3. Various forms of theme-oriented meetings and exchanges (e.g. group meetings with expert talks, group excursions, chats with experts and online fora)

Providing participants with the possibility to individually monitor their energy consumption and get feedback and additional information, as well as opportunities for information exchange over a longer time period, was expected to stimulate informed choices and support climate-friendly behaviour leading to reduced CO_2 emissions.

Data sources include three panel surveys that were conducted at the beginning, in the middle and at the end of the citizen panels' participation period (between spring 2010 and autumn 2012). The first survey had 495 respondents, the second 372 and the third 342. A further essential data source is the participants' CO_2 emissions over time in specific fields of everyday life (energy consumption at home, transport, nutrition etc.) including consolidated CO_2 balances, generated from the online CO_2 calculator.

Main Results

The hypotheses behind the participatory approach were to achieve the reduction of CO_2 emissions by supporting and encouraging an increased awareness of climate-relevant actions and a change to a (more) climate-friendly behaviour. Collective social actions by local communities combined with individual information feedback, including comparison and competition elements, were expected to stimulate joint efforts, increase awareness and reinforce commitments. It was also expected to stimulate issue-oriented exchange and social learning, back individual efforts and empower the citizens to at least partially remove the constraints that block sustainable behaviour - even if it cannot extend to a change in social practices in general. The expectable contribution of e-participation was to increase participation opportunities and reduce participation effort through economizing effects and information advantages.

The first result was that the gap between declared intentions and actual participation in these initiatives, which demand long-term commitments and a continuous, bimonthly input, turned out to be huge. Actual participation was much lower than expected from declarations of intent in preceding local surveys. Of the 1 158 registered participants in the seven panels, only 429 participants provided data up to the last measurement at the end of each panel (until autumn 2012). Participant profiles in these local climate dialogues are skewed towards significantly higher levels of education and older age groups. They also show significantly higher levels of interest in the issue of climate change and its mitigation, of sensitization and issue knowledge and of beliefs in the efficacy of targeted actions. However, not all are "environmentalists"; the majority is constituted by a group that could be called "sensitized", and about one fifth are citizens with only a modest interest in climate issues at the outset.

Overall, a clear majority of the panelists made use of the opportunity to inspect their CO_2 balances, frequently or even after each data entry. A still higher percentage confirmed learning effects, awareness raising and valuable guidance on points for the improvement of their balance. The opportunity to compare one's balance with others (panelists in the same region or country) was of a lesser priority, and only every other panelist ascribed an effort-enhancing effect to it. Community-building effects are clearly observable as the community experience seems to have increased somewhat after one year. A majority of the participants reported that the collective process alleviated barriers encountered at an individual level and that it strengthened individual efforts to change climate-related habits.

The hypothesis that the design of the participation process with its potential for community building and mutual learning, together with individual information feedback, monitoring and comparison of consumption effects, would stimulate and enforce climate-friendly practices is only partly confirmed. A regular provision of information and feedback to citizens over a longer period of time, based on their individual consumption data, encourages and reinforces responsible behaviour in favour of reduced CO_2 emissions. This tends to induce informed choices among the participants in some relevant areas. When it comes to impacts in terms of an increased awareness of climate effects, changes of behaviour and CO_2 balance, a different picture emerges. A substantial percentage of the participants shows an increased sensitization and reports behavioural changes in certain areas of consumption induced by the participation process. However, these concerned the more "low-hanging fruits" of home and heating whereas some activities causing higher CO_2 emissions, including high impact cases, such as air travel, largely persist.

Validating changes based on subjective assessments by hard data on CO_2 reductions turned out to be difficult. On the individual level, a majority of the participants improved their CO_2 balances and achieved at least a 2 % reduction per year in six of the seven cities. Viewing the collective level, i.e. the overall CO_2 balance of each local panel, tends to show a less positive picture. The panels in five locations showed a CO_2 reduction that achieved or nearly achieved the target, whereas two showed no improvement or even deterioration. Possible explanations for these differences are variations in contextual factors, such as the amount of care devoted to the participation process. On the other hand, high impact activities like air travel can play a decisive role, so that individual improvements among the majority of the participants combined with the opposite trend occurring in the rest of the panel can produce a negative collective balance.

The e-participation option increases participation readiness (around two thirds of the participants are "onliners"). Hence, the most important effect of the e-participation opportunity is to extend the participation rate. However, e-participation is not a panacea as onliners did not differ from offliners in terms of the effects achieved.

Conclusions

Participation approaches in combination with individual eco-feedback can foster sustainable behaviour and local climate protection. Prospects for achieving targeted impacts on CO_2 balances are more mixed, more difficult to ascertain and dependent on supportive context factors.

Participation initiatives especially attract population sections with higher issue awareness and “sustainable citizenship“, less easily “mainstream“ sections. Free choice of participation media and offering a combination of traditional and electronic communication channels is important, even though the majority prefers e-participation.

Major challenges are: widening and deepening participation, measuring and validating material impacts with control-group data, achieving impact on social practices and policies. To extend information-centered participation towards more space for deliberative and consultative interactions between citizens and local governments seems to be crucial in this respect.

Some options for CO_2 reduction are one-off activities, such as changing the electricity provider and switching to green electricity or installing new heating equipment, while others require changes of long-established consumption patterns that are hardened by habits and often constrained by external barriers. Information provided on the basis of a rational-choice model obviously does not provide an effective framework for an answer to the question of how to change such patterns and institutional constraints. Hence, the Thaler-Sunstein hypothesis of “Information saves energy” seems of limited validity. Efforts to change individual behaviour needs to come to terms with the fact that it is deeply embedded in social, institutional and material contexts and changes occur as a part of social practices. How these can be influenced, how they can be accounted for by different participation formats and how the methodological constraints and validity problems of CO_2 calculation can be overcome are issues that require further research.

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Project-Shaped Participation

Engaging the Public in New and Emerging Technologies

Alexander Bogner

Abstract

In recent times, the introduction of new technologies has been accompanied by an increasing number of participatory and dialogue events. As science and technology become ever more interwoven, these events focus on 'upstream' technology development ('technoscience'). As a consequence, issues to be discussed in participatory events get highly abstract and practical applications become hypothetical at best. Against this background, participatory technology assessment faces three main challenges: exclusion, streamlining of the discourse and hyping. This article discusses implications of and possible solutions for these challenges.

Introduction

What are the current trends in participation in the field of new and emerging technologies? How does the fact that new and emerging technologies are rarely subject to public debate affect the idea, the practice and the role of participation?

When talking about participation in a new and emerging technology, this implies a focus on a special kind of participation. In the following, we are not dealing with user involvement in the development or improvement of technologies, often referred to as open innovation (see von Hippel 2005). Rather, we are dealing with lay people's involvement in the process of Technology Assessment (TA) at an early stage, which raises several challenges for TA (Bogner 2012).

The case of synthetic biology can serve as an example: by initiating public dialogues or citizen conferences, people are invited to discuss ethical and social implications; however, since concrete applications of synthetic biology are missing at the moment, people are not expected to contribute to a specific innovation. So, participation takes place under special conditions, changing the nature of public engagement and challenging profoundly the role of participation in TA.

This observation is the starting point of my presentation: in the context of new and emerging technologies, the form and role of participation changes profoundly. Since it involves important challenges for TA, my main aim to sensitize for this change, to illustrate what lies behind and what results from it.

Technoscience and Upstream Engagement

First of all, we have to recognize that talking about new and emerging technologies implies talking about a new socio-technical constellation. This is mirrored in the notion of 'technoscience', which new and emerging technologies are often debated under ever since Bruno Latour popularized the term (Latour 1987).

Critical STS scholars characterized technoscience as a new era in which science is dominated by technology; science, in this view, is no longer legitimized through the pure gain of knowledge alone. Rather, its applicability and its innovation potential provide legitimation (Forman 2007; Nordmann 2011). In other words: science has to be legitimized with respect to societal values and expectations – seeking the truth is not enough any more.

In a broader sense, the term 'technoscience' implies that technology development does not follow basic research in a linear way; rather, principles of feasibility and marketability already influence basic research. Fundamental decisions on applications are taken early during research, possibly deciding the fate of a technology for good. STS scholars have therefore emphasized the progressive entanglement of basic research and technological development.

With a view to participation, this means that participation has to set in at an early stage – in order to influence technology development effectively. In other words, interpreting modern science as technoscience resulted in the quest for moving participation 'upstream'. This has become particularly evident with nanotechnology. As soon as nanotechnology appeared on the agenda, scholars, such as Wilsdon and Willis (2004), argued for upstream engagement.

The central idea was to intensify public involvement through a stimulated dialogue much earlier than previously. From 2000 on, a series of public engagement events on nanotechnology took place in several countries. However, moving upstream public participation to an early phase of science and technology development entails some problems. It sets in at a point in time where there is no cause for public controversies; there are no concrete applications that could trigger citizens' concerns or stimulate public imagination (Gaskell et al. 2005). Consequently, the public tend to be little interested.

A paradoxical situation emerges: when a field of science and technology is new and decision-making agendas are relatively open to influences from the public, the public's interest in engaging with these issues is low. The consequence is that lay people need to be actively interested and motivated to participate.

Project-Shaped Participation

In the age of innovation, public engagement is strongly encouraged for good reasons. However, due to the abstractness or the virtual character of the emerging technologies at stake, participation has to be actively organized from outside – depending on external resources. In other words, such participation often takes the form of a project aiming at bringing people into a dialogue on technoscientific issues at an early stage. We call this new setting project-shaped participation (PSP). PSP means:

- Public dialogues and engagement procedures are initiated and organized by professional participation specialists, often from the field of TA.
- Participation often takes the form of a project funded by a third party (external funding agencies).
- Participation takes place largely without reference to existing public controversies, actual demands for participation or explicit individual concerns. Its role and function(s) are unclear to a large extent.

You may argue that we have already seen this new kind of participation experiments or projects in the late 1980s. And, in fact, the first citizen conferences were organized in the wake of the GM conflict and other technology controversies (Joss/Bellucci 2002). Since then, a variety of participatory methods developed into what we call today Participatory Technology Assessment (PTA).

Obviously, there is an important difference between PTA and PSP: PTA emerged against the background of public controversies and partly violent conflicts. PTA was expected to contribute constructively to finding political solutions in cases of manifest conflicts. PSP, in contrast, mostly aims at bringing people into a dialogue at an early stage (‘upstream’). PTA was to channel open protest against technology, PSP is to raise people’s interest in new technologies.

In past technology controversies, there was no need to invite people because they organized themselves; the protests sometimes took militant forms as we have seen in the struggles over nuclear power plants in Germany and elsewhere (Radkau 1995).

In our times, info trucks instead of police cars enter the scene. Information is literally driven to the public to make people debate the chances and risks of emerging technologies. With a view to nanotechnology, for example, the German Ministry of Education and Research has launched a public-dialogue initiative by sending out a rolling communication centre (‘Nano Truck’) that visits up to 100 cities a year across the whole of Germany (www.nanotruck.de/en/home.html).

Today, participation on technology issues is no longer protest-shaped but project-shaped. Let’s take the citizen conference as a prominent example again. Today, this procedure primarily aims at interesting lay people in technology issues and stimulating a public debate. In 2006, we saw the first transnational experiment in engaging lay citizens (‘Meeting of

Minds'). In several meetings, 130 people from 9 EU member states discussed ethical and social aspects of modern neuroscience (Boussaguet/Dehousse 2009). On a global level, the first participation experiment took place in 2009, in preparation of the Copenhagen Climate Summit. Organized by the Danish Board of Technology (Rask et al. 2011), 4400 people from 38 countries from all over the world discussed the implication of climate change and related policy options in 44 citizen conferences (http://globalwarming.wwviews.org/node/259.html). In 2012, a second global citizen deliberation followed, this time dealing with biodiversity.

Challenges for TA

If participation gets project-shaped, TA institutions – as a central actor in initiating and organizing participatory events – face several challenges. First of all, if denoted a project, the procedure has limitations in the following areas: time (i.e. a defined beginning and end), issue (i.e. a clear task definition) and social reach (i.e. discussing the problem among a defined range of participants). In addition, the organizational setting of PSPs often creates an experimental situation. Participants are surrounded by scientific observers and microphones. Organizers as well as evaluation teams gaze at the lay citizens and keep analysing how the citizens master their tasks.

Since I am a scientific observer as well, I will discuss several challenges PSP is facing today, based on several case studies carried out in several research projects (Bogner 2012). With special regard to TA, the key challenges encompass three aspects called a) exclusion, b) framing and c) hyping.

a) Exclusion: Dialogue and deliberation among citizens result in the exclusion of certain participants.

In the course of PSP deliberation, norms become established that lead to the exclusion of those participants who cannot, or do not, want to fit in with those norms (see also Young 2000). Often the number of participants decreases significantly over time. Among those who drop out are people who often hold extreme or exotic views. They are afraid of becoming complete outsiders within their group. This is one of the most obvious problems we have to deal with in TA. This problem has been addressed frequently.

b) Framing: The citizens' deliberation process results in a streamlining of the discourse.

As a rule, PSP events deal with new and emerging technologies, i.e. issues that lack an established perspective they can be debated under. Synthetic biology or cognitive enhancement are relevant topics today but not debatable as such or as a whole. Such abstract issues need to be made interesting and debatable to a lay audience. In other words, any upstream debate needs a dominant frame that determines which aspects are relevant (for example risk or ethical aspects) and which arguments are legitimate (Nisbet 2010).

Such frames tend to be based on previous debates over other technologies (Torgersen/ Schmidt 2013). Relying on past technology debates means to restrict the actual debate to well-known aspects, structuring it along the typical ethical, legal and social aspects previous expert panels already raised on other technologies. The danger is, in other words, that the lay people's discourse becomes mainstreamed (or streamlined or narrowed).

This effect can be observed empirically in the course of a PSP. In PSP events, the lay people's exchanges, even though initially covering a broad range of aspects, become increasingly focused on the experts' discourse. Lay expertise becomes a copy of expert expertise, failing to open-up the discourse by introducing new aspects. This is paradoxical in some sense: the successful involvement of laypeople results in a mainstreaming of the discourse. This problem has not always been addressed sufficiently.

c) Hyping: TA has to elicit public attention while resisting the hype.

From our observations of participation becoming project-shaped, an additional challenge for TA arises: if nobody is interested in participating, the TA organizers have to mobilize. Thus, it becomes especially important to raise public attention. Frans Brom, the director of the TA department at the Rathenau Institute, says:

"For getting attention, a perspective needs to be formulated that can be disputed. In order to stimulate social debate and formation of political judgements, we need to evoke objections and, at the same time, remain scientifically and socially reliable." (Brom 2009, p. 1)

This statement formulates the basic problem of TA. On the one hand, TA has to address technology issues in a polarizing and controversial manner to stimulate a public debate. TA has to dramatize the issue at stake using utopian imaginaries and exaggerated expectations (positive or negative). On the other hand, TA is dedicated to providing a scientifically sound basis for technology policy and contributing to a rationalization of the discourse over technology.

To foster public engagement without uncritically echoing the hype – this constitutes a central challenge for TA in the era of PSP.

Conclusions

The term PSP was coined to capture a somewhat irritating situation: the increasing demand for involving citizens in technology-assessment processes meets little interest 'from below', which has unintended consequences. I mentioned the exclusion of people involved and the mainstreaming of discourse.

With a view to emerging technologies, the impact on the discourse caused by providing certain frames for citizen deliberation must be considered carefully. We have to rely on frames to make new technologies debatable, but the introduction of frames determines the image and the imagined future of a technology. This calls for a careful dealing with the framing issue when organizing PSP events. Perhaps the participants should already debate the way they themselves prefer to frame the issue at stake. Possibly, this will lead away from traditional TA involving well-informed (or expert-instructed) lay people to more experimental forms of addressing options and expectations.

That said, and despite the challenges mentioned, we should not underestimate the usefulness of lay people's involvement in TA. However, the participation must not be an end in itself. We need to better assess its precise role in each case, especially when it comes to new and emerging technologies.

To do so, we could use a twofold approach. On a theoretical level, possible roles of participation could be determined with regard to different strands of the theory of democracy. This could lead to theoretically founded expectations of benefits. On an empirical level, we could analyse interaction processes taking place in PSP. This would reveal the participants' worldviews and motives underlying the concrete outcomes. This may provide better clues with regard to their properties and performances.

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What Can TA Learn from 'the People'

A Case Study of the German Citizens' Dialogues on Future Technologies

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Abstract

The Citizens Dialogues on Future Technologies (CDFT) marked a certain 'participatory turn' in Germany. Here, we take a closer look at the CDFT, their methodology, their topics and what such a large participatory process may entail for technology assessment (TA). Throughout the CDFT, different topics showed interesting changes in how the participants discussed and handled themes and how this, at times, diverged from the initiating ministry's foci. For TA, participation processes, such as the CDFT, can be important practices for gaining insights into transdisciplinary knowledge through a 'dialogue of many'.

Introduction

Since the mid-1960s, political sociologists have observed a 'participatory revolution' or 'participatory turn' (Joss 1999, Abels 2007, Jasanoff 2003). Demands for a greater public involvement in decision-making regarding science and technology policy, such as issues concerning urban planning, waste management, environmental policy or health risks, have arisen. Another indication of this trend has been the conceptual debate on citizen involvement in the field of TA since the 1990s. As many sciences and technologies have far-reaching and direct consequences for society, many organizations have begun to put theoretical considerations into practice and are active in developing participatory methods of TA (pTA), such as the Danish consensus conferences (Danish Board of Technology 2006). Simultaneously, the public criticizes the role of the so-called experts in advising decision-making, as it seems they disregard viewpoints and interests other than their own (Joss 1998, p. 3). Therefore, there is a "difficulty in trying to obtain balanced and meaningful information" (ibid.)

Against this background, it "was very important for proper democratic debate and decision-making that politicians, the public and the media are presented with the whole spectrum of viewpoints" (ibid.). As a result, politics that argue for public participation in policy-making and planning processes, e.g. public hearings on tunnels or wind turbines, have been manifested as this inclusion of affected people is connected with the hope of producing better and more robust policies.

A growing demand for more direct democracy, participation and involvement in decision-making in the political sphere can also be seen as a trend in all of Europe – e.g. numerous funding calls and strategic documents of political institutions explicitly require the integration of citizens and stakeholders (e.g. Irwin 2006, Bogner 2012).

Within this much-described 'hype' of participation we would like to focus on the question of what TA can essentially learn from 'the people'. Do the citizens enrich the base for the decision-makers with regard to issues of science and technology, do citizens' statement alter the foci of 'the experts' and therefore offer added 'value' to the perspectives and decisions regarding technology and society? To approach these questions, we exemplify the large-scale participation process, "Citizens' Dialogues on Future Technologies" (CDFT, "Bürgerdialoge Zukunftstechnologien"), initiated by the German Federal Ministry of Education and Research (BMBF) and depict first insights and thoughts for further in-depth analysis. The project was organized by a consortium mainly made up of the consultancy IFOK, the Institute for Technology Assessment and Systems Analysis (KIT-ITAS) and the Center for Interdisciplinary Risk and Innovation Studies (ZIRIUS).

Three Dialogues – Three Topics

Starting in mid-2010, the CDFT aimed to incorporate the perspectives of citizens regarding future technologies. What was unique, at least for Germany, was that the initiating organization was a federal ministry that not just commissioned the process to an external organization but remained in an active leading role, keeping its organizational and political responsibilities. It was hoped that this would enhance the possibility of the results feeding into the actual policy-making process. Most importantly, the CDFT offered the involved citizens the opportunity to formulate concrete recommendations for science and policy and thereby shape the 'handling' of future technologies. In total, three rounds, each with different topics, were carried out. Apart from the active role of the ministry, other unique aspects were the high budget, the dimension and extent of the Dialogues and the scientific evaluation of the whole process parallel to the methodology development.

The Dialogues themselves dealt with topics that posed certain methodological challenges – they related to future (technological) issues, were part of a specific context and were problem-oriented. In the aftermath of Fukushima, Germany's highly discussed withdrawal from nuclear energy and the accompanied fundamental changes and transitions in energy production were subject of the first eight Regional Dialogues. These took place from July to November of 2011 with the goal of discussing and developing approaches to solve energy questions formulated by the ministry regarding energy efficiency, renewable energy, energy grids and bridging technologies. In the next round, the Citizens' Dialogues took on the topic of high-tech medicine with a focus on telemedicine, neuronal implants as well as palliative medicine and intensive care. These topics were again framed by the ministry itself. For each of these three topics, two Regional Dialogues took place. A total of six regional dialogues were conducted from September to October of 2011. The last Dialogue round from fall of 2012 to February 2013 focused on the challenges of demographic change with its repercussions in fields like working environment, education and lifelong learning, as well as social aspects.

The Dialogue Concept: Participation 'Big Style'

The process itself was designed by the CDFT consortium in accordance with a generic model for dialogues (Decker/Fleischer 2012). In the first phase, the contextual basis and socially relevant themes were identified and reflected using the method of focus groups (e.g. Barbour 2007) and online opinions. On the basis of these outcomes, an impulse paper provided information for participants regarding the thematic spectrum, potential key issue areas, relevance and citizen approachability. This paper served as the basis for a more detailed discussion during the Regional Dialogues, which can be methodologically compared to "21st Century Town Hall Meetings" (Lukensmeyer/Brigham 2002).

All three topics were discussed in six to eight Regional Dialogues all throughout Germany with around 100 participants each.[1] Each Regional Dialogue followed the same sequence: in the first discussion-round, the citizens' concerns and expectations were documented and a second round was made up of developing more concrete approaches and policy recommendations for dealing with and solving the issues articulated. The goal of each Regional Dialogue was to put together a report with initial recommendations, which was then given to a representative of the ministry. Additionally, an accompanying online dialogue where citizens could comment on the topics and statements of the Regional Dialogues took place.

The third and final phase of each Dialogue round was a two-day-long Citizens' Summit. Here delegated participants of the Regional Dialogues were able to develop concrete recommendations regarding science, economy, politics and society and write a final summarizing citizens' report, which was officially passed on to the federal minister.

The entire process was accompanied by an advisory board made up of representatives of research, science, the economy and civil society, including relevant ministries. The board members and selected participating citizens were able to comment on the documents produced at the end of each phase. The board itself had several roles within the CDFT process. Besides discussions and reflections of the resulting documents, members of the board were present during the Regional Dialogues and final Summit to offer their expertise to the participants. Moreover, dissimilating the results of the Citizen's Dialogues within their communities and networks was an important role for the experts, thus carrying the results of the CDFT into organizations in the fields of science, economics, politics and society.

The project also included an element of self-reflection as the entire process was evaluated in a scientific manner. The evaluation included, inter alia, participant surveys, the observation of participants at various events and structured interviews with the moderators, participants and members of the advisory board. Findings of the evaluation were often discussed directly within the consortium in order to adjust and improve the methodology during the process itself.

Thematic Frame and Handling of the Topics

A first interpretative look at the Dialogues shows several overarching themes, specifically for energy and high-tech medicine, that differ substantially from the topics 'assigned' by the ministry. Participants of the Energy Dialogues were concerned with the decentralization of energy production, which was seen as a possibility to strengthen the regional participation of citizens and municipalities by helping them become more independent from large energy companies. Furthermore, participants stated that the political framework in the form of taxes, research funds and new laws was an important tool for encouraging energy efficiency, development of new technologies and education of the public. Overall, offering advice and guidance to citizens was seen as the main job of the government. The necessity of large investments in research for the improvement and development of technologies and economic aspects regarding the importance of supporting the enlargement of highly qualified people were also discussed.

During the High-Tech Medicine Dialogues, the three different topic areas (neuronal implants, telemedicine and palliative medicine and intensive care), which were specified beforehand by the ministry, characterized many discussions. Yet, similarly to the Energy Dialogues, certain overarching themes could be distinguished. Data privacy, informed self-determination, equality with regard to access to new technologies as well as assistance and human care in connection to the role of technology were the main themes of all the Dialogues.

The Dialogue on demographic change was thematically somewhat different than the others. The ministry decided to change the strict technological frame to include more general social aspects. The Science Year 2013 "The Demographic Chance",[2] which was also conducted by the same ministry, also framed the Dialogues. The three different thematic foci (working world, living together and education) did not highlight the technological aspects of demographic change (i.e. care providing robotic systems, telemonitoring, etc.), but concentrated on more 'everyday' aspects. The outcomes of these Dialogues also show certain over-arching topics. These included, for example, exchanges and collaborations between young and elderly people regarding all three of the aspects (working world, living together and education), e.g. integration of more experienced older employees in the workplace. Other aspects included support for families and assisting the integration of immigrants and individuals with a migration background in schools, workplace and society in general. Even though these wider topics were identified by the evaluating team when clustering the outcomes of the regional Dialogues, the ministry decided to stick to the original frame. This meant that topics such as collaborations between young and elderly people were discussed in each of the single frames, which proved to be difficult to discuss for the participants of the Citizens' Summit.

As described above, the CDFT rounds all had fairly similar methodological structures; main building blocks were the Regional Dialogues and the final Citizens' Summits. Yet the topics differed substantially from one another. Therefore, looking at the way the participants based their arguments and how the discussions were conducted can show interesting differences between the three topics. For the Energy Dialogues, the citizens often chose a more general societal frame to base their arguments on. Topics like decentralization or governmental responsibilities were dominant during the discussions, making the problems society faces as a whole the center of attention. In contrast, the high-tech medicine discussions were characterized by more individual perspectives. Here, participants often referred to their personal situation with experiences that 'legitimized' their arguments (such as sicknesses). Even though health care in general and the fear of a two-class system played a role, the main focus was on providing people with the ability to make their own informed choices. After these two Dialogue rounds, it already became clear that citizens often reframe and contextualize their arguments and statements. This was also the case in the Dialogues on demographic change. Without the strict thematic technology focus of the other dialogues, they were marked by citizens who often saw themselves as experts and therefore able to legitimize their arguments through their own experiences. Many participants were engaged in voluntary work and therefore had insights into projects and initiatives dealing with aspects of demographic change, which made this topic feel 'close to home' for many. The focus here was on individual as well as on wider societal problems and themes in the context of demographic change.

Conclusions

This general interpretative analysis shows that several overarching themes in the Dialogues differ considerably from the topics 'assigned' by the ministry. We could observe this multiple times, e.g. during the Energy Dialogues where citizens' preferred to discuss the decentralization of energy production instead of "bridging technologies". In retrospect, the citizen live up to the role they are assigned by the ministry, but in the role of 'everyday experts', their judgment and framing of topics does not always conform to political rationality. Thus, this effect should be considered when planning and benchmarking lay participation and should be reflected with regard to the expectations of their outcomes. Nevertheless, the CDFT was a 'real' dialogue in the sense that one dialogue partner (ministry) set the frame and the other partner (citizens) was able to 'answer' and reframe, giving the 'conversation' a new direction.

Apart from these contextual findings, the Dialogues are also an interesting format for pTA. Compared to other, usually much smaller, participation approaches, they gave a relatively large number of citizens the opportunity to take on an active role in the societal discussions on new technologies and the framing of possible policy decisions. Furthermore, the Dialogues had a qualitative level; going beyond, for example, referendums and enabling an understanding of citizens' narratives regarding new technologies. Yet it can be assumed that the strong focus on consensus-reaching during the Citizens' Dialogues and the fixed thematic framework given by the ministry constrained the outcome to a certain degree, which would have to be examined further.

In the context of TA, these formats can support a certain 'sensitivity' of TA researchers and decision-makers with regard to issues important to the public and the potential integration of these into wider policy-making by providing insights into normative frameworks, values and interests of citizens. Political consulting and public engagement go beyond simply assessing citizens' perceptions or hopes and fears (e.g. Wynne 2006). They include the creation of new forms of participation that influence the development of policies in certain ways (ideally decided upon beforehand), which, of course, is not an easy task. This is grounded in the understanding that new technological developments are shaped socially and do not just occur linearly in a separate sphere, which also shows in the different expectations of actors with regard to the outcome and the impact of formats, such as the Citizens' Dialogues. The participants themselves want to be taken seriously with regard to their recommendations and assessments. The actors from the political and scientific side often do not regard citizens as 'fit' to answer highly complex questions and are unsure as to what the participants' role is, which results in difficulties when transferring the results into political and professional fields and coordinating these with actual policy decisions. It remains to be seen to what extent and in what form the suggestions, ideas and concerns articulated in the citizens' dialogues will actually influence political, economic and social decision makers, thus having some kind of impact and becoming more than mere 'engagement exercises'.

Nevertheless, including the public (i.e. social groups, stakeholders or laypeople) in the process of assessing and evaluating (future) technologies is an integral part of TA. The argument could be made that through participation, different kinds of (transdiciplinary) knowledge can become a part of the assessment process. During the Citizens' Dialogues, it could be observed that citizens often applied complex technological developments to their own specific social background and context. The incorporation of this can enable a transdisciplinary approach to include the 'dialogue of many' for more networked and inter-related knowledge regarding TA.

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What Can TA Learn from Patient Narratives

Using Narrative Methodology to Assess the Role of Patients in Dutch Hospitals

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Abstract

Using narrative methodology, we assess the feasibility of the active and independent patient, an image portrayed in Dutch government papers and contested by patient organizations, medical occupational groups and political parties. 109 stories about hospital care from 103 patients were collected online. Storyline analysis resulted in nine experience types that describe prototypical situations in which patients find themselves in the hospital. These nine types offer a rich picture of patient perspectives on quality and safety of hospital care. Being in the hospital creates a tension for the patient. On the one hand, many patients are scared and become silent. On the other hand, many patients feel the need to speak out, and to be involved in their own care trajectory. We argue that this tension cannot be taken away, as it is a part of being a patient in a hospital. Instead, we propose that the hospital system should be designed in such a way that sensitivity for this tension is taken into account. Patient narratives could be fruitfully deployed for this purpose. Our study shows that narrative research is a promising method for TA as it offers a tool for identifying contextualised dilemma's experienced by stakeholders and users of large socio-technical systems.

Introduction

Changing role of patients – towards an independent and active patient in Dutch healthcare

Dutch patients have become more independent and active. That is, at least, how patients are often portrayed in Dutch governmental papers. Patients have gained more say in the health-care system with the effectuation of the Medical Treatment Contracts Act (WGBO) in 1996. This law has given patients the right to actively take part in decisions concerning their own illness and treatments by means of informed consent, accompanied by official complaint procedures. In an environment of marketization, ever-increasing care budgets and the long-standing political wish to control health expenditures while maintaining quality, an active and independent patient has become the key solution to many problems in health care, at least rhetorically. At the same time, the image of the active and independent patient has been criticized by Dutch patient organizations, medical occupational groups and some political parties because such a patient does not exist. This tension raises the question of how real this independent patient is.

In this project, we explore a novel method of Technology Assessment which is derived from the field of narrative health research (Sools 2012; Murray & Sools in press). In this article, we explore how this methodology can enhance TA, mainly to assess the feasibility of the active and independent patient. We use the hospital as the location for investigation. The hospital as the complex socio-technical system is characterized by a highly hierarchical structure in which the patient has the lowest rank. We use narrative methodology to explore the perspective of the patient as one of the users of this complex system. The research questions in this article is: How feasible is the independent, active patient in hospital care, viewed from patient perspectives?

The Narrative Method

In our online study, we used a mixed-method design consisting of a qualitative part (online written narratives and focus groups) and a quantitive part (questionnaire).

Data Collection

We collected written patient narratives on hospital care by means of a website. We used the format of a written letter with a heading, an addressee and a sender to collect the experiences. The letters could be between 200 and 2 000 words. Furthermore, we asked the patients to formulate a wish at the end and to propose a solution for how to make this wish come true.

This limited pre-structuring of the form enabled easier processing and comparing of large quantities of letters while retaining the exploratory, open nature of the content of the stories. Openness to the patient perspective and their own words is a central feature of narrative research. After posting the story, participants were asked to answer a few questions related to the interpretation of the story, for instance if they felt it was a positive, ambivalent or negative experience and for what reasons. This was done to gain insight into the themes that were important to participants while in the hospital and to identify the main lessons to be learned from their perspective. This was used to find out what issues contribute to good or bad hospital care for patients. Furthermore, to see how representative the stories were of the general population, we asked some background questions related to the writer: about the kind of their illness, the length of their stay, the location and type of the hospital and socio-economic variables such as gender, age, educational level and income of the writer.

We chose an online tool for its known advantages, such as easy accessibility and availability for anyone with access to the Internet. The threshold to participate was lowered not only with regard to location but also temporally because participants can choose their own best moment to write the story. Moreover, physical presence is no longer necessary, and the Internet provides a high degree of anonymity (Gerhards et al.2011). The downsides are that the method of written narratives selects people who feel capable of writing and people with access to computers and the Internet.

In order to engage patients to share their stories, we drew attention to our website in several ways. First, we contacted over a 100 Dutch patients organizations with information about the project and asked them to spread the information about the project. Many responded to our request by placing some information on their website or in their paper magazines. We contacted all 109 Dutch hospitals and asked them to place posters and flyers. About one third of the hospitals replied positively and received posters and flyers. We engaged the ambassadors of the project – a group of ex-political representatives, doctors and patients – to help bring the project to public attention. Furthermore, we posted banners on online medical and health fora and posted calls to participate in the project on more than 100 of these websites. We placed some ads and advertorials in free local and national newspapers. By these means we tried to reach both patients who were already active on Internet fora and in patient organizations as well as patients who were not.

Over the course of one year we received 109 narratives by 103 unique authors. Writers of the stories were a heterogeneous group of varying gender, age, education level, income and experience with hospital care. We received more stories from female writers (77 %), from people with a higher education (53 %) and native Dutch writers (94 %). We received a comparable amount of exclusively positive (25 %) and negative stories (26 %). However, most stories (43 %) were classified as ambivalent, containing both positive and negative elements. A minority of the stories (6 %) were classified as neutral. Experiences addressed both academic (24%) and local hospitals (73 %) or both (3 %) and covered much of the Netherlands and described more than 50 different illnesses. The majority of the stories (64 %) concerned a longer stay in the hospital, other stories concerned visits to outpatient clinics (36 %). In most stories, the patient was also the writer (76 %), but a minority of the stories were written by a family member or a friend of the main character (the patient) in the story (24 %).

Narrative Analysis

We analysed the narratives in two different ways: 1) storyline analysis of the patient experience of the hospital system, their perception of the patient role, and patients' reflections on good and bad quality of care, and 2) thematic analysis of tensions in these storylines.

Storyline analysis is a narrative method of analysis based on the pentad (Burke 1969; Bruner 1990; Sools 2010) consisting of five interconnected elements which together form a storyline: 1) The setting or location of the story, 2) the Agent, 3) the acts or events, 4) the goals or intentions and 5) the means or helpers. The storyline is defined by a tension that is generated by a deviation from the expected order of things. First, thirty narratives were analysed in an iterative process combining in-depth analysis of single stories and broad analysis of all stories in order to find patterns of differences and similarities in the stories. This resulted in nine experience types, which have been checked intersubjectively by the research team. These nine types were subsequently used as an analytical framework for the remainder of the collected stories and refined and adjusted accordingly. Eventually, nine well-described experience types remained that captured the diversity of the whole sample. These were then summarised in four themes, which each indicate a particular dilemma or tension related to our research question regarding the feasibility of the active and independent patient.

Results

Nine types of stories

The storyline analysis resulted in nine experience types that described prototypical situations in which patients found themselves in hospitals. These were:

1. *'The patient wants to be involved as 'co-professional', seeks recognition of medical expertise within the setting of the hospital.'* This type of story can be understood as a negotiation of the boundaries of the patients' expert role. It calls attention to ambivalence and dilemmas of acting out the expert role for patients.
2. *'The attentive and articulate patient is forced to act as guard or "Centre" of good care.'* In contrast to storytype one, patients are endowed with a larger and different role than desired. In this storytype, patients are forced to pay attention and alert caregivers on errors in a situation of sub-optimal care, which arises as a result of failing cooperation and communication between caregivers and between hospital departments.
3. *'The patient who listens to his/her body indicates that something is not right, but "vague complaint" is not taken seriously.'* This storytype draws attention to the role of embodied knowledge, and whether this knowledge is considered a viable source for medical diagnosis and treatment, or subjected to objective scientific validation. How health care professionals take body signals into account, is not only a medical matter, but as these stories show also of consequence for patient autonomy.
4. *'Patient with initial trust in healthcare feels powerless to counteract failing care.'* Storytype four can be regarded as a from-bad-to-worse story in which initial patient trust in the hospital turns into distrust and despair. This storytype focuses on how (failing) quality of care at an earlier stage influences trust in hospital safety in later stages.
5. *'The patient who is not well informed about what awaits her, dares say nothing of the unpleasant treatment.'* This storytype locates what, how, when, where and by

whom patients need to be informed. The story draws attention to possible differences in perception between health care providers and patients about what counts as (un) wanted intimacy.

6. *'The medical ignorant patient wants to be informed in an involved manner, to let fear and uncertainty decrease.'* Similar to type five this storytype locates patients' need to be informed. Specific to type six is the need for information in a situation where the patient feels left to his fate by the doctor who sees him/her primarily as an interesting object of study. Another similarity between type 5 and 6 is that both stories warn of objectifying the patient instead of attending to their personal concerns, fears and desires.
7. *'The patient who expects "extra care": healing and practical support from A to Z.'* Central to this storytype is the negotiation of what is considered standard care and what counts as additional care. What can patients reasonably expect and who decides what is standard care and what not?
8. *'The patient who is prepared for the worst, has and unexpected positive experience.'* This storytype is the mirror of storytype 4 in the sense that now the patient has low expectations of the hospital and in fact fears the worse. When, unexpectedly, the hospital visit turns into a positive experience, this could result in increased trust in the hospital system. This storytype shows that good care can make a difference.
9. *'The patient with serious illness experiences uncertainty and despair about life due to illness.'* This final storytype calls attention to the way in which medical interventions also have social consequences and psychological effects on patients. This storytype calls for attending to patients existential questions in the context of healthcare.

Four Themes

To understand what we can learn from personal stories about the feasibility of the active and independent patient in hospital care, we identified the following four themes.

1. *Insecurity or anxiety in an unfamiliar situation.* This theme challenges the notion of the patient as an independent, active consumer or citizen in a healthy situation. Illness, disease or an acute admission to a hospital causes people to feel insecure and anxious or frightened. This can be caused by pain, the fear of (possible) death or physical weakening or the unknown prospect of living with an illness. In many stories, people first dealt with the anxiety and insecurity caused by a diagnosis or their hospitalization and then with other elements of visiting the hospital. Considerations of the active and independent role of patients should take this unfamiliar situation into account, instead of assessing patients and their capacities to act independently and actively in a decontextualized fashion.
2. *Appreciating the active independent patient, a challenge?* In contrast to theme 1, we have learned from the stories that there also are many patients who indeed want to

play an active part in their own care trajectory. Patients want this for several reasons: because they feel jointly responsible, because they have a great amount of knowledge concerning their illness or because they feel they cannot leave the responsibility for good care to the hospital and are afraid of mistakes. Others see a lack of efficiency or wastage and want to report it. Many patients feel that active involvement is not always appreciated by caregivers.

3. *(Dis)empowered by the hospital.* Many patients feel disempowered in a hospital – even people who, under normal circumstances, feel empowered – the hospital system facilitates this feeling. Patients experience that they are badly informed about procedures, diagnosis or treatment. Patients feel doctors and nurses have little time and empathy for their emotions and feelings. In some stories, patients who expressed complaints were simply ignored. Patients subsequently did not communicate this out of fear of being seen as troublesome .

4. *Unknown expectations.* Patients' expectations of hospital care do not always match the reality of hospitals. Some people enter hospitals with low expectancies and are positively surprised. In other cases, the care does not live up to expectations, which might result in a bad experience or even complaints. Health care professionals also have, often implicit, expectations of patients. Patients and healthcare professionals' expectations often do not match. This may contribute to positive, but more often to negative patient experience.

Conclusions

Our study shows that listening to patient stories about their own experiences and to their own words has a lot of potential for gaining insights into the quality and safety of hospital care.

How being in a hospital creates a tension that affects the feasibility of an active patient role

What narrative technology assessment offers is the recognition that health care is a practice with high moral and emotional stakes (Kleinman and Seeman 2000). It may come as no surprise that being in a hospital is not a pleasant, emotionally neutral experience. However, the narrative approach teaches us how this personal truth is enmeshed in a relational and systemic practice. Patient experiences and professional care experiences meet with system requirements and result in dilemmas for all involved. These dilemmas are considered very real by patients on the individual level, and, at the same time, have implications on the organizational and policy levels.

In summary, the four dilemmas that were most prevalent in our study share a common feature relevant to the discussion on patient activity and independence. On the one hand, many patients are afraid and become silent. On the other hand, many patients feel the need to speak out and be involved in their own care trajectory, for valid reasons. This tension between becoming silent and wishing to be active and independent is present in many of the contacts between patients and care professionals and often defines the kind of contact patients have with care professionals, as we have seen in many of the stories. A hospital is a complex socio-technical environment in which social and technical processes are intertwined and need to be managed. Moreover, care trajectories of a single patient often involve many disciplines for diagnosis, radiology, treatment, the daily care, et cetera. This distribution of actions and care requires good integration and the sharing of information with the patient throughout the process. This makes hospitals hard to grasp for patients and contributes to both becoming silent and the need to be active and pay attention.

The patient and their well-being as political aim

Moreover, this tension defines many political and societal discussions about the role of the patient in the health-care sector. Political parties and many patient organizations wish to strengthen the position of patients. Others wish to leave patients alone and instead increase the authority of medical professionals. Both of these wishes can be seen as the sides of the same coin. The active and independent patient, as it is now presented by the government, seems to offer a way to support silent patients in hospitals. But the same goes for opposing views that argue that patients are not capable of taking an active part in their own care trajectory. Proponents of both directions have patients and their well-being as their objective.

However, we would argue that this tension cannot be taken away, as it is a part of being a patient in a hospital. The taking of sides pro or against active and independent patients does not take away the tension, nor does it solve it. The hospital system itself could become more aware of this tension and could develop a sensitivity for this tension. The use of patient narratives could be useful for this purpose.

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CIVISTI Method for Future Studies with Strong Participative Elements

Mahshid Sotoudeh, Walter Peissl, Niklas Gudowsky and Anders Jacobi

Abstract

Long-term planning with a time-horizon exceeding 20 to 30 years is an important element of sustainable development. At the same time, economic actors apply flexible policies and use short-term planning to ensure profit. Environmental and social problems may also sometimes call for short-term solutions in order to save systems in acute danger. This creates a paradoxical situation: a society needs to define long-term targets for its infrastructure and achieve systematic changes in pursuing those, but the necessary short-term actions might not be in line with such long-term goals. If this apparent paradox is not solved through an appropriate governance method, it might lead to conflicts between different policy goals. The concept of reflexive governance for transition management (Voß et al., 2006) tries to solve this apparent paradox and combines a number of short-term planning processes in a stage-wise and reflexive way to create a more comprehensive and innovative process of long-term planning for sustainable development. In this contribution, we introduce and discuss the CIVISTI method as a reflexive instrument for integrating different types of knowledge and creating a bridge between short- and long-term planning of research agendas. The method is designed for identifying future visions based on people's hopes and fears, integrating them as input to dialogues between citizens, scientists, stakeholders and policy makers and identifying different future expectations on science and technology.

CIVISTI Method and a Brief Overview of Findings

Forward-looking activities and the identification of goals set by the society are a fixed element at each stage of reflexive governance. The main challenge is how to integrate different knowledge types, such as citizens' visions and experts' recommendations, into long-term planning in order to support the decision-making process. The CIVISTI method, an innovative forward-looking approach, addresses this challenge for research agendas through a well-designed combination of consultation and reflection steps.

Most forward-looking activities take as their starting point what could be called the supply side. CIVISTI, on the other hand, tries to foster demand-side approaches. The CIVISTI project was a European research foresight exercise funded by the Socio-economic, Sciences and Humanities (SSH) Programme within the 7th Framework Programme of the EU (2007 – 2013). The aim of the project was to identify new and emerging topics for EU R&D policy by consulting citizens in seven European countries (Denmark, Austria, Belgium, Finland, Malta, Bulgaria and Hungary) and contribute to the future EU research programme for 2014 – 2020. The CIVISTI project revealed European citizens' visions of the future and transformed these into relevant long-term science, technology and innovation issues. A short introduction to the method is presented below.

Seven Citizen Panels of 25 people each were established, one in each of the seven CIVISTI partner countries. Each Citizen Consultation (CC1) took a long-term look at the needs, wishes, concerns and challenges of the future through a deliberative process. This was done during seven national citizen consultation weekends. The results were 69 visions for the future. After the translation of all visions into English, content analysis was performed. The second step was that experts and stakeholders analysed the citizens' visions and transformed them into research recommendations and policy options for European research (Jacobi et al. 2011).

In the third step of the process (CC2), this list of 30 recommendations for research agendas and policy options was passed back to the citizens. The citizens validated and prioritized the new Science and Technology agendas and policy options the experts had developed on the basis of their visions. The second citizen consultation generated the feedback possibility for citizens and the validation of results. Citizens defined a set of criteria for good recommendations for a transparent validation process. The Austrian citizen panel defined among others the need for balanced recommendations that consider environmental and social impacts of technologies, generate jobs and are clear and understandable.

The feedback had a key function because although experts translated specific aspects of the citizens' visions into more practical recommendations, they lost some of the former spirit of the visions in this transformation. The second round of reflection and validation of the experts' recommendations by citizens solved part of this problem through additional comments by the citizens.

The final results were presented to relevant policy makers at a Policy Workshop in Brussels. A detailed description of the CIVISTI process can be found in Jacobi et al. (2011). The results of the project show that citizen visions included a broad spectrum of interdisciplinary issues related to ageing, eco cities, education, energy, multicultural society, social fairness, mobility, intelligent devices, safety and security, and other questions.

The content analysis after the Citizen Consultation 1 showed that the citizens discussed the future in their holistic and "interdisciplinary" visions. The aim of the content analysis was to help experts and stakeholders find new issues and approaches for science, technology, innovation (STI) and policy-making (in relevant policy sectors). Each citizen's vision in CIVISTI contains multiple (approximately 8) themes at different levels of impact (individual, local, national, European and global levels). The format and time schedule (1.5 days) of citizen consultations encouraged shorter, 1-2 page narratives of what the future might or should look like 30-40 years from now.

The content analysis was based on a grounded theory approach that is generally applied in sociological analyses of qualitative data. The key idea of such an analysis is that any kind of qualitative data can be understood only through some form of conceptualization (or categories), and that these conceptualizations should have some kind of grounding in the data to which they refer. The idea of the grounded approach is, in other words, to maximally base the analysis on the data rather than apply any predefined concepts/categories to the analysis.

The CIVISTI top ten recommendations for research and development are as follows:

- Attractive public transportation
- Decentralised energy
- Re-appropriate the countryside
- Tools for disabled people
- (European) eco-cities
- Social innovation for ageing society
- Direct democracy through e-voting
- Develop effective urban infrastructure
- Policies towards immigrants and refugees
- Dignity in the dying process
- Plants for extreme weather

The above comprehensive list shows that a promising application of CIVISTI results could be their use as a holistic framework for the evaluation of activities and an early assessment of long-term plans. Therefore, the results as a whole should be analysed and refined to create an integrated set of criteria for future research activities. For instance, according to the top-10 recommendations package, the technology development for ageing society should be related to the needs of eco-cities, independent living, active ageing at work and social participation with the help of public transport, social innovations, etc. and be developed on the basis of specific local situations. In the same way, a public transport system should consider the idea of an ageing society and so on.

CIVISTI Method as a Tool for Knowledge Generation

One of the main functions of the CIVISTI method is the translation of implicit knowledge of emotions, fears and hopes related to the future to explicit knowledge of needs for scientific research. The method supports generating knowledge of interrelated societal and technological issues and contexts. The citizens' visions are a source for interdisciplinary and comprehensive description of future societal challenges. Balabanian (2006) shows the challenge of innovation due to the complexity of Challenges. He considers environmental problems to be a part of new societal problems, parallel to other issues such as health problems due to industrial waste and hazards, psychological/emotional problems due to the substitution of machine values for human values, militaristic problems due to hi-tech militarization and social problems due to centralization. In view of the interdisciplinary character of the citizens' visions, experts have the possibility to identify expected interrelated societal challenges with environmental and economic problems. The scope of expert recommendations based on the citizen visions is therefore broader and more comprehensive than usual.

The three CIVISTI steps from visions to validated recommendations can be shown on the following short example from Austrian reports (www.civisti.org):

- *CIVISTI Citizen Consultation 1-Austria, June 2009*

Vision 9: Disabled people as fully valuable members of the society. Integration of disabled people should be achieved through affordable tools and the involvement of disabled people in daily life as well as more research on treatment and the prevention of disability even before birth.

- *CIVISTI Expert & stakeholder workshop, June 2010 in Sofia*

Recommendation (R2): Tools for disabled people based on Vision 9 . Investigating the state of the art in the development of tools for disabled people and older adults. Based on the introduction of a balanced multidisciplinary approach to the issue by involving experts from technological and social sciences

- *CIVISTI Citizen Consultation 2-Austria, October 2010*

A part of the citizen feedback regarding the recommendation of "tools for disabled people" is presented below:

"…Disabled people are an enrichment of life. Therefore, they deserve support and greater integration. As obstacles in daily life exclude disabled people, I think research in the area is urgently required."

"Recommendation (R2) reflects strongly (at least partly) vision 9, and it is partly desirable. However, the original vision focused on prenatal and postnatal cases."

Validated recommendations from all seven countries were finally presented at the final policy workshop in Brussels in January 2011.

The CIVISTI method has been analysed at the ITA since 2011 on the basis of the integration of results in the decision-making process on the local and national level (Sotoudeh et al. 2011). The results of explorative interviews show different views about the impact of this participatory method. The interviewees mentioned inter alia that the scientific community, the administration, and the media have different mechanisms for the selection of results and need different levels of information. Main factors identified for the improvement of the integration of results are optimized timing between different phases of consultation and reflection, thematic focus, integration of local policy especially for discussing tensions between short- and long-term projects and new strategies for the validation of qualitative results.

Conclusions

The CIVISTI method generated multidimensional and holistic targets. The method is unique in its emphasis on the demand side as its starting point. The strong focus on citizens' visions of the future of Europe is an enriching innovation for futures studies. While citizen consultations in foresight studies and forward-looking activities usually go no further than letting the citizens express their visions or opinions in relation to a subject, CIVISTI takes the next step as well.

The CIVISTI method provides a systematic and citizens-oriented assessment of relevant issues for future scientific research and technological development. The method is valuable for the generation of knowledge and identification of values since it identifies implicit knowledge of future hopes and fears, which can be discussed by experts and stakeholders, integrates this knowledge with corresponding stakeholder and expert recommendations and generates new knowledge of research needs that will be evaluated by all involved citizens.

While the qualitative character of knowledge generation in CIVISTI has been well developed, there is a need for research and optimization of the integration of results into the decision-making process.

In light of this the ITA applies the CIVISTI method in a new project for the identification of citizens' visions on Autonomous and Ambient assisted Living (AAL) in Vienna. To improve the validation process, results of the qualitative part of CIVISTI will be presented for a broader public debate and evaluated with an on-line tool. Close cooperation with the city administration and interested groups at the city level should improve the consideration of short- and long-term issues and the integration of results into long-term development and city planning. An external evaluation of this project will provide more insight with regard to the need for further development of this forward-looking method.

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The World Wide Views Citizen Consultations

A pTA Response to a Global Challenge

Bjørn Bedsted

Abstract

Many of the issues addressed by technology assessment (TA) studies and projects are now also addressed in a global governance context. This article presents a response to this development, the World Wide Views citizen consultations, and current trends in TA and participatory TA (pTA) reflected in that response. It presents the World Wide Views method as one example of a way forward for TA, with larger projects and more collaborators.

Introduction

Many of the issues addressed by technology assessments in Europe (both on the national and the European level) are also increasingly addressed in policy discussions and negotiations on the global level. Patent law is addressed at the WTO, water scarcity in the World Water Forum, climate change and energy policies under the UN Convention on Climate Change, synthetic biology and geoengineering under the Convention on Biological Diversity, health policies as a part of the Sustainable Development Goals and it-security and privacy in the Internet Governance Forum.

One of the consequences of this development is the fact that the democratic gap between citizens and policy-makers grows as policies influencing their daily lives are formed further from the potential reach of their influence. This democratic gap is of a particular concern to the pTA tradition in, predominantly, European TA. TA practitioners in the pTA tradition have been engaged in designing TA processes allowing for the input and influence of a wide variety of societal actors, both for practical reasons (basing results on a wide knowledge base) and for reasons of principle (including societal groups with stakes in the issue at hand). Thus, motivations among TA practitioners range from the more technocratic to the more democratic and, of course, often they are a mixture of both.

Reasons for including citizen participation in TA are equally practical (offering decision-makers knowledge about the public support for alternative developments and policies) and principled (it is only fair that citizens who are going to live with the consequences of technological developments are also offered the opportunity to influence them). This last rationale is more predominant among those believing that a well-functioning democracy should encourage collaboration between policymakers, scientists, citizens and stakeholders between elections and less so among those who believe that elected representatives are elected to take responsibility for decision-making and should not waste too much time consulting other societal actors, especially citizens, in the process.

Thus, European pTA, or at least a good part of it, has been – and still is – involved in a political struggle to promote the practice and institutionalization of participatory, deliberative and collaborative forms of democratic governance. The development of the practices and theories of democratic governance has run parallel to the practice and theory of TA for many years,[1] and methods used in the field of pTA have been applied to non-TA issues and vice versa. Some TA institutions have been more deeply involved in both traditions than others. Interventions in and contributions to TA-related decision-making processes have been, at least partly, motivated by the ambition to create a space within those processes for citizens, stakeholders and experts to collaborate and interact with decision-makers. A range of pTA methods involving citizen participation have been developed, applied and acknowledged in several European countries and increasingly used in similar or hybrid forms on the European level.[2] They offer decision-makers an alternative and supplement to advice offered by experts and interest groups and they have long been recognized by the European Commission as a way of remedying the democratic deficit and the lack of public support for EU policies (EC 2001). While they are getting better known and sometimes applied in the European governance landscape, no similar space has been introduced or tradition installed for citizen participation in international governance. World Wide Views is the first and only initiative so far.[3]

The World Wide Views Method

World Wide Views is a multisite citizen consultation. It is called World Wide Views because it has been developed and twice used for global citizen consultations, but it can also be used on the regional and national level.[4]

The core of the method is to have citizens at multiple sites debate the same policy-related questions relating to a given issue on the same day. So far, the standard has been to have 100 citizens participating at each site, selected to reflect the demographic diversity in their country or region.

Before the citizen consultations, participants receive written information material presenting facts and opinions about the issues at hand. Information videos are screened at the actual consultations as an introduction to each thematic session.

The questions put to the citizens are identified by way of a comprehensive consultation of policy-makers and stakeholders worldwide in order to address the most pertinent, debated and disputed policy issues debated in the policy process addressed. The information material is designed to present citizens with pros and cons of voting one way or another on the questions at hand. The information material is reviewed by a scientific advisory board and both the questions and information materials are reviewed by citizen focus groups in different parts of the world prior to being finalized. The videos present a summary of the written information material.[5]

All meetings follow the exact same format: the day is divided into 4-5 thematic sessions. An information video introduces the thematic issue and citizens are then presented with a set of questions (3 to 5) with prepared answering options. Groups of 5-8 citizens deliberate on the questions before them, assisted by a trained table moderator. At the end of each session – which can take between 30 minutes and 1 ½ hour, the citizens vote individually on the questions.

Figure 12: Lay citizens > Information > Deliberation > Vote > Thank you! > Global results

Votes are then collected and reported to the World Wide Views website, where results can be compared as they arrive throughout the day – starting in Asia and finishing on the American West Coast. Comparisons can be made between countries, continents and different groupings, such as developing and developed countries. The first World Wide Views (on Global Warming) also included a session in which citizens made up their own recommendations for policymakers. The second (on Biodiversity) offered partners the opportunity to do so in order to produce recommendations to the national and local level.

The results are subsequently analyzed and presented to policymakers - both by the responsible partners on the national level and by the coordinators on the global level, which has so far been at the UN Conferences of Parties to the climate and biodiversity conventions.[6]

The method was developed by the DBT and other partners in the World Wide Views Alliance,[7] which was established for this purpose, prior to the climate COP15 in Copenhagen in 2009. The aim was to develop a method that would be cheap and easy to use for partners in all parts of the world; a method that would produce results that could be easily communicated to policymakers; and a method that would provide participating citizens with balanced information and give them the opportunity to discuss the issues at hand with other citizens.

The method has now proved to be functioning and meaningful in 2 global citizen consultations. It has built up a worldwide capacity and network and has pioneered the introduction of citizen participation in global governance. It is probably best considered to be a work in progress and some of the challenges to its future successful application are the inclusion of more citizens and connecting more closely with policy-making processes. This is partly a matter of developing the methodology further and partly a matter of simply using it on a regular basis in order to prove its worth to policy-makers.

World Wide Views Projects

World Wide Views on Global Warming involved over 50 partners responsible for organizing 44 deliberations in 38 countries, two months prior to the UN Conference of Parties (COP15) to the Convention on Climate Change in 2009. Results were presented by the partners to their national national policy-makers and by the coordinators in collaboration with a few partners at the COP15 in Copenhagen. The consultations were mainly sponsored by partners in the WWViews Alliance, and while some support was received from the Danish Foreign Ministry, no official ties were developed between World Wide Views and the Danish host country or the UN secretariat to the Convention on Climate Change.

This situation changed for World Wide Views on Biodiversity in 2012, leading up to the UN Conference of Parties (COP11) to the Convention on Biodiversity. 42 partners (both new and old members of the WWViews Alliance) organized 34 deliberations in 25 countries. This time, the initiative was co-initiated and co-sponsored by the Danish Ministry for the Environment and the UN Secretariat to the Convention on Biological Diversity was in the Steering Group. This made it somewhat easier to make policy-makers aware of the results, and they were shared with more high-level policy-makers than in 2009. The most tangible sign of recognition and appreciation of the WWViews process was the fact that a COP decision (X1/2 – 24) on the initiative of EU countries was adopted, encouraging

"..parties, relevant organizations and stakeholders to support and contribute to communication initiatives, such as the World Wide Views on Biodiversity, which combine the implementation of Strategic Goals A and E regarding mainstreaming of biodiversity, participatory planning, knowledge management and capacity-building." (p. 95 in the "Report of the Eleventh Meeting of the Conference of the Parties to the Convention on Biological Diversity" [8])

Thus encouraged, the Danish Board of Technology is trying to raise funding for a World Wide Views 2 on Biodiversity, with the long term ambition of organizing global citizen consultations with regular intervals, thus carving out a space for a continued and structured dialogue between citizens and policy-makers. Attempts will also be made to raise funding for World Wide Views citizen consultations on other issues addressed by policies formed on the global level.

Results from WWViews on Global Warming[9]
The participating citizens voted on alternative answers to 12 predefined questions and produced a large number of recommendations phrased in their own wordings. Synthesizing the results, the following policy recommendations from the citizens were deduced: • Make a deal at COP15 • Keep the temperature increase below 2 degrees • Annex-1 countries should reduce emissions by 25-40 % or more by 2020 • Fast-growing economies should also reduce emissions by 2020 • Low-income developing countries should limit emissions • Give high priority to an international financial mechanism • Punish non-complying countries • Make technology available to everyone • Strengthen or supplement international institutions

Table 9: Results from WWViews on Global Warming

Results from WWViews on Biodiversity[10]
The participating citizens voted on alternative answers to 18 predefined questions. Having analysed the results, the following points were highlighted in the Results Report: • Most citizens worldwide do have some knowledge of biodiversity • Citizens think most people in the world are seriously affected by biodiversity loss, and more participants from developing countries than developed think that their country is so affected • Citizens worldwide are very concerned about the loss of biodiversity • The establishment of new protected areas should be given higher priority than economic aims • Efforts should be made to protect nature areas • Eat less meat and intensify agricultural production • Incentives and subsidies leading to overfishing should be phased out • Protection of coral reefs is a shared responsibility • More protected areas should be established on the High Seas • All countries should pay for protecting biodiversity in developing countries • Benefit-sharing should apply to already collected genetic resources • Use of genetic resources from the High Seas should benefit biodiversity

Table 10: Results from WWViews on Biodiversity

Conclusions

Doing TA on the European level is already complex as it is. The number of stakeholders increases significantly when going from the national to the European level. When addressing TA-related policy processes on the global level, the number increases even more, and it is a practical challenge for TA to adequately include the knowledge and views of such a large group of actors and to determine which ones to engage with. New networks and partnerships have to be formed with different organizations, and TA projects will quite simply have to grow in size in order to remain relevant to the policy-making processes that are shaping technological developments. This is already a trend on the European level, especially with the shifting consortia formed within the European Union's 7th Framework Program (now substituted by Horizon 2020), in order to address various technological challenges. Organizations practicing the European tradition of TA are still not engaged in similar modes of collaboration on the global level.

European TA has developed through a strong connection to national parliaments, which has been crucial to the way it has sought to connect with policy-making processes. On the European level, this connection has translated into efforts to connect with the European Parliament and its STOA Panel through the ETAG consortium. Since there is no elected parliament on the global level, TA organizations will need to address and connect with policy-making processes in new ways on this level, and the UN is probably the most obvious international body to connect with.

World Wide Views is one example of how new, collaborative networks can be established and policy-making processes addressed on the global level while still addressing the national policy level, as well as the local one, where, for example, climate and energy initiatives are increasingly taken. It is an example of a future direction for TA, especially pTA, and it is a proposal for a way in which TA can contribute to closing the democratic gap between citizens and global policy-making processes. Hopefully, many more will grow out of the European TA tradition.

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PART IV

QUESTIONS OF SUSTAINABILITY

Articles from the PACITA 2013 Conference Sessions:

TA and Governance (II)
Participation within the Field of Climate Change (V)
Assessing Sustainable Mobility (IX)
Energy Transition (XIII)
Sustainable Development and Consumption (XIV)
Emerging Technologies (XV)
Participation: Practical Cases (XVIII)

FIELDS OF TRANSITION

Agricultural and Food Systems Are Key Sectors for a 'Great Transition' towards Sustainability

Elisabeth Bongert and Stephan Albrecht

Abstract

Politics of sustainable development require a Great Transition (GT) on all levels of society. Agricultural and food systems are core sectors of the necessary turnaround of production, distribution and consumption patterns. The industrialization of agricultural and food systems has brought in its wake widespread ecological degradations, alienation and loss of food sovereignty for households, destruction of family farms, dependence on input industries, increasing concentration of land ownership, and many diet-related diseases. There is a strong food and health nexus. Lack of sufficient, safe, diverse and healthy food makes people sick as much as excess eating. TA traces impacts of technological innovations on environment and society. Since Global Assessments (GA) have advanced the framework of assessments, TA can and should be a part of the research capacity for sustainability. Integrated Inter-Systems Assessment (IISA) delineates an approach of combining the corpus of knowledge and methodologies from TA with normative and sustainability-oriented premises.

Industrialization of Agricultural and Food Systems

The industrialization of agricultural as well as household practices, such as plant cultivation, animal husbandry, processing, marketing, preserving and cooking, has been and is part a of global industrialization, which has started to emerge in European societies ca. 1830. Looking at human history, industrialization is a rather recent phenomenon, whereas agricultural and food systems have been essential and indispensable parts of all human societies from the very beginning. A human society is neither conceivable nor feasible without functioning agricultural and food systems (Diamond 2005). One key feature of industrialization and industrialism[1] is fossil energy. The illusion of unlimited energy resources, such as coal and crude oil, led, among other things, to agricultural practices that utilize large amounts of fossil energy in terms of synthetic fertilizers, agrochemicals and machinery. As a consequence, fundamental knowledge and insights, gained and passed on from generation to generation, about synergies and incompatibilities regarding soils, nutrient cycles, water management, plant breeding, cultivation and animal rearing have passed into oblivion (Diamond 2012 ; IAASTD 2009 a; b). Together with the long-lasting boom of energy consumption a second key feature of industrialism evolved, namely urbanization. According to UN statistics, roughly two-thirds of the global population lived in rural areas in 1950 – in 2050, prospects tell us, this might be the other way round. Since the medieval times, cities have been synonyms for freedom, progress and a good standard of life. Growing urban populace has become more and more alienated from the production and processing of food. With regard to food, the main thing was that it had to be cheap. While food supply and prices have been issues of utmost political relevance since ancient times, the industrialization of agriculture and food systems offered the opportunity of ever-increasing production and decreasing prices. But what originated as an opportunity and a promise, metamorphosed to the so called 'agricultural thread mill'. Technological progress brought about lower consumer prices but resulted in ever-lower producer prices as well, thus instituting the vicious cycle of the economies of scale, spatial separation of the production and processing of plants and animals, millionfold destruction of family farms and an ever-advancing concentration of land ownership. The farms that remained in the thread mill became heavily dependent on input, machine, finance and other industries.

Since the 1980s, two additional elements of the industrialization of agricultural and food systems have emerged in the wake of global neo-liberal politics. The first can be dubbed as the industrialization of knowledge. Legal instruments like patent laws have been expanded by legislation and judicial decisions from their original domain, namely technical and industrial processes and products, to living organisms and parts of them, such as plants, cells, microorganisms and animals. The expansion has been driven mainly by for-profit actors, most notably transnational chemical, pharmaceutical and food-processing corporations, and some also universities floundered about in the hopes of getting a piece of the supposed big cake. Plant breeding, for example, which had, for millennia, been an open, cooperative, collective, and often also spiritual endeavour of farmers, and, in recent decades, for breeders all over the world, producing public goods, mutated into a business for chemists, geneticists, molecular biologists, lawyers and patent attorneys' offices mostly in OECD countries. Private corporate ownership of plant varieties has led to a big wave of levelling of plant cultivation and a corresponding loss of diversity. The second element is the emergence of vertical integrated global agro-food corporations and globally-integrated value chains for food, e.g. for poultry or pigs. These corporations dominate and prescribe in detail every single step in the value chain from agricultural plant cultivation or animal rearing to the size and the look of packaged food in supermarkets. While the whole process is centrally planned, the region of the world in which the respective steps are done or produced is random (McCullough et al. 2008; Davis 2005). Mono-cultural crop farming and large-scale livestock farming (poultry, pigs, cattle) implies ever-growing use of pesticides and antibiotics with a serious impact for human health and ecosystems (GRAIN 2013).

The Great Transition From Soil to Fork

The industrialization of agricultural and food systems – as well as other sectors of society and economy – is not fit for the future because the very precondition of its development and sustenance, namely cheap fossil energies, is expiring (Deffeyes 2001; von Weizsaecker et al. 2009). Moreover, the use of large amounts of fossil energy has caused and continues to cause serious destructions and degradations of nearly all ecosystems as well as other global life-sustaining systems and cycles like carbon, climate, nitrogen or phosphorus, so that the livelihoods of future generations, especially with regard to healthy, diverse and sufficient food supply, are jeopardized. Since the United Nations Conference on Environment and Development (UNCED) 1992 in Rio de Janeiro, the politics of sustainability have become an important topic of global, national and regional politics. However slow the progress in sustainability politics on all levels might be, the task of the Great Transition (GT) with regard to sustainable development is unavoidably on the table. Four key features are especially relevant here:

- GTs occur in a co-evolutionary manner, rely on a great number of changes in different socio-technical (sub)systems and take place on local, national and global action levels.
- GTs include both the development of (niche) innovations as well as their selection on the part of the users and their social embedding through markets, regulations, infrastructures and new social guiding principles.
- GTs are influenced by a large number of political, scientific, economic and civil social actors and consumers.
- GTs are radical processes with regard to their impact and range; they may, however, sometimes take place very slowly over several decades (German Advisory Council on Global Change 2011, p. 83-84).

Any substantial meaning of sustainability or sustainable development implies a radical turnaround in production, consumption and political as well as social organization of all industrialized or industrializing countries in particular (Albrecht 2001). The main idea of sustainability is to harmonize the human society and its metabolism with nature while using the opportunities and boundaries of ecosystems and the power of the sun. And at the very basis of this new societal organization, which would be compatible with nature, lie agricultural and food systems. The key principles of sustainable agriculture are:

- Integrate biological and ecological processes, such as nutrient cycling, nitrogen fixation, soil regeneration, allelopathy, competition, predation and parasitism into food production processes
- Minimize the use of those non-renewable inputs that cause harm to the environment or to the health of farmers and consumers
- Make productive use of the knowledge and skills of farmers, thus improving their self-reliance and substituting human capital for costly external inputs and

- Make productive use of people's collective capacities to work together to solve common agricultural and natural resource problems, such as for pest, watershed, irrigation, forest and credit management (Pretty 2008)

These principles fit into the general and fundamental characters of sustainability, namely persistence, resilience, autarchy and benevolence (Royal Society 2009). The GT from soil to fork thus means inter alia:

- New balance between rural and urban areas
- New criteria and benchmarks for good life (buon vivír), health, wealth and prosperity (Acemoglu/Robinson 2012)
- Sound local and regional cycles throughout the agricultural and other value and trade chains, e.g. zero waste
- New balance between cultivation, processing, cooking and consumption of food, which promotes food sovereignty not only for nations but also for producers and consumers
- Sustainability science, occupational training and education
- International cooperation and exchange structures along the following principles: human rights first, intra- and intergenerational justice, fair reciprocity

The Food & Health Nexus

To re-evaluate sustainable development of society from the essentials also means to acknowledge and rebuild the multiple nexuses between agriculture, food and human well-being and health, physical as well as spiritual. In 1850, the German philosopher, Ludwig Feuerbach, coined the well-known phrase: "Human beings are essentially what they eat" in a review of a textbook on food by Jacob Moleschott (Moleschott 1858) published in his day. This phrase reminds us that there is no healthy and active life without permanent access to sufficient, safe, healthy and diverse food. A lack of food as well as malnutrition and excess eating makes people sick. Not accidentally does the Human Right to Food in the Universal Declaration of Human Rights emphasise such a comprehensive conjunction and mutual dependence between health, food and life in decent conditions. In many industrialized countries, we can see a long-term rise of cardio-vascular diseases, obesity, type II diabetes and other diet-related syndromes of diseases. 20 to 25 per cent of adults in North America and Europe are clinically obese. Even in developing countries with high incidence of undernourishment and hunger, obesity is on the rise. On the other hand, more than 10 per cent of all human beings are chronically undernourished and starving. The health impact is fatal, especially for pregnant women, mothers and children under five years of age. Furthermore, evidence from studies shows that the destruction of cultivated fields and the predation of food and animals is an immediate and important part of violent conflicts, civil wars and gang warfare all over the world (GHI 2012; Conflict Barometer

2012). Such violent disorder hits foremost the most vulnerable groups and plunges them into hunger, poverty and diseases (Bello 2009).

Food has also strong spiritual aspects in many different cultures of the world. Meals are cornerstones of communities, within families as well as within wider communities (e.g. Bhogal 2003; Hamilton 2003). Industrialization of food production, processing, cooking and eating eventually results in a ruin of the social web and context. Food culture as a fundamental routine of social exchange, recognition, appreciation and cohesion is replaced by an individualized and alienated uptake of calories and liquids. Such eating behaviours on a large scale are the manifestation as well as the cause of many forms of psychosomatic disorders (Delpeuch et al. 2009).

So, to regain food sovereignty means to rediscover and re-establish food culture as an essential prerequisite to staying sane and healthy. Food sovereignty for all human beings as a key feature for the GT not only implies corresponding national and regional policies but also a conquest of the colossal power of the vertical integrated global agro-food corporations (Roberts 2008).

Conclusions

Technology Assessment (TA) has, from its very beginning, traced impacts of human technologies on environment and society, thus building up a substantial corpus of knowledge, also concerning agricultural and food systems (e.g. Meyer 2006). Since 1990 Global Assessments (GAs), climate change, biodiversity, freshwater, forests, agriculture and ecosystems have extended the scope of TA considerably by modifying the framework of research. Impacts remained important issues but two additional components have emerged. Firstly, solutions for complex problems, such as water scarcity, climate change, soil fertility etc., have become crucial parts of proposed actions. Secondly, normative premises have started to play an increasingly important and accepted role, such as the reduction of hunger, poverty and environmental degradation, empowerment of women, social justice or building up capacities to improve health, education and nutrition. The normative umbrella of these premises is provided by the paradigm of sustainability, which is – or should be – the core of public policies and institutions. It should not be just one of many acceptable policies and policy choices. TA is thus, with its productive analytical capacity and its systems-oriented approach, a part of the GT. But the new frontiers of research directed towards the GT also call for methodological innovations and a problem-adequate design of research. TA can and should advance towards an Integrated Inter-Systems Assessment (IISA). Some key features of the IISA are:

- Research topics and projects are developed and designed in a cooperative and participatory manner with Civil Society Organisations (CSOs) and other stakeholders (this characteristics has been discussed in the fields of science and humanities as a transdisciplinary research design for over fifteen years) (Albrecht 2013).

- Research on complex interactions between human societies and ecosystems has to acknowledge that all sustainable development – as well as unsustainable – is bound to time and place. Therefore, any non-reflective generalization of research results is inappropriate and all research organizations need to consider this essential fact – especially with regard to research funding and designs.
- Innovations are mainly social and political processes, and development and the use of technology is embedded in the contexts of time, place and culture. Sustainability-oriented innovations may clear the way forward (i.e. back) from greed to need (Braun 2010).
- Research on complex systems as a part of the GT has to observe interfaces and trade-offs, which are inevitable elements of innovation and change towards sustainable development.
- The IISA contributes to ending what can be dubbed as sectoral thinking. The development of societies is a historical process. All parts of society interact with all other parts, in some cases directly, in others indirectly. Sectoral thinking, often following epistemic boundaries of scientific disciplines, tends to neglect and underestimate the on-going interplays between the so called 'sectors', as does politics on all levels, from communities to the global level.

The IISAs can prove to function as experimental stations for sustainability and an important component of the universe of research for sustainable development.

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TA and Sustainability in Australia's Mining and Resource Extraction Sectors

Justine Lacey, Kieren Moffat and Peta Ashworth

Abstract

Technology assessment (TA) is applied in a wide variety of contexts around the world. However, there is currently no significant body of TA work that focuses explicitly on technologies and processes used in mining and resource extraction. There are several reasons why this may be the case. For example, there are perceptions that mining is an 'old industry', and not part of a future built on new renewable energy sources. Resource extraction has taken place for centuries and TA may be considered to have little to offer in terms of new analyses of how mining shapes our societies. However, mining technologies and processes are undergoing significant changes and developments which impact on our lives and those of host communities in a range of ways. This paper summarizes current research on TA and mining being developed and undertaken in Australia.

Introduction

History has shown the successful development and implementation of new technologies across the mining[1] and resource extraction sectors have played a critical role in achieving greater economic return for the organizations and countries involved. Despite this, the impact of mining on the communities in which they operate has not always been perceived as beneficial. One component that can significantly influence how these sectors are perceived is the use of technologies and processes for extracting and developing these resources. Over time, we have seen multiple transformations of the technologies and processes used, which has not only increased the rate at which resource extraction can be performed but also helped to minimize the impact of mining activities on host communities.

Recent examples include the use of automated vehicles, such as driverless trucks and other remote operated underground machinery (McNab et al. 2013), leading to the consideration of fully automated mines of the future. It is anticipated these will incorporate robotics, artificial intelligence and methods such as biomining.[2] It is not out of the question that much of this might be done from the mine operator's home many thousands of kilometres away. Despite these improvements in the technologies and processes being used, mining is often still viewed as a contentious activity.

Therefore, the choices we make about mining technologies and processes, and how we implement them reflect one of the most critical interfaces between mining and society (Lacey 2012). These choices are particularly important because they play a central role in the way mining is conducted, and how it is experienced by those who live and work near mining developments as well as those who live far from mine sites but ultimately benefit from mining activities (Hajkowicz et al. 2011; Moffat/Lacey 2012). This paper aims to understand the value that technology assessment (TA) can bring to this domain by drawing on examples where it has been applied in the Australian minerals industry to date and exploring its potential for ongoing application into the future.

Mining in the Australian Context

Mining is a well established industry in Australia, and it features prominently in discussions about economic prosperity. For the period 2009-10, the total contribution of mining to Australia's Gross Domestic Product (GDP) was AUD 122 billion. This equated to 8.4 % of the total GDP and just over half the value of total exports from Australia for that period (Australian Bureau of Statistics 2012). The top two resource commodity exports from Australia are iron ore and coal, and in the last decade alone, production of iron ore has increased by 180 %, and coal by 47 % (Measham et al. 2013). Alongside the emergence of new commodities such as liquefied natural gas (which has seen a production increase of 150 % over the same period), the rapidly increasing scale of mining has led to a range of complex interactions in the economic, social and environmental spheres, resulting in an increase in the level of public scrutiny about its role and how it operates.

Issues under the spotlight include the environmental impacts of the extraction processes; the related use of non-renewable resources such as fossil fuels; the economic distortion that results from one part of the economy booming while other parts languish (i.e. a 'two-speed economy' (Cleary 2011)); and the impacts on communities that live near large or multiple mining projects. There has also been increasing concern in relation to land-use conflicts and competing resource use such as agricultural production and coal seam gas mining in the eastern parts of Australia (Witt et al. 2013). As a result, there is increasing attention being placed on how mining activities are conducted and their 'social licence to operate'[3] (Lacey et al. 2012). Within increasing accountability, there are also rising expectations that citizen voices will inform how the costs and benefits of mining are distributed (Harvey/Brereton 2005).

The Importance of Mining-Focused TA

Despite its economic contribution, there remains considerable debate as to whether mining is sustainable in its own right (Hilson/Murck 2000; Whitmore 2006). For example, it is often argued that mining cannot be considered sustainable as the resources being extracted are non-renewable and, therefore, finite (Horowitz 2006). This is particularly the case with energy resources that are often extracted and only used once. In addition, their use also introduces concerns about related impacts such as increased greenhouse gas emissions and climate change. And although metal resources such as copper and gold have the capacity to be recycled and reused many times, their extraction and processing can be water and energy intensive. Thus, mining development is underpinned by not only the decisions of the types of resources we are extracting but also the impacts of the ways we are consuming them.

In accordance with the Oslo Definition, sustainable consumption is "the use of services and related products which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations" (Norwegian Ministry of Environment 1994). Here there is a focus on how to balance the benefits of using resources against the need to also minimize the impacts of their use. Thus, it is useful to highlight the interconnections between mining and resource extraction and its contribution to the overall sustainability of society. This can include questions about energy security and the shift to renewable energy sources as well as how metals and minerals are used in a variety of other technologies that support our social endeavours. For example, the use of everyday devices, such as computers, mobile telephones and televisions, or more specialist applications in the health sector (McClellan et al. 2013). To ignore the role of mining is to fail to fully address the question of what constitutes a sustainable society (Siegel 2013).

For those with any connection to TA, it is well understood that the raw materials of the Earth remain critical for the development of many of the new technologies and systems that are subject to the majority of current TA analyses. New transport systems, information and communication technologies and even emerging medical interventions make extensive use of the raw materials we obtain from mining. As such, questions about how we mine and use the Earth's geological resources remain embedded in the decisions we make about their use. In this regard, it has been argued that sustainable use of resources relies heavily on the governance arrangements that are in place (Lockwood et al. 2010). In the natural resources domain, this has been reflected in the emergence of new governance models that focus on collaborative decision making and an increased level of participation in these decisions by citizens and other stakeholders (Graham et al. 2003).

Participation in resource decision-making is therefore critical to how we might make informed choices about mining technologies and processes. This includes not only who should be involved but also how they should be engaged – from experts to citizen stakeholders. As such, TA provides an approach that encompasses both the technical and the democratic aspects of the choices we make about mining technologies and processes.

Applying TA to Mining Technologies and Processes

In recognition of the ongoing challenges of the interactions between the technical and social contexts of mining, there has been increasing research undertaken to understand how best to inform decision making about mining technologies and processes (Franks et al., 2013). Initial efforts in this regard have tended to reflect a more constructive TA approach, in which the focus has been on broadening the design or redesign of new technologies (Schot/Rip 1997). Such research efforts have also often reflected a strong focus on improving the environmental sustainability of these mining technologies and processes, and predominantly engaged the opinions and advice of expert stakeholders on these matters. Recent examples of this approach to the assessment of mining technologies and processes include participatory action research undertaken with scientists to shape the design of kiln technology being developed in order to reduce methane and gas waste from coal mining processes (Katz/Solomon 2008) and efforts to apply social life-cycle assessment to the use of a renewable resource, such as biomass, in iron ore smelting as an alternative to metallurgical coal (Weldegiorgis/Franks 2012).

This more constructive TA approach has, however, provided the foundation for considering how to incorporate a broader range of stakeholder voices in informing decisions about mining technologies and processes. An increase in coordinated citizen action against mining activities in Australia has also highlighted the need to better understand and encompass a broader range of views about these activities (Witt et al. 2013). While it is recognized that decisions about technologies and processes are critical to achieving greater economic and environmental sustainability, those decisions equally reflect critical social choices. This combination of factors highlights the need to extend current research on mining TA to encompass a more participatory and deliberative focus; in effect, to incorporate elements of both analytic and democratic practice (Van Est/Brom 2012). This represents the opportunity to think about how to activate a broader range of conversations that need to occur in order to capture more representative social views on mining technologies but also to embed the potential to use more deliberative processes within a mining-focused TA approach. The benefits of this also lie in the potential to empower a broader range of participants and include a more diverse range of knowledge and perspectives to "broaden the ethical and social analysis of technology" (Sclove 2010, p.27). As Gutmann and Thompson (2000, p.161) state, the move toward democratic deliberation can also provide a "morally justifiable way of dealing with...moral disagreement".

In response to these considerations, CSIRO has proposed a TA framework that aims to provide an approach to conducting evaluations of mining technologies across a variety of design, performance, investment and decision contexts so as to:

- Inform technology design (and re-design) within R&D institutions and organizations
- Inform technology options for deployment in new or existing mines, or transitions to alternative technologies by mining companies and operators
- Inform policy development and approaches to regulation of new and existing technologies and the contexts within which they are deployed by government
- Enable communities affected or likely to be affected by technologies or issues of focus to develop and articulate the attributes that will underpin local and societal acceptability of new technologies or mining practices (Lacey/Moffat 2012)

What this framework seeks to do is to establish a methodology that will drive the identification of not only the data sets but also the knowledge bases that are needed to make these kinds of assessments and can also be applied meaningfully across all of the key stages of the mining value chain from exploration activities through mining but also processing and metals production. There is also scope to extend beyond minerals recovery and processing into the domains of manufacturing and even recycling. At these points in the value chain, choices about how we use metal and mineral resources become much more directly connected with choices about consumption patterns and lifestyle choices.

Current research that is incorporating these broader stakeholder perspectives and deliberative processes in the way we think about the application of mining technologies and processes involves an examination of the impacts of mechanical mining processes and chemical mining processes. This involves assessing the costs and benefits of traditional mining processes such as underground and open cut pit mining against the costs and benefits of chemical mining processes such as in situ leach mining (predominantly used for uranium extraction but with potential application to the recovery of metals), hydraulic fracturing (for recovery of unconventional oil and gas) and underground coal gasification (a process which converts coal into gas in situ). While it has been argued that chemical mining processes can be a more cost-effective way to recover 'non-economic' resources or reduce the environmental costs associated with surface disturbance (Roberts et al. 2010), there are also concerns being expressed about potential groundwater contamination or health impacts (Centner 2013). What has become clear is that some of these technologies and processes are generating significant social controversy with hydraulic fracturing, for example, promoting serious debate in Germany, currently banned in France and receiving strong governmental support in the United Kingdom (Cameron 2013). The full range of concerns and impacts of these technologies and processes need to be systematically addressed, and this requires the participation and input of a broader range of stakeholders, alongside technical experts.

Conclusions

This paper has provided a summary of the development and current trajectory of TA research focused on mining technologies and processes currently underway in the Australian context. While mining technologies and processes have not been a strong area of focus in the TA research, it is clear mining activities are interconnected with a range of other resource-use decisions made within society. Further, while mining might be considered an ‘old industry’ and one which will inevitably reach its conclusion in the future, the nature and scale of mining around the world suggests that mining activities are currently expanding and gathering pace. There is a continuing evidence that mining brings significant social and environmental costs but also a range of social and economic benefits. This is not only the case in strong mining economies, such as Australia, but also in emerging resource economies, such as Greenland, which is now grappling with the question of ‘mining the Arctic’ and the kinds of tradeoffs that must be assessed in this social, economic and environmental context. While this national or, in some cases, regional approach to mining tends to dominate current decision-making about resource development, the introduction of issues, such as climate change, quickly makes it evident that these issues are globally shared. Some of the most difficult mining-related matters of the future are those likely to span international boundaries. Invariably, decisions about mining technologies and processes have far-reaching implications for us all. It is in this context of complex decision-making and tradeoffs that TA research and practice provides the opportunity to move beyond the standard technical and descriptive impacts of mining technologies to consider more normative questions relating to how technologies shape the interface between mining and society. This will also allow us to look more closely at how we make decisions about these technologies and our preferred social futures.

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The Rise of New Manufacturing

Transitioning Skills and Technologies into the Future

Janelle Allison, Dayna Broun, Justine Lacey and Sarah Jones

Abstract

Manufacturing plays a critical role in every advanced economy, yet many businesses, particularly in regional economies, face the significant challenge of recruiting suitably skilled workers to keep up with the demands of a now globally competitive market. As manufacturing evolves, so do new technologies, materials, processes and products. The transition from 'old' to 'new' manufacturing brings significant economic, environmental and social benefits. Often described as a 'third industrial revolution', 'game-changing' and 'disruptive', technologies are transforming manufacturing. The impact, when coupled with low skill levels and/or geographically dispersed labour markets, is a significant challenge for regional manufacturers.

This research draws on a case study from a small regional economy in North West Tasmania (Australia) with a long-standing history in manufacturing. It is home to a large global mining equipment manufacturer and a cluster of small engineering/manufacturing firms linked through a common supply-chain network with state, national and global significance. Our research suggests a series of critical transitions is occurring, as firms transition from 'old' to 'new' advanced manufacturing techniques. Technologies and skills are changing as demand increases globally and technology advances. Relevant strategies for workforce and skills development have never been more important. The findings demonstrate significant risks yet considerable opportunities. Collaboration between industry, tertiary education and government agencies is becoming critical in building a global competitive advantage.

Introduction

Manufacturing plays a critical role in every advanced economy in the world today (Roos 2012). The sector contributes to the biggest spending on applied research and innovation in these economies and is a key driver for productivity, contributing to the largest share of world trade and driving export earnings. However, many manufacturing businesses, particularly in regional economies, face the significant challenge of recruiting a suitably skilled workforce to keep up with the demands of a now globally competitive market. This is especially the case as manufacturing is evolving into a highly skilled and competitive sector, with advances in technologies enabling new processes and products to be made every day. The transitions from ‘old’ to ‘new’ manufacturing have many economic, environmental and social benefits. Some are describing this transformation as the “third industrial revolution” (MIT 2012) as it is changing the face of the manufacturing industry as we know it. ‘Game-changing’ and ‘disruptive’ technologies are being introduced to reconfigure products, materials, technologies and processes. However, the impact of these emerging technologies on manufacturing supply-chains throughout the world is not yet fully understood. What is clear, however, is that when coupled with a low skilled or geographically dispersed labour force, these changes are resulting in significant challenges for rural and regional peripheral economies.

This research draws on a case study example of a small regional peripheral economy, which has a historical ‘manufacturing hub’ in the North West of Tasmania, a small island state off the southern coast of Australia. Tasmania’s manufacturing sector is small by global standards. However, it is also significant as it is home to a large global mining equipment manufacturer and an associated cluster of small componentry firms, all linked through a common supply-chain network with state, national and global linkages. Our research suggests that this cluster of regional manufacturing firms is moving through a series of five key transitions. These transitions imply a shift in both technologies and skills. In order to understand these transitions, this research aimed to work with a cluster of firms to develop relevant workforce-planning and skills-development strategies for the future. The findings of this collaborative research involving industry, the higher education sector and government agencies, demonstrates the national and international impact of these changes in regional manufacturing is profound, both in terms of risks and opportunities.

Manufacturing in North West Tasmania: The Case Study Context

Like in many other countries, manufacturing in Australia is becoming less about simple production lines, low-cost labour and high-volume/low-margin products and more about customized high-tech products and designs, specialized services and innovative prototyping and testing. The rise of these ‘new’ types of manufacturing, particularly in regional areas, has meant a decrease in low-skilled jobs resulting in an over-supply of low-skilled workers. Yet there is a severe shortage of experienced, highly technical, highly skilled workers. These ‘new skills’ are rare to find (and hard to attract), hence firms are beginning to adopt a ‘grow your own’ culture within the region. The result is a growing disconnect between the labour market and the availability of the types of education and skills now required to build sophisticated products.

In regional economies, manufacturing occupies an ambivalent position. It is often seen as an ‘old’ industry yet it remains a core economic activity (Liveris 2011). This is the case in North West Tasmania. Recent placed-based economic development plans identify manufacturing as a ‘propulsive industry’ and AusIndustry (2011) data on manufacturing investment, along with surveys of industry innovation (Smith & O’Brien 2008; O’Brien 2010), confirm a significant commitment by the manufacturing sector in Tasmania towards innovation and new production technologies. However, there are also significant challenges facing the sector and a strong reliance on manufacturing in this region. Manufacturing is both the largest employer and the greatest contributor to the region's economy. In particular, many SMEs in this region are dependent on supplying one primary customer that builds underground machinery for the mining sector. As such, the demand for these services invariably follows the 'peaks and troughs' of the mining industry which has a flow on effect to the broader regional economy.

New research that cuts across technology, economics and the social sciences is vital for new innovations and the future success of manufacturing in Australia (Productivity Commission 2003). Businesses must harness research capacity and convert ideas into new products and services in order to gain a competitive advantage. They must collaborate to collectively form capabilities and jointly solve problems. While this is challenging in small regional economies where competition amongst SMEs is often fierce, the localized 'know-how' (e.g. a long trades history and a 'can do' attitude) evident in North West Tasmania affords additional opportunities for the manufacturing cluster to value-add and leverage services to gain competitive advantage.

Research Method

The research was designed, using social network analysis methodologies, to apply the development of collaborative regional solutions to regional challenges and promote a shared vision for industry's future through collective skills development, cooperation between firms and collaboration with other regional stakeholders. Using a combination of interviews, workshops and supply-chain mapping within industry, this research aimed to understand the factors that underpin the regional comparative advantage and how existing advantages may be leveraged to drive regional innovation and adaptive capacity. The study focused on addressing skills shortages by understanding and articulating the real challenges faced by industries as they respond to rapid changes in the sector, including a mismatch in labour supply and demand (both now and in the future).

Forty six (46) businesses were included in the study, spread across a geographical catchment of approximately 70 square kilometres. Interviews were conducted with business managers/owners who were asked a series of questions relating to:

- General business operations
- Supply-chain linkages
- Current collaborative activities
- Education and skill requirements
- Regional assets
- Competition, challenges and growth opportunities

The critical findings from this research were 1) there is a series of critical transitions currently occurring in manufacturing; 2) tailored regional solutions are required for skills development; and 3) collaborative innovations are needed to underpin the regional competitive advantage. It also demonstrated the need to 4) define a direction for the sector and 5) understand and articulate the unique regional capability and specialization.

The Five Critical Transitions in Manufacturing

Our research identified a series of five critical transitions currently occurring in the manufacturing sector which have the capacity to significantly impact the future performance of industry (Allison et al. 2013). The first transition reflects the changing focus from low-value to high-value manufacturing. The importance of manufacturing for advanced economies has now been recognized, particularly since the global financial crisis. Countries which have best navigated the GFC are those which have well-established high-value-added export-oriented manufacturing industries (Roos 2012). This transition is evident in North West Tasmania from the shift towards the production of low-volume, high-value and large-scale mining equipment. The flow-on effect of this shift is the requirement for consistency and quality in the components supplied for this machinery, using more sophisticated equipment, advanced skills and ongoing innovation and improvement.

The second transition is a shift in the mindset and perceptions of manufacturing. No longer equated with the dirty 'smoke stack'-producing factories and unskilled labour of the past, new manufacturing is high-tech and focused on zero waste. In this we are seeing a transition from the 'black arts' to a new green manufacturing future. This requires transferable skills so businesses can successfully make the transition from old operations to new ways of working. The data indicates firms are very aware of the need to change this 'old' perception of manufacturing. It also reveals that the 'sophistication of the craft' is still required. For example, welding is still an essential skill, but when combined with other specialist skills (such as physicists for example) this is where new ideas can be generated that add maximum value to the businesses.

The third transition involves the 'game-changing' shifts that are now transforming manufacturing (Anonymous 2012; MIT 2012). These are the step changes in materials, processes, products and technologies used in manufacturing. In particular, the technologies gaining most attention in this space include additive manufacturing, assistive automation, advanced design and smart information systems (Mak 2012). Many businesses are using new technologies and processes to diversify their business into the supply of niche products, which are often exceptionally profitable in high-cost environments. For example, the design and manufacture of sophisticated machine monitoring, control and guidance systems. In fact, our research suggests that in some cases, business is being brought back into Australia due to superior quality and enhanced performance of local firms. However, the adoption of these new technologies also has social implications for firms, as the human-technology interface requires they not only invest in purchasing new equipment but also in developing the skills to operate it.

The fourth transition is being reflected in the closing of the gap between manufacturing and manufacturing services. There is no longer a clear distinction between the secondary and tertiary services associated with manufacturing. These services are emerging as new commercial opportunities for manufacturing businesses as firms and their customers begin to recognise servicing as a value-added product purchased with the machinery. For example, firms that would normally be seen as constrained by geographical location are beginning to leverage the opportunity to provide quality servicing to remote sites. This transition is still being developed in many cases, but it is closely linked to new forms of business innovations.

Finally, the fifth transition reflects a series of relationships and new partnerships between industry, universities and R&D institutions to broker new knowledge solutions for manufacturing firms. It also reveals how the mutuality of these new forms of engagement is driving new opportunities and new dialogues. Our research indicates there is a desire in the manufacturing sector to engage with external organizations (to build government, education and research linkages). The sector also sees an increased benefit in building stronger linkages between firms to establish collaborative projects of direct commercial benefit, referred to as "coopetition" (Roos 2012).

Designing Tailored Regional Solutions to Skills Development

Understanding the impacts of these key transitions is critical for identifying the skills needed for new manufacturing and the education and training solutions required for adequately equipping the workforce with skills to address present and future challenges for industry. This relates to the key challenge of management capability and the ability to adequately plan the workforce – as a gap needed to be addressed in order to be productive (Green 2009). Skills development and workforce planning were clearly identified as impacting the ability of the manufacturing sector in NW Tasmania to grow. Firms collectively suffer from critical skills shortages and difficulties associated with attracting and retaining suitably qualified workers. In thin and geographically dispersed labour markets like the North West of Tasmania, educational offerings are often 'piecemeal' and firms cannot afford to lose productive workers for the three years required to complete a standard university qualification. The combination of these factors has contributed to low levels of tertiary education attainment in the sector (and therefore the region) demonstrating a need to re-shape and transform our current education practices.

A new form of 'disruptive education' is required – one which reconfigures existing resources and teaching techniques in order to respond to the transitions occurring in manufacturing. It requires education providers to work closely with industry, to re-think how education is delivered, including what is contained in the curriculum, and how this can be embedded into workplace practices through work-integrated learning models. Training options need to be responsive to market demand and equip regional firms with the knowledge that investment in equipment is important, but ultimately it is the investment in people which will underpin their future success and competitive advantage in global markets. Education providers and industry must connect with existing workers and young people, who are the next generation of highly skilled staff, through early skills development and by way of matching appropriate qualifications, skills and jobs. If done effectively, this gives education providers an opportunity to 'skill-up' the supply-chain for the regional competitive advantage. In this case study, three learning pathways were identified and established as a means of addressing technical skills shortages (engineering courses), improving efficiency and performance (lean/continuous improvement training) and recognising and growing potential leadership in the region (management/leadership programmes).

Collaborative Innovation Underpinning Regional Advantage

Finally, the nature of the relationships taking place in and around manufacturing is changing. In particular, a shift is evident in new partnerships between industry, universities and R&D institutions to develop and broker new knowledge solutions. This is revealing how new forms of dialogue are critical to identifying new opportunities for the sector and how ultimately, collaborative innovation will underpin the regional competitive advantage.

However, there remains significant competition between firms, which has traditionally made collaboration difficult. There are also no formalized networks or an industry body that could support the growth and development of the sector in the region (Enterprise Connect & UTAS 2013). In spite of this, firms are beginning to recognize the need to 'gear-up' for future success and the importance of collaboration in enabling this to happen. They also understand that in order to compete globally, they need to develop sector-wide strategies that demonstrate their collective capacity to prospective interstate and overseas investors. In many cases, however, firms do not have the resources or confidence/leadership capacity to actively market themselves through these types of activities. Finding the appropriate support mechanisms to enable this to happen will be the key to enabling competitive advantage for a future success of industry (Porter 1985). Lazzeretti et al (2008) also suggest that firms with a 'related variety' (complementary competencies) have the opportunity to capitalize on local proximity for the benefit of maximizing economic output and enabling global competitiveness to be maintained regardless of location. There is substantial evidence to suggest this opportunity exists in NW Tasmania, however, firms must work together to build on past trajectories, reconfigure resources and establish new forms of dialogue in order to collectively reshape and rethink the future of manufacturing in the region.

One way to break down 'institutionalization' is to engage firms in programs that share and build knowledge into and across formal learning settings. Education providers are ideally placed to play this role as the 'catalysts' for shared knowledge creation and collaboration by offering programmes that target the development of new innovations through a collective generation of ideas. In order to do this, they must embrace new forms of disruptive education and value existing knowledge and experience as a 'platform' for further learning and expansion of skills (Harmaakorpi 2006). As a result of this, new dialogues between education providers and industry are emerging in order to adequately understand the new skills (or skill combinations) required to support manufacturing into the future. Tacit knowledge and strong localized 'know-how' is what has sustained industry in the North West of Tasmania to-date. However, businesses are beginning to recognize this is no longer sufficient and are turning to universities and R&D institutions for assistance with access to new forms of knowledge. This presents an opportunity for education providers to respond with applied-research projects in partnership with industry and tailored training initiatives, which develop skills and encourage collaboration as a solution for the longer term economic success of the sector.

Conclusions

The aim of this research was to profile 'new' manufacturing using a case study of a cluster of firms undergoing a series of transitions in North West Tasmania. It has sought to provide insights into the types of skills and training approaches needed in regional economies in order to foster ongoing innovation and maintain global competitive advantage. Our research suggests that regionally tailored solutions are essential for enabling and sustaining collaboration and capacity building which may, in turn, address the challenges facing manufacturing firms today. It found that building skills education and training solutions with industry is critical for sustaining innovation and a competitive advantage over the longer term.

Overall, this research suggests a platform for collaboration centred on industry participation and capacity building may be helpful in enabling strategic partnerships to occur between industry, government and education providers. This platform may be created through engagement in workforce-development activities in a non-threatening environment (such as a formal learning setting), so firms can come together to build trust, a common language and a collective direction, which will in, in turn, stimulate collaboration. Industry concerns need to be prioritized and addressed through the development of regionally relevant solutions that enable new forms of dialogue to be developed, not only between education providers and industry but amongst firms themselves. This may then lead to the collective 'unpacking' of issues and solutions for the sector. The new dialogues also help to break down traditional cultural barriers or 'stigma' related to high levels of formal education and act as catalysts for change by creating a highly skilled regional workforce and increased competitiveness.

Our case study demonstrates a region which is undergoing a series of significant transitions, as it shifts from historic forms of manufacturing to a new, advanced manufacturing future. Firms are now beginning to recognise that increased networks, information sharing, embracing new skills development and even engaging in R&D may support innovation and the long-term success of the sector. There is also an increasing appreciation for collaboration as a means of maintaining competitive advantage. This research also reveals the game-changing approaches being adopted as a result of 'new manufacturing' techniques. It demonstrates that a new approach to collaboration is needed – one that unites education providers and the government to work with industry and leverage existing resource configurations and local 'know how' to generate new solutions for regional economies. It is only when the needs of regional industries are clearly understood, that industries may be assisted to skill-up, gear-up and provide clever solutions for the future success of manufacturing economies in not only Tasmania but other regional areas throughout Australia.

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ENERGY TRANSITION

Governing Energy Transitions in Post-Communist Countries

The Case of Polish Nuclear Power Programme

Piotr Stankiewicz

Abstract

The plan to build nuclear power plants in Poland is a challenge not only in the technological and investment fields but in the social dimension as well. Introducing nuclear power to the Polish energy system faces controversies of a political, economic, cultural and ideological nature. Implementation of the Polish Nuclear Power Programme, launched by the Polish government in 2009, is therefore a major challenge in the area of public participation in the decision-making process. The purpose of this article is to provide an insight into the nuclear programme implementation from the perspective of the three models of technology assessment distinguished by Wiebe E. Bijker.[1]

Introduction

Since 2009, the Polish government has been implementing the programme to build nuclear power plants in Poland called the Polish Nuclear Power Programme (PNPP). The aim of the article is to provide an insight into the process of the development of nuclear energy in Poland in terms of the implemented technology assessment model. Wiebe E. Bijker distinguishes between three approaches to technology assessment: classical (expert-based), "extended" and participatory model. The first one is a classical technology assessment model based exclusively on experts and scientists, applicable in situations where the risks are known and identified, as it is in the case of asbestos or radioactivity.

The second, "extended", approach goes beyond the classical model and is based on the input from selected representatives of external stakeholders and their experts. The third type of TA, "participatory", should be, according to Bijker, used in case of significant differences in the risk assessment, a lack of social consensus on the desired direction of development and a willingness to accept certain risks. In addition to experts and stakeholders, it should also engage "ordinary" citizens to develop, through a public debate, a coherent solution to issues such as neurobiology and human enhancement technology (Bijker 2013, cf: Klüver et al. 2000, p.114).

Because technology assessment is not an institutionalized procedure within the Polish administrative and legal practices, it is difficult to talk about TA in a different way than implicitly, referring to the elements of decision making that are usually included in the scope of TA. The only formal traces of TA in Poland are the status of an associate member of the EPTA granted to the Bureau of Research and several authors – such as Lech Zacher and Andrzej Kiepas – that have been trying for years to propagate this approach (see Zacher 2012, Kiepas 2012, cf Bińczyk 2013, p. 326-341).

Preparation of the Polish Nuclear Power Programme

The project to build nuclear power plants in Poland was launched in January 2009 when the Council of Ministers adopted a resolution to start the work on the Polish Energy Programme. The programme aimed to launch the first Polish nuclear power plant by 2020 and others (with a total capacity of 6000 MW) by 2030. Polska Grupa Energetyczna S.A. (PGE, Polish Energy Group) was selected as the main contractor. In May 2009, Hanna Trojanowska, previously a director at PGE SA, was appointed the Government Plenipotentiary for Nuclear Energy.A draft of the PNPP also envisaged a two-year education campaign, which was scheduled for the beginning of 2010. It was meant to ensure the public acceptance for the nuclear power plants once the locations were specified.

The problem of managing spent fuel resulting from the operation of a nuclear power plant was entrusted to a team of experts at the Ministry of Economy, which was to prepare the National Plan for the Treatment of Radioactive Waste and Spent Nuclear Fuel.

In September 2010, the process of public consultation of the PNPP was initiated. According to the Ministry of Economy, "the document was sent to more than 100 institutions, associations and ecological foundations (also opposing to nuclear energy)".[2] At the end of December 2010, the Environmental Impact Forecast of the PNPP was also presented for public consultation. In the following years, 2011 and 2012, a cross-border consultations were carried out as well.

In July 2013, the PNPP was recommended for intergovernmental consultations. This meant a minimum of 3-year delay to the scheduled implementation of the nuclear programme. The site selection is now planned for the years 2014 – 2016 and the completion of the construction of the first nuclear power unit for 2024. The PNPP was approved by the Council of Ministers in January 2014.

Site Selection

With the beginning of work on the PNPP, the Ministry of Economy initiated the process of site selection for future nuclear power plants. For this purpose, a ranking of 28 potential sites was submitted to the Ministry by local governments and other entities. Żarnowiec in the Pomerania province ranked in the first place (65.6 points), Warta-Klempicz (59.9) in the Greater Poland province was the second and Kopań (55.8) in the West Pomerania province was in the third place. It was consistent with the common estimates and expectations presented in the public discourse at that time.

Regardless of the ranking provided by the Ministry, one and a half years later, in November 2011, the PGE submitted its own list of three potential sites for the first Polish nuclear power plant, which were Choczewo, Gąski and Żarnowiec. Choczewo and Żarnowiec are located in Pomerania province and Gąski in West Pomerania province in the municipality of Mielno (on the Baltic coast). All three sites were treated by PGE as equal “candidates” for the construction of the first Polish nuclear power plant, and the final choice was to take place within two years, by 2013. But it was only in January 2013 when the PGE announced the completion of the tender offer for a detailed location study, which would have been carried out by atheWorleyParsons consortium and last more than two years.

The Choczewo site (specifically Lubiatowo-Kopalino in the municipality of Choczewo) was previously analysed, and it occupied the 18th position in the ranking of the Ministry of Economy (47.2 points). Unlike Gąski, which was seen as a huge surprise during the public discourse as the site was not included in the ministerial list and had never been considered in the context of building a nuclear power plant.

As a result, still in December 2011, the councilmen of the municipality of Mielno unanimously adopted a resolution opposing the location of a nuclear power plant in Gąski. A few days after the announcement of the PGE decision, the residents began collecting signatures for a referendum which eventually was held in February and ended with 94 % of voters expressing their opposition towards the location of a NPP.

Information and Education Campaign

The governmental plans for the nuclear programme implementation provided relatively much space for social debate. PLN 21 000 000 (about EUR 5 000 000) was allocated for the preparation and implementation of a two-year education campaign. The campaign was to be carried out by a company selected through a tender.

Back in 2009, the Ministry of Economy ordered Implementation of information campaign on nuclear power: Security that pays. The document was written by a private marketing company Partner of Promotion and served as a starting point for drawing up the description of the object of a contract in the Terms of Reference for an information campaign on nuclear power. The tender announced by the Ministry of Economy was won by a consortium composed of Partner of Promotion, Migut Media and Maxus-Warszawa, and the value of the contract amounted to PLN 18 000 000. In April 2012, two years after presenting the ranking of possible NPP locations, the Explore the Atom informational and educational campaign was officially launched.

The aims of the campaign, in accordance with the Terms of Reference, are:

- To increase the knowledge of Poles on nuclear power and to outline the benefits of building nuclear power plants
- To achieve social acceptance for nuclear power development
- To obtain permissions for the construction of nuclear power plants from the residents of regions where the location of nuclear power plants is considered

Simultaneously with the Ministry of Economy, the PGE has been carrying out its "Consciously about Atom" informational and educational campaign, which was launched in 2011. The PGE has been focusing on organizing local consultation sessions, running information centres and reaching out with information to local communities.

Technology Assessment Bodies in the PNPP

The realization of such a major social and technological innovation as nuclear energy in Poland seems to be a great opportunity for the implementation of technology assessment and technological change management, as well as solutions in the area of uncertainty and risk management, risk communication and technological conflict management (see Stankiewicz 2009). However, the Polish Nuclear Power Programme does not envisage involvement of any institution or implementation of any solutions that go beyond the classical, expert-based technology assessment model. This is particularly evident in the Programme guidelines: among the institutions that underpin the implementation of the nuclear programme, there is no entity that would enable stakeholder participation; also, even among the fourteen specific objectives to meet the PNPP's main goal (which is the implementation of nuclear energy in Poland), none of them refers to public participation in the evaluation of proposed solutions. The absence of appropriate institutions, which would allow representatives of social groups to evaluate the options for energy-sector development in Poland, results in strategic decision being made without prior consultation. It has been generating strong resistance and social discontent from the very beginning.

The government's key decision to launch a nuclear project in Poland has not been preceded by a public debate. The strategic policy document for the construction of nuclear power plants was adopted nearly a year after the resolution of the government to launch the work on the PNPP. Even after the nuclear disaster in Fukushima in March 2011, no discussion about the safety of nuclear power plants, the associated risk or the calculation of expected profits and losses has ever been initiated. Instead, it was immediately decided to continue the nuclear programme in the same shape, relying on the belief that the choice of "the-state-of the art" technology of generation III + reactors will ensure our safety. The consultation process concerning the Environmental Impact Forecast of the PNPP was limited to a minimum. The document of 1080 pages was sent for public consultation on December 30, 2010, that is on the Thursday preceding the New Year's Eve, followed by a New Year's weekend and Epiphany, a statutory holiday, a few days later. A period of 21 days was provided for the consultations of this key PNPP document, which is the minimum consultation period required by the Polish law. It was only after the protests of non-governmental organizations, which indicated the breach of provisions such as the Aarhus Convention, the Espoo Convention and directives of the European Union, that the Ministry of Economy prolonged the consultation period until March 31, 2011.

Another example of limiting the technology assessment process and excluding the representatives of other communities and social groups can be the issue of spent-fuel management in the PNPP: it was entrusted to a team of experts at the Ministry of Economy, which prepares the National Plan for the Treatment of Radioactive Waste and Spent Nuclear Fuel. Unfortunately, the author of this article was not able to find any information – neither on the website of the Ministry of Economy, nor in press releases and on websites devoted to energy – on the composition and working methods of the team of experts. It can therefore be assumed that the proportion of people representing different circles in the team is negligible at best.

Participation through Communication?

Public communication in the nuclear programme is limited to education and to convincing the public of the need to build nuclear power plants in Poland. This can be seen in both of the previously mentioned aims of the informational and educational campaign ("broadening knowledge" and "gaining social acceptance"), as well as in the specific objectives of the PNPP. Although no public participation in the process of technology assessment has been ensured, they mention "growth and maintenance of public support for the development of nuclear energy" (goal 7), and "increase of the level of public education in the field of nuclear energy" (goal 8).[3]

The informational and educational campaign planned in the PNPP cannot be considered a solution enabling efficient, participatory technology assessment. However, judging by its goals, it seems that it has never been meant to perform such functions. The concept of the informational and educational campaign, as prepared for the Ministry of Economy, is characterized by:[4]

1. ***PR style***: "gaining social acceptance" is to be implemented by typical marketing and promotional activities and methods such as product placement (placing content related to the construction of nuclear power plants in TV series – so-called idea placement), TV and radio spots and viral marketing. The authors of the campaign write explicitly about "advertising campaigns", "public relations activities", "promotion of nuclear energy."

2. ***The manipulative nature*** of the planned actions aimed at gaining social acceptance by defeating the "enemies" of the nuclear project. For example, in the Third Party Access chapter (p. 62), the authors plan to use the strategy of a "third party", well-known in public relations. It involves the use of individuals and organizations not directly involved in the campaign for the delivery of positive content about nuclear energy to increase the "reliability of operations through presenting them as objective facts provided by a number of parties".
3. ***Ignoring and denying*** the risks associated with the development of nuclear energy; in line with the "Security that Pays" title, the operational objective of the campaign is to strengthen the following messages:

- Modern, "mass", safe and inexpensive energy
- Demonstrating the universality of nuclear energy security/independence
- "Demystification" of Chernobyl
- Development of Polish industry and science

Accordingly, the "key messages" of the campaign include, among others, that: energy is "safe, inexpensive, environmentally friendly, proven and effective". Three of the five key messages are based on a denial of risk (safe, environmentally friendly and proven).

According to the expert-based model of technology assessment, which largely ignores the social context of innovation, the focus of both the "Explore the Atom" government campaign, as well as the "Consciously about the Atom" campaign carried out by PGE, was on discovering the secrets of nuclear technology, introducing the society to the nuances of nuclear physics and the operation of reactors, as well as the essence of radioactivity.

At the same time, administrative, legal, political and investment decision-making processes have almost no representation in public communication. There is no information on the current state of works and on solutions considered for these issues on the campaign websites of the Ministry of Economy and the PGE. There is also no update on the current progress of the work on the subpages of the Ministry of Economy devoted to nuclear energy.

Restricting access to public information can even be intentional sometimes, as exemplified by the situation that occurred in connection with the public opinion polls on nuclear energy regularly conducted by the Ministry of Economy. In response to the author's request for access to the results of polls carried out in the autumn of 2011, one of the employees of the Department of Nuclear Energy replied, justifying the refusal:

"The recent poll showed support falling by 4 percentage points compared to the earlier study. The Ministry would not want to provide the opponents of nuclear energy with the argument that the society does not want nuclear energy."[5]

The refusal to grant access to open information generated with public money in the name of “not providing arguments for the opponents of nuclear energy” does not have much in common with a transparent decision-making process that allows public participation.

Conclusions

The analysis of the implementation of the Polish Nuclear Power Programme carried out in this article, in connection with the issue of technology governance, shows that the classical expert-based approach to technology assessment is being realized. It is aimed at convincing the public to accept decisions already made and does not take into account the inclusion of relevant social groups in the decision-making process in a way that goes beyond administrative consulting concerning new legal acts.

Because the debate on nuclear power in Poland has begun nearly thirty years after it took place in other Western countries, it is worth taking an advantage of this kind of “benefit of backwardness” and basing the debate on the experience of other countries – both those associated with nuclear plans, as well as those connected with the operation of technology assessment bodies – in order to use the process of nuclear energy implementation to develop the respective spheres of competencies by public institutions and Polish companies. The work on the PNPP could be a “window of opportunity” that – if properly used – could be utilized not only to create a Polish nuclear industry but also – based on experiences from other countries – to deploy a technology assessment system in Poland that would be adapted to our conditions and would take into account our cultural and political specifics. This could be the perfect first step for preparing for – already ongoing in the West – discussions and disputes regarding nanotechnology, neuroscience and the consequences of the development of genetic engineering. However, the above analysis clearly shows that the actions accompanying the PNPP strengthen the current technocratic model of decision-making rather than use the opportunity to implement the new practice of technology assessment.

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Energy System Transformation – Governance of Trust?

Patrick Sumpf, Christian Büscher and Carsten Orwat

Abstract

The following article deals with the social premises of large-scale energy transformations toward smart grids from a consumer perspective. Visions of such transformations often encompass a changing role of consumers who are supposed to become increasingly active in dealing with new markets, technologies and organizations in future energy systems. Such development towards increased reflexivity, decision-making and complexity in consumer activities presupposes the mobilization of trust as an action-enabling mechanism. This social prerequisite is likely to develop into a major challenge for energy transition projects as both an enhancing or blocking component, creating opportunities and risks. Drawing from a discussion of trust, distrust and confidence, we conclude that an increasing need for a systematic occupation with trust on different levels of future energy systems will arise – "Governance of Trust". Subsequently, we present first results from theoretical and empirical research conducted for the "Systemic Risks in Energy Infrastructures" project of the Helmholtz-Alliance ENERGY-TRANS.

Energy Systems as Smart Grids

Energy systems around the world are in transition. Visions of future energy systems as in the German "Energiewende", for instance, comprise transformation toward decentralized energy generation due to renewable energy integration, creating a network of various energy sources, distributive structures, storage capacities and, most importantly, inclusion of active consumers (Ramchurn et al. 2012). In Europe, numerous projects on so-called "Smart Grids" are operated in order to evaluate opportunities for the implementation of innovative technical components like sophisticated grid sensors or "intelligent" information and communication technologies (ICTs), as well as innovative social arrangements like novel market mechanisms (see JRC 2013). One distinct feature of smart grids is the application of "smart meters", enabling two-way communication between consumers and suppliers.[1] Thereby a major element of current energy scenarios is the widespread interlinking of households, commerce and industry into an intelligent system of energy management, mainly via smart-meter communication, so as to improve efficiency, environmental protection and affordability of electricity (ibd.).

With regard to the overall socio-technical complex of energy supply, the organization of generation, transport and distribution of electricity has to be aligned to a crucial equilibrium of demand and supply coordinated chiefly by ICT signalling mechanisms in the envisaged smart grid (Pearson 2011; Ramchurn et al. 2012). It is in this way that the integration of volatile renewable energy sources (RES) is enabled, as consumers should not request too much electricity in times of low RES output, for instance. At times of high shares in RES generation, oppositely, customers are supposed to concentrate their use of electricity in order to shift so-called "peak loads". Not only, according to technical prerequisites in dominating visions, does this result in higher energy efficiency, it also serves the purpose of "grid-supportive" measures required to secure grid stability and security of supply (Amin/Stringer 2008; B.A.U.M. Consult 2012). As a consequence, accompanying this vision is the widespread idea of provoking "prosumers", i.e. active consumers adapting their energy-consumption behaviour on the basis of smart meters and becoming engaged in energy trade, helping to maintain electricity availability and contributing to the overall grid performance if necessary. In doing so, formerly passive consumers are supposed to increasingly develop an active future role in dealing with electricity devices as well as being able to act as electricity vendors in "Virtual Power Plants" and "Smart Markets" (e.g. Amin/Giacomoni 2011; Bundesnetzagentur 2011; Ramchurn et al. 2012; B.A.U.M. Consult 2012). Concrete activities of prosumers could, among others, comprise the use of certain electrical appliances (e.g. heat pumps, air-conditioning, washing machines) at given times, depending on grid conditions, or the discharging of electrical-vehicle batteries to the grid, for instance, responding to signals in order to secure the demand-supply equilibrium (ibd.). Measures of this kind are conceivable among private, commercial and industrial consumers, whereas our focus is on broad household usage of smart grid appliances and respective patterns of behaviour. Tackling the issue of smart grid development in this way, we genuinely follow the basic assignment of technology assessment (TA) – to expose the premises of prospective technology programmes, analyse their secondary problems and bring all societal consequences to full display.

Acting in Socio-Technical Constellations

Problematically, a common neglect in technology-oriented energy visions is the dimension of "social volatility", i.e. the potential for atypical, dysfunctional consumer behaviour, which may run counter to the technically required smart grid operations for system stability. Indeed, the relationship between the natural volatility of renewable energy sources and the social volatility of consumer behaviour is of central importance in the transformation of energy systems: at any rate, future consumer experience with smart grids is likely to lift the formerly latent "background" processes (permanent supply of electricity with little access points to the system) into persistent manifestation, as active dealing with energy issues becomes a significant matter of everyday life. Consequently, this development would lead to a qualitative change concerning the degrees and forms of trust consumers and associated actors have to invest into novel technologies, markets and supervisory agencies and the control and sanction systems encompassing them. Trust, in this way, becomes effective as action-enabling mechanism among electricity consumers confronted with unfamiliar uncertainty and complexity, bridging the gap between the "social" and the "technical" (Edwards 2004, 209).[2] In conclusion, trust determines the degrees of social volatility (Do I trust or distrust smart meters?) and is, therefore, the social cornerstone of consumer behaviour and the resulting effects this may have on an overarching, systemic scale. What are the conceivable consequences of such development?

The Impact of Trust

The special quality of trust in relation to smart grids concerns its enormous dependency on the behavioural conformity of consumers in terms of "appropriate" smart-meter usage or economic activity (= trust), as incorporated in many dominating visions, turning it into a major issue in energy-transition projects around the world. In this way, actions of individual smart-meter users and small-scale electricity vendors in emerging markets may have significant cumulated effects on the overall rationality of the energy system, potentially altering efficiency, environmental protection and security of supply aims. A qualitative change regarding the significance of the ordinary customer's behaviour for the functioning of the whole can be associated with this development. Consequently, the average consumer becomes a central actor within the future energy system, equipped with a high degree of decisional autonomy. In case of potential catastrophic consumer perceptions like power outages, data protection problems or loss of control frames against the background of potential autonomous software agents, consumers can plausibly be assumed to have the right and the possibility of denying and altering operations with smart meters. This leaves sufficient probability for cumulated effects like collective distrust against the new grid or parts of it.[4] Following this scenario, consequences of lacking trust could constitute a failure of the overall system function, particularly as a follow-up of smart-meter refusal by broad consumer groups. Accordingly, it is unlikely that consumers fully fathom the algorithmic depth of smart meters and thus have to trust the devices as "black boxes".[5] Comparable "emergent effects" (Greve/Schnabel 2011) of cumulated, collective behaviour have been observed with the rejection of E10 biofuel in Germany, for instance (d'Arcy Hughes 2011), sudden investment withdrawals in the financial sector (Shapiro 1987) and periodical or even constant distrust of the food sector as with EHEC in Europe (Sumpf 2013) or milk powder in China (Zhang 2013). Therefore, dispense and withdrawal of trust in systems (Giddens 1990) and the mechanisms and consequences surrounding it develop a special significance within complex, opaque and overarching trust chains as in tangled energy transformations, creating the systemic risk (Büscher 2011; Orwat 2011) of energy system failure (power outage, market breakdown) by consumer trust withdrawal.

Trust and Confidence

Following the above events, if reflexivity among average customers should in fact increase, the resulting scientific observation concerns the rise of particular problems of trust and confidence. Trust is a social mechanism allowing for action under uncertainty and becomes growingly important when decision demand and complexity increase (Luhmann 1979;

Coleman 1990; Möllering 2006). Confidence, on the other hand, is a relative of trust, but it is not bound to decision-making as disappointments of confidence are attributed to external factors rather than to one's own decision in case of regret (Luhmann 1988). Following this distinction, one would rather (explicitly) trust in the electricity-price stability of one's own chosen supplier and (implicitly) experience confidence in the general stability of electricity supply, for instance. If one followed the smart grid visions described hitherto, trust investment into smart meters (software agents, correct algorithms), trading partners (Virtual Power Plants) and supervisory institutions (control and sanction agencies) would be required, to name the least. Confidence is requested in terms of a general optimistic attitude toward the functioning of the overall energy system, be it clarification of responsibilities, security of supply or legal security. The transformation into smart-grid energy systems is now likely to cause a pattern shift from confidence to (system) trust among consumers and therefore, growingly, a shift from problems of disappointment attribution towards external factors (e.g. politics, provider, supervision) to self-reference, i.e. one's own decision(s).[6] This shift in trust patterns is likely to occur as a consequence of new business opportunities and increased choice requirements between decision alternatives for consumers in smart-grid energy systems (which provider, which tariff, which business co-operation, what time does my dish-washer run etc.). For active "prosumers" to be endowed with action capacity within this diffuse new system, trustworthy decision-making embedded in a climate of general confidence into (parts of) the overall system would be necessary. The relationship between confidence and trust in this way can be described by mutual spirals either of reinforcement (virtuous circle) or weakening (vicious circle), determining the future condition of the system (Luhmann 1988, 104). Virtuously, confidence and trust will mutually stabilize each other and create an atmosphere of business optimism and massive exploitation of the new smart grid possibilities in technology and markets. A vicious scenario could be a situation of households equipped with potentially mandatory, "empowering" smart meters but distrusting, possibly little confident users who would, unintentionally, redirect the expected overall effects from the new grid by behaving outside expectations.

Blind Trust

All of this is not to say that a lack of trust among consumers is a negative development in any case, nor is it an advocacy toward some sort of a "trust creation" for smart-grid implementation – it is simply dysfunctional with regard to what is expected of "prosumers" by the majority of smart-grid practitioners, promoters and stakeholders (e.g. BMWi/BMU 2011; JRC 2013). On the contrary, distrust can serve an important function of learning and remaining mindful of sudden societal changes, which is a crucial prerequisite of a system's reproduction, particularly in times of transformation or crisis. Sociologically, distrust is not the opposite of trust but its functional equivalent, reducing complexity into a narrow action corridor by making a few actions probable and certain others highly unlikely (Luhmann 1979, 71ff). In other words, distrust provokes counter-strategies to circumvent the distrusted situation or object by means of a search for alternatives, boycott, aspiration for autonomy etc. In comparison to a lack of trust, which can hold back actions from being executed at all, a distrusting attitude typically also results in a mobilization of action potential. In this way, it can counter developments of trust/distrust equilibriums tipping towards the trust side, adding up to "blind trust" by promoting affirmative decision-making in areas of massive needs of "ignorance exploitation" (Strulik 2006). This can be seen in grand-scale energy transformations with the aim of treating sectoral innovations as productively as possible. With further reference to the equilibrium paradigm, an extensive increase of (potentially unjustified) trust into the emerging smart grid objects (technologies, markets, organizations) and respective large-scale practice by broad consumer groups in transformed energy systems could also amount to a source of systemic risk – in everyday life, we would possibly speak of "carelessness". In this way, the often one-sided demand for trust toward non-transparent mechanisms of highly innovative economic branches like smart grids can contribute to a dysfunctional state of overdrawn trust in the system, keeping the relief function of partial distrust rather low. Trust in this way can evolve into a "risk fertilizer", into blind trust, which raises risk dynamics through unreflecting demand and operation of trust actions. This results in an unquestioned way of dealing with trust conditions and consequences in order to give way to the unfolding of economic innovation potential.

Governance Structures and Institutions

In current energy systems, complex governance structures with detailed regulations, standards and conventions of security responsibilities, roles, rights and duties are directed towards maintaining the overall confidence in the reliability of electricity supply. Such regulations and institutional arrangements (e.g. Ruthig 2011) are mainly relevant for commercial actors and business-to-business relations among network operators, i.e. transmission-system operators and distribution-system operators as well as energy generation facilities. Although average consumers have little or no knowledge of the actual operations, effectiveness or working details of this complex arrangement, our thesis is that the observation of their existence and functioning is nonetheless a crucial trust factor for electricity consumers (e.g. Luhmann 1979, 57). We further assume that their existence largely contributes to the formation and maintenance of confidence in the functioning of the entire electricity system, backed by long-term experiences of stable electricity supplies. As Edwards (2004, 185) points out: "The fact is that mature technological systems reside in a naturalized background, as ordinary and unremarkable to us as trees, daylight, and dirt. Our civilizations fundamentally depend on them, yet we notice them mainly when they fail, which they rarely do". Against the background of little or no direct interaction with the so-called "energy system", for the general population the existence of infrastructures realizes itself in failure, and we rely on the assumption that "some agency" is supervising.

If one takes the outlined developments toward the smart grid for granted, the extension of confidence relations toward new trust relations including active consumers or "prosumers" requires that governance structures also have to be reconsidered. However, the possible shift from confidence towards system trust by increased demand for decisions and more actively trusting market partners, technologies and organizations may be a burden too great to deal with for individual “prosumers”. In particular, information asymmetries resulting from information advantages by trading partners (Akerlof 1970) can go against these partners trusting each other – the worst case being that co-operations or markets do not arise or break down in the sense of the vicious-circle scenario outlined above. These arguments may offer rationales for providing “institutionalized distrust” either by creating new institutions or revising or extending the above-mentioned conventional security regulation and governance structures in future energy systems. In analogy to the global financial system, “guardians of trust” (Shapiro 1987, e.g. rating agencies) are likely to play a crucial role in order to possibly ensure the formation of market networks, like Virtual Power Plants, or signal trustworthiness of smart meters towards consumers. In smart grid visions, such institutions may encompass certification agencies, market intermediaries and online platforms that provide recommendations, establish reputation or signal certain qualities to increase the probability for market and technology interaction (Ramchurn/Huynh/Jennings 2004; Pearson 2011; B.A.U.M. Consult 2012; Orwat 2011). With reference to the prior paragraph, the result can be an additional boost and acceleration of market transactions by providing supposedly trustworthy decision support in otherwise opaque social constellations, driving the high demand for trust as an “action enhancer” toward the risk of an inflationary trust development.

Conclusions: Governance of Trust as Emerging Challenge in Energy Policy?

Reflecting all of the prior, trust seems to develop a role as “reverse salient” (see Hughes 1986) in energy transformation – it is likely to become the central resource in socio-technical energy constellations, determining the possibilities of future transformation of energy systems either as an enhancing or blocking component. In any case, both types pose a risk to the overall rationality of envisioned smart-grid energy systems. The special relation between trust and confidence, in this way, is likely to complement discussions on “public acceptance” of energy transitions as the major social challenge in energy policy in the decades to come (see Kasperson/Ram 2013).

We predict that a need for the systematic occupation with trust as an explicit component and target of governance instruments will arise, an issue we call “Governance of Trust”, without intending to support an idea of “trust-building” in smart grids. Instead, the equilibrium between trust and distrust as complementary social mechanisms is likely to play a key role in the future governance of smart-grid energy systems as well as the prospective pattern shift from confidence to system trust. Therefore, conventional security governance by means of detailed regulation and traditional legal intervention as outlined above could be complemented by a stronger focus on trust symbols and related trust sensitive factors, commonly responsible for variations in trustworthy behaviour. To find further indicators for the influence of trust/distrust equilibriums on different levels of the energy system (e.g. households, corporate actors, public opinion) could be a task for research aimed at finding action recommendations, e.g. for political, non-governmental and/or economic organizations facing respective governance challenges.

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Stakeholders and the Development of Bioenergy Markets

The Proposition of Clear Priorities

Kerstin Schilcher and Johannes Schmidl

Abstract

Biomass stakeholders from eight Central European countries (Austria, Czech Republic, Germany, Hungary, Italy, Poland, Slovakia, Slovenia) were invited to express their respective opinions and assessments concerning the framework conditions for bioenergy, the national biomass action plans and national renewable energy action plans, measures and instruments for the support of bioenergy, the prospects and the most favourable markets for bioenergy deployment and the role of bioenergy in relation to other renewable energy sources. The purpose of this article is to showcase what the stakeholders expected of their nBAPs and their nREAPs. The presented results of the transnational Stakeholder Dialogue concentrate on which renewables will provide most additional gain, and which kind of biomass-utilization will be most important for reaching the nREAPs-goals.

Introduction

In December 2005, the European Commission presented the Biomass Action Plan with the aim to cope with the increasing dependence on imported energy and to develop a new energy policy strengthening competitiveness, sustainable development and the security of supply. It is in this wider context of an integrated and coherent energy policy and, in particular, of promoting renewable energy sources that the European Commission encouraged member states to establish national biomass action plans (COM(2005)628final).

The Biomass Action Plans were supposed to identify available biomass reserves, to quantify the biomass share in the current demand and to point out the potential for utilization. Furthermore, they should describe the member states' strategies for promoting bioenergy use in heating and cooling and electricity and transport sectors and the instruments and measures to implement them. Several countries have developed such Biomass Action Plans accordingly. However, with the introduction of the National Renewable Energy Action

Plans (nREAPs), a separate national Biomass Action Plan was no longer required. Still, it should form an integral part of the overall nREAP, especially chapters concerning bioenergy policies.

The European Commission (EC) established a template for the National Renewable Energy Action Plans (nREAPs) in the Directive 2009/28/EC. This directive required all member states of the European Union to submit the nREAPs to the EC by 30 June 2010. The national Biomass Action Plans (nBAP) formed an important part of them. In particular, the nREAPS had to contain information on targets for renewable energy in the heating sector and corresponding policy instruments for achieving these targets. Thus, with the European Directive for renewable energy (Directive 2009/28/EC, 2009), the heating sector became a focus of European Energy Policy (Kranzl et al. 2013). This will require considerable efforts for the development of RES potential in Central Europe. As bioenergy is currently the most important source of renewable energy in this region (Kalt et al. 2010), it will be crucial to further increase its use in a responsible way, with regard not only to economic development but also to environmental and nature protection issues as well to social impacts. The purpose of this article is to showcase what the stakeholders expected of their nBAPs and their nREAPs. The presented results of a transnational Stakeholder Dialogue, concentrate on which renewables will provide most additional gain, and which kind of biomass-utilization will be the most important to reach the NREAPs-goals. The research was carried out within the framework of the 4Biomass project, which was financed by the EU INTERREG IVB Programme for Central Europe and the European Regional Development Fund, was developed with the vision to promote an integrated, sustainable and efficient bioenergy policy in Central Europe. Project partners from Austria, the Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia established comprehensive studies on political framework, available domestic biomass potential and trade within the countries and beyond.

Stakeholder Dialogue

Between November 2009 and September 2010,[1] biomass stakeholders from eight Central European countries (Austria, Czech Republic, Germany, Hungary, Italy, Poland, *Slovakia*, Slovenia) were invited to express their respective opinions and assessments concerning the framework conditions of bioenergy, the national biomass action plans, measures and instruments for the support of bioenergy, the prospects and the most favourable markets for bioenergy deployment and the role of bioenergy in relation to other renewable energy sources. As a part of collecting information about the role of the nBAPs about strategies for reaching the respective national goals and about the best support mechanisms for renewable energy sources, an online questionnaire was developed and a stakeholder-dialogue was started. The “Stakeholder Dialogue” method was chosen in order to give stakeholders an opportunity to give feedback on the national action plans and a chance to directly recommend to policy-makers how to improve the design of bioenergy policies.

In addition, this method allowed for an analysis on a national level as well as on a cross-country level. The relevant stakeholders identified were, for example, companies concerned with bioenergy, associations, research institutes, individual experts and interest groups.

Based on the results of collecting information about the role of the national Biomass Action Plans (nBAP), about strategies to reach the respective national goals and about the best support mechanisms for renewable energy sources, an online questionnaire was developed and a stakeholder-dialogue has been carried out. The 1 221 stakeholders who filled out the questionnaire, or at least parts of it, responded to a list of questions in national languages, which were identical for all of the eight national teams. This article refers to the answers to this set of identical questions.

The questionnaire was developed by the Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe e.V. FNR) in close cooperation with the Austrian Energy Agency and completed by the project partners in a stepwise approach. The completed questionnaire was translated into the national languages of the participating countries and was put online in November 2009. It was modestly adapted to the respective national requirements, but most of the questions were the same for all of the participating countries. The questions of the survey were concerned with the following: framework conditions of bioenergy, the national biomass action plans (nBAP), measures and instruments for the support of bioenergy, prospects and most favourable markets for bioenergy deployment and the role of bioenergy in relation to other renewable energy sources.

The online survey was closed in September 2010 (Schilcher/Schmidl 2011). This article includes a detailed analysis of the outcome of the survey, including recommendations for the design of bioenergy policies in Central Europe. The report only refers to the part of the questionnaire that was the same for all of the participating countries. A second group of questions referring to specific national legislations and features was evaluated separately, and the individual national reports can be found on the 4biomass-website.[2]

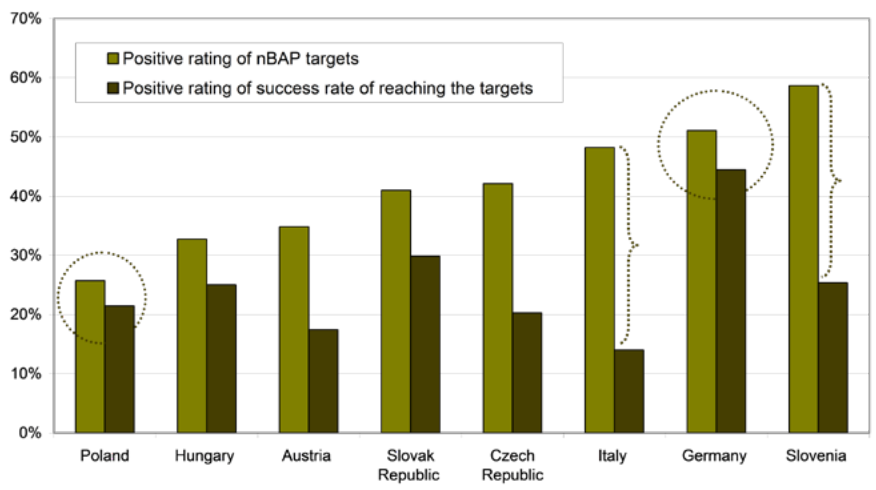
The largest group of respondents came from Germany with 213 experts (or 17 %), followed by the Czech Republic (166 or 14 %), Austria (138 or 11 %), Slovakia (130 or 11 %) and Poland (124 or 10 %). Italy was represented by 117 persons (10 %), Slovenia by 115 experts (9 %) and Hungary by 90 (or 7 %). A group of 119 experts (or 10 %) did not disclose their country of origin.

Regarding the professional background of the respondents, a slight bias towards science and research can be observed, which can be partly explained by the composition of the consortium of this project. The largest group of experts was from the science or research sector (208 experts or 22 %). The services and consulting sector was represented by 154 persons (or 16 %), followed by end (energy) users (145 persons), industry (125 persons) and company (113 persons) representatives (Schilcher/Schmidl 2011).

Results

The stakeholder rating of nBAP-targets and of the success rates of individual countries in reaching these targets show that stakeholders endorse the nBAP targets but remain sceptical with regard to reaching them. Experts from Hungary and Poland are the most critical of their nBAPs, and experts from the Czech Republic, Germany and Slovakia like them. Regarding the likelihood of reaching the overall targets of their BAPs, significantly more experts think that their countries will not reach them than that they will reach them (40 % vs. 25 %). Experts from Austria and Hungary are particularly critical, and German experts are the most confident that the overall targets will be reached.

Experts working for governments or in the services sector are more frequently in favour of their action plans than the respondents engaged in associations or in companies. The support for the targets of the respective national BAPs by experts who work on the national or international levels is lower than by those who work on regional or local levels. The same can be said of the estimation for reaching the targets of the respective action plans: the more internationally the experts are working, the more sceptical they are. Civil servants and policy experts praise the overall goals of their BAPs in general, yet, at the same time, they do not see much chance of reaching those goals. Experts working for companies and associations are sceptical with regard to reaching the overall goals, too, and energy end-users, in contrast, are more optimistic.



Positive = "very good" and "good" | Questions: How do you rate the nBAP targets of your country? (n=580); How do you rate the success rate of your country in reaching these targets in the future? (n=550)

Figure 13: Positive rating of targets of the BAPs vs. rating of success rate of reaching the targets

Figure 13 indicates that, especially in Italy and Slovenia, there are large differences between the highly valued targets of the BAPs and the lowly rated probabilities of success. We interpreted that the targets in these countries could be too ambitious. In Germany, on the other hand, there is a high correlation between the approval of the targets and the probability of success. In Poland, in turn, both the targets and the probability of success were regarded by the experts as poor (Schilcher/Schmidl 2011).

One distinct and politically highly relevant response is equally significant in all the participating countries and with respect to all sectors of stakeholders analysed: biomass for heat will most significantly contribute to the reaching of the nBAP goals (see Figure 14). This clear message remains applicable even if biomass is compared to other renewable energy sources like wind and hydro.

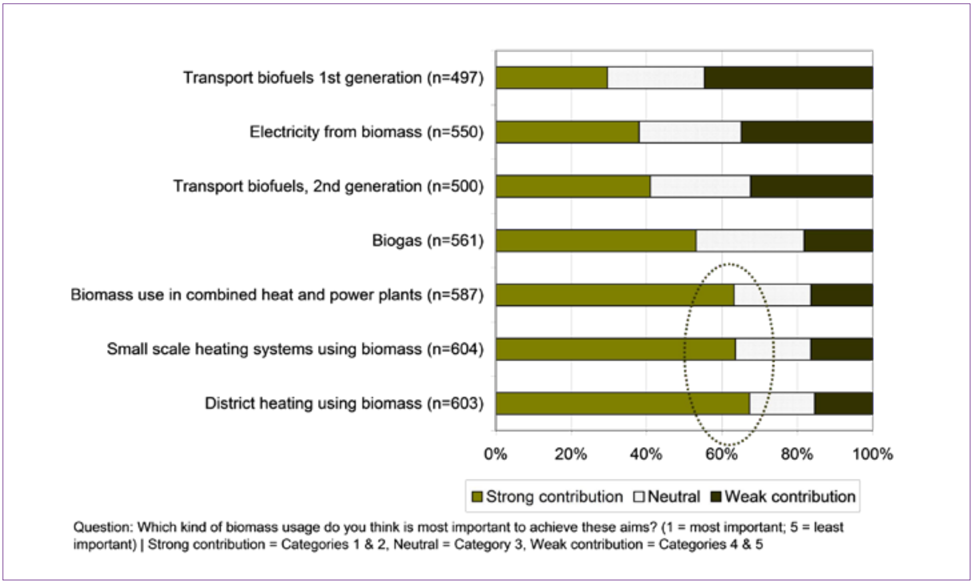


Figure 14: Importance of different biomass technologies for achieving the nBAP goals

The experts´ assessment of the best strategies for reaching the goals of the national BAPs differed according to the sectors of electricity, heat and fuel.

- For electricity production, the most important measure is financial support, especially in the form of feed-in tariffs. Experts from Austria, Poland, Hungary and Slovakia in particular demanded higher feed-in tariffs.
- To reach the goals of the national BAPs in the area of heat, the experts argued that it is most important to reduce the costs for the "hardware" like stoves and boilers, to increase the availability of biomass and to offer financial incentives for investments.

- The best way to support biofuels is to reduce their costs by tax exemptions, reductions or refunds. It was also emphasized that the support of research and development is important in this area.
- In some countries, notably Italy, Poland and Hungary, the experts noted the low availability of national biomass resources in general (Schilcher/Schmidl 2011).

And what is the importance of renewable energy sources in the future? Heat from biomass will, even if compared to other renewable energy sources, provide the most additional gain in primary energy supply for their respective countries in 2020, the stakeholders state. At the same time, however, 60 % of the respondents, final energy-users in particular, argue that heat from bioenergy will need more support for market introduction. The additional contribution to energy consumption by electricity from biomass was ranked second, followed by solar and wind energy. Hydrogen from renewable sources and liquid biofuels of the first generation will, according to the consulted experts, provide the least additional gain in primary energy supply (see Figure 15).

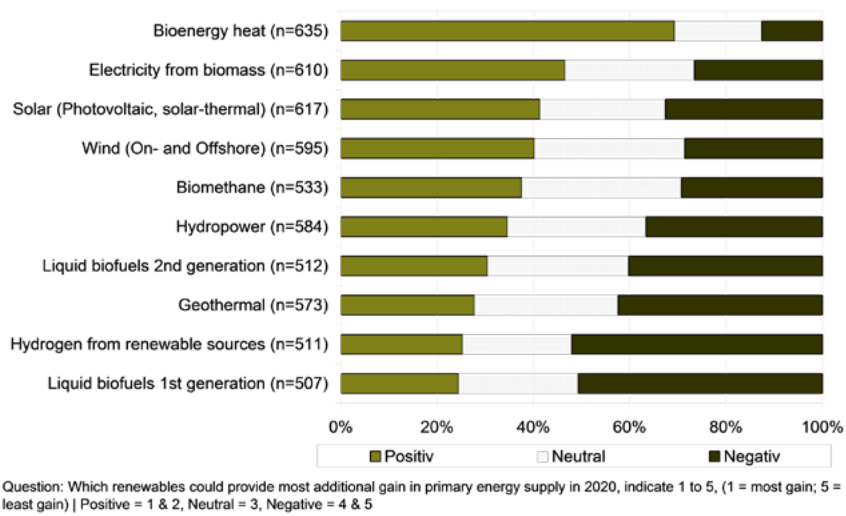


Figure 15: Additional gain in primary energy supply in 2020?

In a nutshell, the result is clear: heat from biomass, both small scale and from district heating plants, will be the most important renewable energy source, both as compared to all renewables in general, and to other forms of biomass in detail.

Measures for Reaching the nBAPS Goals

Respondents were asked what were the most successful strategies/measures for reaching the overall goals of their nBAPs? To support market integration of technologies for electricity production, the consulted experts considered feed-in tariffs, reduction of costs for products and financial support for research and development most important. Least important to support market integration are quota systems for biofuels, voluntary schemes and premium tariffs.

To reach the goals of the national nBAPs in the area of heat, the experts argued that it is most important to increase biomass availability, provide financial support for investments and for research and development and reduce the costs of products (technologies). Similarly to the answers above, quota systems, voluntary schemes and premium tariffs were not regarded as effective for supporting market implementations of heat technologies.

To support market implementation of biofuel technologies, the most important thing is to reduce the costs of the products (technologies) and provide financial support for research and development. However, experts also argued that it is important to set sustainability criteria and verify the compliance of these criteria. Tax exemptions, reductions or refunds and a shift of the system of taxation towards eco-taxations are other measures that would support market implementation of biofuel technologies. Again, voluntary schemes and premium tariffs do not seem to be adequate measures for supporting market implementation of biofuel technologies, neither are capital grants or tradeable certificates.

Conclusions

The Stakeholder Dialogue within the 4Biomass project was an opportunity for biomass-stakeholders of the Central European region to give feedback on the national action plans, and a chance to indirectly recommend to policy makers how to improve the design of bioenergy policies. It resulted in a clear vote for local and regional use of biomass for heating. This utilization path lowers greenhouse-gas emissions, reduces energy costs and provides long-term job opportunities.

All Partner Countries of the 4Biomass Project possess a considerable biomass potential, however, the stage of its development is very different. Although European directives and as well national promotion schemes have enabled a significant progress in recent years, this progress has led to quite uneven results. The highest increase of biomass as a share of the total energy consumption in Central Europe from 2000 to 2007 was achieved in Germany (+ 4.5 %), Austria (+ 3.5 %) and the Czech Republic (+ 3.2 %). At present, Germany is accountable for slightly more than 50 % of the total biomass production and consumption among the Partner Countries (Kalt et al. 2010). Nevertheless, for securing domestic demand and achieving EU targets, it will be necessary for most of the Central Europe countries to import a certain amount of biomass.

Biomass is a limited resource that should be used as efficiently and economically as possible. National, regional and local governments should stimulate the heat and cold production from locally available biomass, if possible in cogeneration with electricity based on biomass supplies from areas within a radius not exceeding a stipulated number of kilometres. This can be an alternative to promoting large scale electricity production, which requires supplies from remote areas.

Despite all differences in the perception of national policies and efforts with respect to further development of renewable energy systems in the Central European States (Austria, Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia), one signal remains constant if bioenergy-stakeholders are being asked: they favour and recommend the most traditional and relatively easy-to-develop market of heat from bioenergy. This can be both small-scale systems for single houses and district heating systems – also existing ones, where biomass-boilers would replace existing fossil-fuel fired boilers.

The results of this survey show that the local use of biomass for heating purposes is favoured as a simple and cost effective solution for reducing emissions of greenhouse gases.

Further recommendations, based on the outcomes of the 4Biomass project, for policy-makers and implementing authorities towards sustainable bioenergy development by a joint and consistent policy approach with regard to biomass for heating and cooling:

- Give heat production the equal support as electricity generation. Support should be given to energy production from biomass on the basis of net GHG emission reductions. Introduce feed-in tariffs or green certificates for heat.
- Continuously promote energy-efficient bioenergy technologies and require fast socially acceptable and economically viable deployment.
- Introduce incentives for consumers to replace inefficient technology.
- Use existing district heating grids for transporting bioheat (and cooling) within local and regional areas.
- Accelerate construction of new heating and cooling systems in the context of integrated urban planning.
- Withdraw support for co-firing biomass with fossil fuels.

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Scenarios for Potential Biomass Futures in the Tri-National Upper Rhine Region

Martin Knapp, Kira Schumacher and Nora Weinberger

Abstract

The integrative multi-disciplinary approach of the 'OUI Biomasse' project deals with a systemic perspective on bio-energy within the transformation of the energy system on a regional scale. Using scenarios as a central instrument of the concept, most sustainable means of biomass utilization on the way to a cross-border biomass strategy for the tri-national metropolis area named 'Upper Rhine Region' (URR) are investigated. Therefore, special attention is paid to the background of scenario-building and to basic methodological steps for depicting alternative pathways for future biomass utilizations: identification of key factors and an assessment of their respective relevance and incertitude, analysis of cross impacts and a combination of compatible shapes of key factors into scenarios, thus enabling a stakeholder dialogue about the best elements for a regional roadmap to a sustainable utilization of biomass.

Introduction

In the aftermath of Fukushima, Germany's highly discussed accelerated nuclear phase-out and the political endeavours to initiate fundamental changes and transitions in energy production – including an extensive reduction of the usage of fossil energy carriers in order to meet the internationally agreed CO_2 goals (Hoffert et al. 1998)[1] – will radically change the energy system in Germany and in many other countries as well. Today, fossil and nuclear energy carriers account for 85 % of the German primary energy supply by 2050, this share should be reduced to a maximum of 20 %, mainly to prevent major climate changes. This transformation of the energy system towards a more sustainable energy supply, with benefits in terms of greenhouse gas emissions, energy security and rural development (Commission of the European Communities 2005), entails a growing demand for bio-energy, focussing on biomass as a limited resource for target products in the sectors of heat, electricity and fuels (Demirbas et al. 2009). Thus, biomass has the potential to become one of the major global primary energy sources during the next century (Hall et al. 1997, European Commission 1997, Kartha/Larson 2000). This can be seen in the fact that the sustainable utilization of biomass resources plays a central role in current EU energy and climate strategies (Kautto/Peck 2012).

Even though the potential of the so far unused biomass is high (Commission of the European Communities 2009), the increasing utilization of biomass brings along great challenges in sustainability due to social, ecological and economic impacts (Upreti 2004). These could spark a discussion on how the expanding bio-energy sector would interact with other demands associated to land use, such as food production, biodiversity, soil and nature conservation (e.g. negative environmental impacts of mono-cropping) and carbon sequestrations (Pregger et al. 2013). A well-known example of this aspect is the competition between fuel tank, feeding trough, and dinner plate. In addition to this, the synergies between the different utilizations have to be taken into account. This would facilitate an improved understanding of the prospects for widely applied bio-energy, for future land-use and for biomass management in general and benefit the question of how the mentioned impacts could be avoided or mitigated.

The 'OUI Biomasse' Project

Against this background, sustainable biomass utilization requires a comprehensive technology-assessment approach taking into account the whole supply chain, divergent usage options, regulatory and industry framework conditions and locally specific environmental and social conditions. This approach was applied in the 'OUI Biomasse' project as a part of which a multidisciplinary collaboration with scientists from all major research institutions in the cross-border Upper Rhine Region (URR) had been set up, unifying the specific knowledge of economists, engineers, physicists, forestry scientists, biologists, chemists and sociologists (DFIU 2013).

The URR consists of four sub-regions (Alsace, North-Western Switzerland, Southern Palatinate and Baden) belonging to France, Switzerland and Germany (Regio Basiliensis 2013). In the URR, 41 % of the total area is arable land used for agriculture, growing different types of biomass, such as crops and wine. Although the URR forms a geographically coherent region with regard to natural conditions (e.g. soils, climate), there are substantial differences in legal frameworks, cultures and anthropological views. As land use patterns are changing continuously and to fulfil the needs of the local population, a coherent biomass strategy for the entire region has to be developed. Furthermore, by involving relevant local stakeholders from politics, administration and industry, the project aims to give an important stimulus to environmental policy and innovation for future development of the URR (French-German Institute for Environmental Research 2013). The main goal of the 'OUI Biomasse' project is to propose necessary implementation steps to achieve a knowledge-based sustainable biomass strategy within the transition of the URR energy system by working out a 'Road-mapping Guide for Actors'. Within this interdisciplinary concept, a harmonized method for a transnational estimation of existing and future biomass potentials should be developed at regional scale for the first time.

This paper wants to focus on one specific research area of this project:[2] building-up scenarios for different alternative developments to analyse their potential impacts under sustainability criteria. Firstly, the theoretical background of the scenario-building is described; then, the methodological implementation within the project is depicted; the final section comprises conclusions.

Theoretical Background of Scenario-Building

Facing growing complexity and uncertainty of social and environmental contexts, such as technological change and biomass utilisation, it is more important than ever to reflect on today's decisions prospectively and to adjust them in a future-oriented and sustainable way. Therefore, the work with scenarios provides a central tool for long-term future prospects for companies, markets, competitors and planning processes for, e.g., political consulting.

The future is generally indicated by complexity as developments and changes interact in multi-layered ways and occur in a partly continuous but also partly disruptive manner. The future is principally hallmarked by uncertainty and insecurity. Considering this, several different future pathways are potentially conceivable. In addition to that, the future is characterized by ambivalence as various possible developments are being or could be evaluated in entirely different ways depending on the perspective of observation. Thus, scenario-building[3] implies a 'scientific investigation of the possible, probable and desirable future developments and shaping options as well as their requirements in the past and the present' (Kreibich 2007, p. 181). In contrast to an image of the future that merely presents a hypothetical future condition, scenarios also describe the developments, dynamics and driving forces from which a certain image of the future arises. Two questions play a decisive role: first, how can the gradual emergence of a hypothetical situation be explained, second, what alternatives exist at each stage of the process for preventing its further development or 'steering' it in a different direction? The scenarios will be expected to generate visions of future developments through the reflection of certain relevant key factors, also referred to as 'descriptors'. The selection and combination of the key factors with regard to a future time horizon is a kind of design work. Here, certain factors and events are intentionally included – others excluded (step: key factor identification) – and correlated in ever-varying constellations based on certain assumptions (step: key factor analysis). The analysis of the key factors can be performed using various methods to explore i) the interdependencies of demographic, social, technological, economic and political developments and ii) which possible future tendencies are imaginable. One method is the so-called Cross Impact-Analysis, which 'provides a number of structured processes for the deduction of plausible developments in the future in the form of rough scenarios and is based on expert judgements about systemic interactions' (Weimer-Jehle 2006, p. 334). 'Its approach is based on the evaluation of interrelations between the most important influential factors in a system by experts who evaluate pairs of these factors (for example as conditional probabilities), and then to find out which scenarios are probable in view of the established network of interrelations […]' (ibid., p. 336). On the basis of this analysis, the consistent set of key factors is assorted, selected and developed into different scenarios. The aggregation of scenarios can be accomplished by literary-narrative or formalized-mathematical methods.

Scenarios for Potential Biomass Futures at Regional Level within the Project

Based on the preliminary work of other project partners, a set of alternative scenarios of future biomass utilization in the URR until 2030 will be developed. To predict possible future trends, a multiple set of structural criteria and key factors (normative as well as propulsive), influencing the prospective biomass utilization, are getting investigated, selected and evaluated. Besides this, trends for future shapes of these factors for verifying assumptions about biomass availability and economical modelling are being evaluated on the basis of indicators derived from the integrative concept of sustainability (Jörissen et al. 1999). With the help of the scenarios, tendencies of changes in ground cover and land use (LULCC) related to different utilization paths of biomass will be identified (Institute for Technology Assessment and Systems Analysis 2013). One scenario will be a reference scenario 'Business as Usual (BAU)' to respectively shape GIS maps of usable biomass potentials on the basis of trend-extrapolation. The whole resulting set of scenarios will be the basis for deriving biomass potentials and impacts of utilization. Based on the insights from the scenario analysis, possible environmental, economic and social impacts of the different pathways, using sustainability criteria and indicators, will be predicted. Furthermore, a local stakeholder discourse will be launched, enabling the most important interest groups from the administration, politics, industry and science in the field of biomass in the URR to validate the scenario results. The stakeholder dialogue further aims to identify the most preferable scenario characteristics and reassembling them in a 'best-case' scenario, which will subsequently constitute the basis for the final roadmap with pathways, options and recommendations, demonstrating the possibilities and conditions for sustainable biomass utilization in light of the current framework conditions and the sustainability goals in the URR (French-German Institute for Environmental Research 2013).

To achieve these objectives, certain relevant influencing factors are taken into consideration on the basis of a comprehensive Internet and literature review. Following the analysis of publication references, a thematic clustering was conducted to allow for a better handling of the variety of factors resulting in seven clusters: agriculture, economy, energy supply, nature conservation, social/human population, politics and technologies. Through the basic search strategy, about 120 factors were identified in the first step. In the second methodological step of the key-factor identification, the assembled factors were discussed at an internal expert workshop to reduce the wide range of factors to a relatively manageable number of potential scenario descriptors. The reduced quantity of 46 factors was then fed into a small-scale questionnaire to be spread among the project group and the associated partners (stakeholders). This survey made it possible to carry out evidence-based decision-making based on benchmarks such as ‘uncertainty’ and ‘relevance’: all experts received the clustered factors and were requested to nominate the most relevant and uncertain factors (in their opinion) on a scale of 0 (irrelevant, certain) to 3 (relevant, uncertain) points, whereby each expert could allocate points up to the maximum of number of topics multiplied by 1,5 (author’s specification regarding statistical literature). This advance ranking represented the first expert feedback on the influencing factors. As no topic was allocated zero points in the evaluation, and even the topic with the lowest score was considered essential by at least one expert, the preliminary strategic key-factor selection was factually confirmed by the experts. These results were then anonymized and aggregated in a ranking list of recommended key-factor priorities. The above-mentioned auxiliary distinction between the clusters was eliminated. The ranking of the topics represented the methodological starting point of the following expert workshop, which was designed in such a way that all key-factor ‘candidates’ could be discussed. The experts gave valuable advice on the grouping of factors with lower granularity with regard to their level of detail into groups of higher granularity, such as the regional structure of politics, governance styles, political priorities, economy, change of values, demographic development (population growth), mobility, technology development, availability of resources, social infrastructures (e.g. mobility needs) and global development (e.g. oil price, climate change). All these key factors should be taken into account, e.g., population growth and economic development are principal factors behind overall bio-energy use. Assumptions about technology development, energy system transformation and changes in the energy intensity of economic activities do influence the translation of bio-energy use into the demand for different energy forms. In addition to the relevance of systems engineering, the development of non-bio-energy technologies is crucial for the ultimate demand for energy from biomass as well. Resource-focussed assessments take the form of inventories of potential bio-energy sources, and of carrying out an evaluation of possibilities for utilizing the sources to fulfil energy purposes.

Based on this, the second methodological step in the ongoing work will be to correlate the identified and selected key factors in varying constellations on the basis of certain assumptions. The following analysis of the key factors aims to explore the reciprocal actions between those potential scenario descriptors and to evaluate imaginable future tendencies. To achieve this, it is planned to put the interdependencies and tendencies up for discussion and to build up a matrix containing judgements, which express the influence of each descriptor on each of the other key factors. These judgements will be gained through verbal analyses and intuitive logics (Huss/Honton 1987) by asking experts until spring 2014.

Outlook and Conclusions

After having finalized the basic preparatory steps described before, the results will all be assembled within a set of alternative scenarios describing various aspects of conceivable general future biomass utilizations. For that purpose, firstly, a comprehensive description of the status quo of all relevant aspects of biomass utilization is to be performed. Starting from this characterization, trend-lines for the future development of the shapes of each key factor are depicted, to build up a referential scenario 'business as usual'. Major framework conditions' trends assumed to be stable and varying shapes of factors directly influencing general biomass utilization pathways are to be combined into further scenarios for possible alternative biomass-utilization developments. Therefore, the results of the explorative analysis described in the previous section will be combined with clearly diverging normative visions of future biomass usage patterns, e.g. on the one hand, strategies of perceiving all options within the limits of regulatory and legal framework for a maximum exploitation of the identified biomass potentials or, on the other hand, privileging targets of nature conservation for upholding ecosystem services, the overall appearance of the landscape as well as its recreational value. These examples show how the description of possible extreme future developments by scenarios can illustrate the range of biomass utilization alternatives.

The preceding paragraphs showed how the scenario-based technology assessment approach, applied within the 'OUI Biomasse' project, was set-up to enable a knowledge-based dialogue between various stakeholders and thus support the building-up of a sustainable regional biomass strategy for the cross-border region of the Upper Rhine. Based on a transnational estimation of biomass potentials, opportunities are drawn for research and development to generate new applications and both innovative and sustainable technologies. Possible environmental, economic and societal aspects and impacts of different transition pathways are going to be illustrated in the alternative scenarios and can thus serve as highly relevant knowledge opening new perspectives for stakeholders from regional politics, public administrations, industry and the society of the transnational URR. This also offers good prospects to initiate the implementation of new subjects and elements for both regional and transnational governance as decision-making for energy transition thus far is still lacking advisory structures for societal and political addressees.

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Transition Pathways to Sustainable Energy Future in Austria

Socio-Technical Scenarios and Key Action Fields

Michael Ornetzeder, Petra Wächter and Harald Rohracher

Abstract

Reducing greenhouse gases by more than 80 percent is one of the great long-term challenges facing our societies today and will doubtless require transformative changes to current energy regimes. Large-scale system transitions, such as the one envisaged for the global energy system in the next 30-40 years, can only be realized through complex processes of change involving global, regional, national and local levels. This chapter reports on experiences with a systematic and interactive process of engagement with stakeholders about potential energy futures in Austria. The approach presented below covers long-term scenarios and pathways for the whole energy system and also includes a more detailed analysis of policy options within selected key action fields. The chapter gives an overview of the chosen approach, briefly illustrates the framework scenarios developed and discusses policy options using the field of the 'spatial organization of energy production and use' as an example.

Introduction

It is generally agreed that the energy system must undergo a radical change in the near future. Indeed, the EU's Strategic Energy Technology Plan calls the reinvention of the energy system in the form of a low-carbon model the critical challenge of the 21st century (Commission of the European Communities 2009). Dealing with such a radical transition requires an awareness of complex learning processes that involve a multitude of actors and levels, such as energy providers, policy actors or consumers, social networks and broader societal contexts (Elzen et al. 2004). System innovations required for a profound change include the reconfiguration of technologies, institutions (e.g. regulation; informal norms, such as professional cultures and cognitive paradigms) and social practices (e.g. use patterns, lifestyles), as well as cultural norms and values. The active social shaping of such transformations depends on the development of shared visions about possible 'future scenarios' of the energy system and on the continuous adaptation of strategies and measures in order to move the energy system in the desired direction. Common learning processes and shared visions are all the more important because actors in the energy field increasingly expect the energy system to be exposed to fundamental destabilization and change.

The E-Trans 2050 project (Rohracher et al. 2011) was an attempt to contribute to this ongoing transformation by focusing on 'key action fields' that have a high potential for system innovations leading toward more sustainability in the energy sector. The approach intended to complement existing quantitative modelling efforts. From the outset, the focus was on necessary changes to institutions, social practices and cultural norms rather than on the precise mapping of technical potentials and desired outcomes. The project was carried out as one of several scenario-building projects within the new research programme of 'New Energy 2020', which supports research and development activities aiming at a long-term transformation of the Austrian energy system.

Approach and Methods of the E-Trans 2050 Project

Foresight or scenario studies about the further development of energy systems have already been carried out in abundance, often focussing on various geographical scales (from global to the EU, national and even regional levels) or particular elements of the energy system (e.g. electricity system, renewable energy sources). Most of these scenarios have a strong 'output orientation', i.e. they aim at quantifying future energy consumption.

The E-Trans 2050 project thus did not aim to contribute further quantitative modelling of energy scenarios but to complement existing scenario models by putting more emphasis on their socio-economic, cultural and institutional foundations and by asking whether such socio-technical visions of the future may also result in additional perspectives and strategies to foster the transformation of the energy system towards more sustainability. To this end, a number of existing scenarios that were perceived to be the most advanced in dealing with socio-economic aspects were chosen and then screened for the socio-economic assumptions upon which they based their different development corridors. The roughly 40 scenario studies analysed ranged from global energy scenarios (e.g. World Energy Council 2007; Shell International 2008; Raskin et al. 2002) to various national scenarios (e.g. Anderson et al. 2005).

Based on an analysis of trends, drivers and inputs from existing literature and energy models, we developed three framework scenarios with different socio-economic conditions. As the next step, stakeholders and experts from various backgrounds discussed and advanced the scenarios interactively in two workshops. The interdisciplinary composition of the participants helped to incorporate different perspectives to describe more profoundly the complexity of the energy transition. It was possible, through the development of scenarios, to combine expectations and visions of the future with transformation paths and political strategies. By defining a number of socio-economic categories, the participants of the workshops identified a number of key action fields for system innovation for each scenario. Once these key action fields had been identified, the stakeholders were asked to evaluate the potential of these for system innovation.

In the final part of the project, we explored the chosen key action fields in more detail, focussing on issues that had leveraging effects on the energy system. The normative scenarios were specified in each key action field and were complemented by backcasting workshops. Backcasting is a particular form of a scenario process with an explicitly normative angle. While forecasting generally attempts to predict the most likely future developments, backcasting first attempts to generate particularly desirable images of the future and then search for possible ways of reaching this future state (Robinson 2003). Backcasting thereby emphasises the societal room for manoeuvre in shaping future developments, e.g. via the implementation of particular policy measures. Thus, in a backcasting process it is not uncommon to develop scenarios that deliberately include the breaking of current trends.

The aim of the participatory backcasting workshops was to find and investigate crucial issues within each key action field that would have the potential to foster system innovation and influence the energy system to a wide extent and that would be relevant for the sustainability transition path. These crucial issues can be seen as sub-fields of key action fields, with related actors and institutions, and within these sub-fields, it should be possible to discuss critical issues and opportunities.

Long-Term Scenarios for 2050 and Key Fields of Action

Based on existing energy scenarios, technology roadmaps, forecasts of the availability of energy resources etc., a first framework of energy visions was drawn up by the research team. The following basic types of possible developments were prepared.

1. *Moderate optimization scenario*: optimization of the energy system and its modernization
2. *Sustainable energy-system scenario*: radical change to a sustainable energy system
3. *Break-down scenario*: economic crisis and energy crisis

We then envisioned more or less plausible and consistent images of developments in the energy system, with its actors, institutions and rules, under different socio-economic framework conditions for each of these basic scenario types. Participants in the two workshops were then asked to further substantiate and differentiate the basic scenarios provided by the project team. The main emphasis was on embedding the technological options within the socio-economic, cultural and institutional contexts of a sustainable energy system, as well as on developing consistent visions and scenarios.

The scenarios were based on two approaches: first, existing scenarios, projections and forecasts were used to develop a framework for three possible but contrasting visions for the future. Second, these three scenarios were then fleshed out further in two workshops with experts and other stakeholders and differentiated into two or three sub-scenarios, widening the range of possible futures.

The concept of key action fields was central to the approach developed and applied in the E-Trans 2050 project. Key action fields are structural issues of policy and social action that are likely to be decisive for the future development trajectory chosen. In particular, we tried to identify cross-cutting fields and new problem framings that needed to be dealt with as a precondition for a transition towards a sustainable energy system.

Several key action fields were identified and selected at the expert workshops conducted in the context of the project. The ones that were identified at the workshops cover well-known and well-established fields of action, such as economic instruments, international agreements, regulation, education and technological innovation but also a number of socio-economic fields that may have been less prominent in previous debates on energy futures. These latter fields, however, are complementary to the more prevalent fields of action and provide important enabling conditions for unlocking the potential associated with the former. In the E-Trans 2050 expert workshops, the following key action fields were eventually chosen for deeper investigation: (1) The spatial organization of energy production and use, (2) reflexive governance using the example of smart grids and (3) the role of civil society in energy transitions.

Key action fields simply capture the decision areas that are critical for determining the direction of a future energy pathway; they do not yet address the question of which actions to take and which specific issues to address in order to ensure a shift towards the most desirable, i.e. sustainable, pathway. We therefore identified more specific sub-fields within each of the key action fields that would allow us to shift the transformation process in the direction of the most desirable scenarios and avoid the less desirable ones. These sub-fields highlighted critical issues, i.e., important preconditions to be met and potential conflicts to be resolved. We will present some results below, using the first key action field as an example.

Example: Spatial Organization of Energy Production and Use

As the discussion among the experts has shown, the aspect of land use and space in the energy sector is still far underdeveloped as a research topic. The significant increase in average living space per person and the ongoing urban sprawl have severe implications for energy consumption. Deficits in the implementation of spatial development plans and the distribution of relevant competences on national, regional and local levels often lead to unplanned settlement in rural areas and therefore to an increasing demand for energy-intensive resources.

The sustainability scenario developed as a part of the project already highlighted the need for new forms of spatial planning, moving towards more coordinated procedures. It underlined the need for legislative reforms, including a variety of spatial-planning instruments, such as establishing development axes and changing incentives related to transport. On the energy-supply side, the sustainability scenario – in accordance with the current policy objectives on the EU level (European Commission 2011) – projects that a very high percentage of energy will be generated by renewable sources, with a notable shift towards decentralization. There is a stronger focus on regional resources and/or on balancing resource potentials via supergrids, including on the international level. Spatial restrictions and limits to the speed at which transmission grids can be expanded make it impossible to simply summarize the spatial requirements of renewable energy resources. Roadmaps and political objectives regarding the use of renewable energy, no matter what their scale, must reflect the limitations that could arise from conflicting demands for land and other resources.

In order to discuss the spatial issues of energy transitions in more detail, we specified a 'sustainability scenario' for the Austrian energy system in 2050 that focussed on issues of spatial organization and was based on eight expert interviews and a literature review. Using this specific vision of the future as a starting point, participants of the backcasting workshop were invited to discuss strategies and necessary milestones that could be helpful in reaching it.

Conclusions: Consequences for Energy Policy and Existing Practices

Based on the results of the backcasting exercises on energy and spatial organization, we may discuss the following three short-term consequences for energy-policy measures.

- First, it became obvious that better coordination of energy policy, spatial planning, and land-use regulation issues is needed in general. This would require the establishment and/or improvement of integrated planning structures on national and regional levels, the redesign of building subsidy schemes, a closer adjustment of land development plans to energy efficiency and sustainability criteria and the fostering of increased cooperation across municipal and county lines in the future.
- In order to support further expansion of renewable energy resources, it is necessary to rebuild regional structures in a way that matches available resources with existing demand for energy services as closely as possible. It will, therefore, be important to provide regional resource-management plans and to develop and implement local and regional energy strategies. Moreover, a reallocation of political and legal competences seems essential – one that goes across and beyond the existing political-administrative structures.
- A third set of measures deals with the development and implementation of sustainable settlement showcases. Radical new settlement models that combine new social and organizational structures with the latest energy technology and transport infrastructure are not yet available in Austria, but such models were given high priority in the backcasting workshop as a first step towards a more sustainable energy system. In order to get those models to work in practice, social actors from research, technological

development, planning, architectural and political fields should work together in close cooperation with investors and on-site users. Therefore, it would be necessary to develop appropriate developer and participation models and to establish appropriate policies and frameworks. The implementation of innovative settlement showcases would be an important first step towards a more sustainable energy future and could open up much-needed opportunities for social and technological learning.

Changes in the spatial organization of housing and mobility, as briefly outlined above, would certainly have a number of implications for present energy practices. The most obvious ones are the necessary shifts in mobility patterns: car use for meeting short-distance mobility needs would be replaced by new and existing public transport systems (shared taxi systems, automated people movers etc.) as well as by energy-efficient individual solutions (e-bicycles, e-vehicles etc.). Shorter distances from home to high-capacity public transport system stops will help to satisfy everyday mobility needs largely without the use of private cars, as will smart information systems. Other important changes will affect the way that people interact with their residential surroundings. The densification of suburban areas means that we may expect a shift to more urban conditions in those areas, with less private green areas, more shared spaces etc., but that we may also expect the local infrastructure to improve.

Of course, the implications for energy policy and existing practices as reported above are limited by the constraints of the chosen workshop design and most of them refer to the Austrian context. However, in more general terms, the reported results show what it would mean to link today's urgent need for action to a long-term vision of a more sustainable energy system.

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Insights from Municipal Interventions for Influencing the Carbon Footprint of Private-Household Practices

Frieder Rubik and Michael Kress

Abstract

This paper examines the activities and measures taken by two German cities, Frank-furt/Main and Munich, that are (directly or indirectly) aimed at the climate-related every-day routines of private households. Following a short depiction of the background and the objective of the research project, the paper first describes the conceptual framework and methodology. The subsequent presentation of initial results begins with a description and evaluation of an exemplary instrument – the electricity-saving premium of the city of Frankfurt – aimed at inducing people to save electricity by offering incentives. A comparative overview of various instruments is finally followed by a summary of the most important inhibiting and promoting factors that influence the success of municipal climate policy instruments aimed at everyday behaviour.

Introduction

In industrialized countries, private households contribute considerably to overall Green-house Gas (GHG) emissions and therefore have a strong impact on climate change. Depending on the basis of calculation (and especially whether indirect emissions are included), estimates range from private households accounting for one fifth (e.g. UBA 2007) to two thirds (e.g. Oeko-Institut 2010) of Germany's total GHG emissions. Various state players are endeavouring to mitigate this share. According to, for example, the EIPRO-study (Tukker et al. 2006), the key areas of interest are housing and energy use, mobility and nutrition. Beyond the national measures – the quasi "top-down activities" – the local level represents an interesting starting point for supporting households in behavioural changes. Closer touch with the people and familiarity with players from the fields of politics and administration might increase the acceptance and impact of measures ("bottom-up" approach).

This paper is based on the findings of a research project titled "Climate change and consumption routines: potentials, strategies and instruments for low-carbon lifestyles in the zero emissions city (www.klima-alltag.de)". The project examines how "consistently low-carbon lifestyles" can be promoted and spread. It is mainly about the changes to everyday routines which mean a major step forward in the reduction of GHG emissions ("leapfrogging"). The project focusses on municipalities – for example, the two cities, Frankfurt/Main and Munich – and their possibilities of exerting influence by shaping municipal infrastructure systems and services. The central question addressed with this paper is, which instruments, measures and services can promote the spread of low-carbon practices in everyday life on the local level.

Conceptual Framework and Methodology

Bodenstein et al. (1997) classify consumption decisions as strategic and operational ones. The former are more long-term, characterized by long planning horizons, and tend to be singular and rather extensively prepared. Operational consumption decisions, on the other hand, have a low binding effect and are frequently habitual. According to Rieß (2010), the term "everyday routine", which we consider central here, describes the handling of situational, currently urgent requirements, problems and tasks without any connection to an overriding goal, which, due to established, stable cognitions, requires a low degree of consciousness and is frequently interrupted and unconnected with changing thematic references. People resort to routines as partial solutions to problems, which were previously found during earlier information processing procedures, can be called up in everyday life and require little conscious self-regulation. This permits more rapid implementation and multiple simultaneous actions as well as forming chains of action in which actions occur in a fixed sequence, thus relieving the burden of decision-making.

However, this conceptual focus on the consumer decisions does not fully cover the research question yet: municipalities are not only in a position to influence the operational and strategic consumer decisions, they also create "structures" as providers of public infrastructures. Examples are the supply of public traffic areas, such as roads or cycle paths, the provision of local public transport or the sale of electricity and/or heat. These services are often provided directly by the municipalities but also indirectly by enterprises which are at least part-owned by the local authority.

This project has concentrated on activities and measures of the two cities, Frankfurt/Main and Munich, targeting the climate relevance of operational consumption decisions and everyday routines of private households. The analysis was guided by a combination of qualitative and quantitative social science-based methods, namely interviews with experts to collect data on municipal climate-protection instruments, two focus groups in both cities, telephone surveys of the general public (citizens of the two cities) and in-depth expert talks with representatives of the municipal authorities and NGOs. Furthermore, interviews with specialists on the local context as well as with users were conducted in order to evaluate selected instruments.

Due to budget constraints, we ourselves could only undertake limited qualitative "estimates". Our estimates of the scope of various instruments are based on the evaluation criteria of evaluation research (cf. e.g. Stockmann 2008, Stockmann/Meyer 2010). We have concentrated on three evaluation categories, namely current climate relief, efforts needed and climate relief potential.

Results

The status quo analysis shows a wide variety of measures implemented by the two cities of Frankfurt/Main and Munich. Besides interventions focussing directly on daily routines (for example, knowledge transfer, incentives or activation of social/environmental standards), important infrastructural measures (especially in the mobility area) and measures influencing strategic/investment-related consumption decisions (especially in the housing area) were found to have a great potential impact on GHG emissions. In terms of the 4-E-Model,[1] the former (infrastructural measures) are mostly "enabling" measures, and the latter (influencing strategic/investment decisions) are mostly "encouraging" measures.

As mentioned above, our project was focussed on interventions intended to directly encourage private households to reduce their carbon footprint in their daily routines – considering all types of interventions in the 4-E-Model: engaging, enabling, encouraging and exemplifying measures. Exemplary local measures are energy consulting, financial incentives, maps showing solar energy potentials or dialogic marketing concepts.

The following section presents energy consumption measures in Frankfurt and our (current) assessment of their impacts as an example.

Example: Electricity-Saving Premium (Frankfurt)

Frankfurt households can receive an electricity-saving premium if they reduce their electricity consumption compared to the previous two years. The last three electricity bills must be submitted as proof. A premium of EUR 20 can be claimed for a saving of at least 10 %, further savings are rewarded with a premium of 10 cents per saved kWh. The economic incentive is twofold, as households also save electricity costs due to their reduced consumption. Subsequent applications are unlimited.

The premium was introduced in May 2008, meaning that the first induced – prospective – behaviour adjustments in electricity consumption were not to be expected until the beginning of 2009. Applications submitted in 2008 were rather retrospective documents of adjustments made earlier – and thus represent windfall gains. By May 2013, 855 premiums have been approved totalling EUR 53 500. On average, each household saved 732 kWh electricity (626 146 kWh total savings) and received a premium of about EUR 63.

So far the degree of awareness of the electricity-saving premium is limited. Only 12.5 % of households, asked in our representative survey of Frankfurt households, have heard of this measure. Among the participants of a focus group it was also hardly known. The experts we surveyed, on the other hand, attested this measure a medium degree of popularity.

Given the limited degree of awareness, it is not surprising that the take-up rate among Frankfurt households is very small. According to our survey, around 8 % of those who are aware of this measure actually have submitted an application for the electricity-saving premium (related to all surveyed, this was only 1 %). These users, however, assessed the measure as very good.

In a public opinion poll conducted in Frankfurt in 2012 (Klima-Alltag 2013), 68 % of those surveyed stated that they considered the electricity-saving premium particularly important; there were no major socio-demographic differences. In our survey, 66 % declared a large or moderate interest in taking up the premium. In the focus groups, there were extremely varying assessments of the instrument: participants with a low to medium level of education tended to show curiosity and interest and a high individual readiness to make use of the offer in the future; however, participants with a medium to high level of education were overwhelmingly negative.

The experts stated that the electricity-saving premium is largely accepted within the municipal administration. It requires a certain amount of organization and coordination in the Energy Department in terms of sifting through and examining the incoming applications, which implies personnel costs. Furthermore, the municipal authority incurs costs for administration and marketing of the programme as well as the cost of the premium payments themselves, which amounted to around EUR 50 000 by February 2013.

Due to the low take-up rate, the current contribution towards reducing greenhouse gases is very small. However, the potential is considerably greater, as the above-mentioned surveys suggest. The Frankfurt electricity-saving premium has so far had relatively little market penetration: the measure itself is remarkable since it has sent a signal, even nation-wide, despite the fact that we live in times of tight public budgets.

One inhibiting factor that was mentioned in the focus groups is the relationship between a bureaucratic effort and a (minimum) premium of EUR 20, which is considered disproportionate and unjustifiable. Furthermore, participants fear the high conversion costs for the purchase of new large electrical appliances presumed necessary in order to obtain the premium: “if you want to make significant electricity savings now to achieve this bonus figure of 10 % and then get the EUR 20, you have to make big investments. It’s not enough just to replace three normal light bulbs with energy-saving lamps. You have to tackle the large appliances.” (TN, male, aged 40). At the same time, households seem hardly aware of the double benefit (premium and reduction in electricity costs). Nor does the message seem to have got through that about 50 % of electricity costs are covered by the premium when the minimum saving threshold has been crossed.

Participants with a medium to high level of education especially criticize the approach of offering financial incentives as motivation for people to save electricity. In their view, climate-friendly behaviour should rather be influenced by a positive personal attitude and individual willingness to protect the climate.

According to experts, the electricity-saving premium, which represents a major part of the programme "Frankfurt saves electricity", needs to be embedded in a broader set of accompanying PR measures: "It has been realized that the programme requires flanking measures. It will never be a self-starter. It will never produce the desired effect by itself. We think that it will only be successful if it is also accompanied by PR measures." (Quote from an interview with an expert.)

Overall the electricity-saving premium currently enjoys only a very low degree of popularity and the take-up rate is light, but in our view, it has a considerable potential for extending its reach and its contribution to emission reductions. To achieve this, it is essential to improve dissemination, to expand cooperation with energy suppliers and multipliers and to change the incentive structure.

Comparative Assessment: A Landscape of Measures

One way of characterizing the various measures examined in this project is a two-dimensional "impact landscape" in which the measures in one of the focus areas – mobility or housing – are graphed for each city. The "impact index" is assigned to the horizontal axis, and the "potential index" is displayed on the vertical axis. Accordingly, the further the values move from the point of origin, the higher the current or potential impact is. This impact landscape thereby clearly illustrates the differences between the current achievement of aims and a future potential.

Figure 16 shows an example for Frankfurt in the housing sector. It indicates that some measures, like the climate-saving books or the galleries of the climate protection ambassadors and energy donors, currently have, and in future will continue to have, a rather limited impact. We therefore attach greater significance to other measures, such as the electricity-saving premium described.

Conclusions: Key Influencing Factors

An initial – still provisional – sorting of the results shows that the scope of the various municipal measures taken by the two cities is influenced by a number of different factors:

- ***Embedding in the national context***: Supra-regional trends and discussions have a major impact on municipal measures. A tailwind – or at least no headwind – can positively influence municipal activities and improve their chances of success.
- ***Knowledge of the target groups***: Reaching the target group is crucial for a successful implementation of measures. The growing division of the population into different segments means that "one size fits all" approaches will not work. The closer the

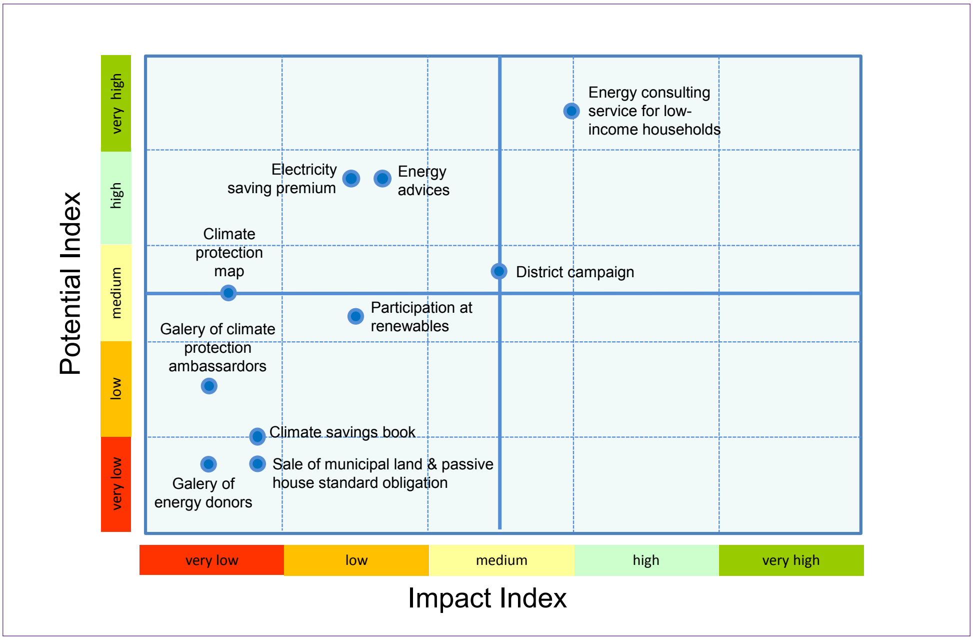

Figure 16: Impact landscape of measures in the housing sector of the city of Frankfurt/Main

measures are designed to match people's requirements, behavioural patterns and living environment, the more likely they are to be taken up.

- ***Contextualization***: Climate policy measures have a greater chance of being successfully implemented if they jointly address different motives - by linking the aim of reducing greenhouse gases with aims such as cost saving, convenience etc. In contextualizing the measures (also in accordance with the 4-E-Model), attention should be paid to coordination and mutual complementation of different types of instruments (e.g. combination of knowledge transfer, social incentives and infrastructural framework conditions) to strengthen the overall impact.

- ***Cooperation and inclusion***: The involvement of stakeholders (e.g. also civil society stakeholders) in the process of formulating and implementing policies increases the acceptance of measures. At the same time, it can enhance awareness of barriers to implementation and reduce obstacles.

- ***Inclusion of multipliers***: Municipal measures are intended to impact the general public. The involvement of people who are well-known and locally enjoy a high reputation can also improve the effectiveness of measures.

- ***Monitoring***: Observing how target groups respond to measures is necessary for assessing where the desired effects are being achieved and where some fine tuning is required and also for conducting political discussions with stakeholders and within the administration.

- ***Institutional arrangements***: Embedding the chosen measures in the municipal administration does not mean that they will function by themselves. They often require political "flank protection", e.g. from the municipal parliament or the mayor, to overcome resistance and opposition from other parts of the administration. In addition to such political mandates, however, it is crucial to have the corresponding competence for action and implementation as measures for which the respective departments have little or no competence are unlikely to succeed.
- ***Interaction***: Municipal measures in the field of climate protection have a strong link with other policy areas, such as social, economic and transport policy. Inter-linking and coordination are necessary for balancing competing or possibly opposing aims.
- ***Resource allocation***: Climate-policy measures are not for free; they require human resources with the corresponding skills for formulating, implementing and monitoring policy measures as well as adequate financing.
- ***Change agents***: Municipal measures become easier if there is a key person within the administration who actively accompanies a measure and stands for its success as well as its implementation. Such "change agents" often take on activities and make a decisive contribution to the implementation through their active role.

This list of influencing factors is certainly not exhaustive (and requires further study with regard to its transferability to other cities/contexts in the further course of the project). However, it shows that climate policy activities encounter numerous challenges and must take the entire policy cycle into account.

The measures we have studied aim at the everyday routine of private households. They are embedded in a wider context of infrastructural offers and measures in the municipal area of public services, i.e. long-term structural investments in areas such as urban planning, transport, energy and health which set the framework for everyday actions. The various forms of instruments and their corresponding effects must be closely coordinated, thereby creating synergies between infrastructure offers and climate policy measures aimed at the everyday routine of private households.

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SUSTAINABLE MOBILITY

Opportunities and Risks of Electric Mobility from a Life-Cycle Perspective

Rainer Zah and Peter De Haan

Abstract

Electric mobility is generally known as "green technology", paving the road toward a sustainable mobility future. The real impact of electrification on our mobility system is, however, more complex. This study focusses on the full life cycle of electric cars, including all important steps from resource extraction and car production to the use phase and the end-of-life. Generally, electric cars reduce air pollution and noise emissions more than future combustion engine cars and they can also reduce dependence on single energy carriers. The possibility of using different renewable energy sources in the mobility sector is a major advantage for electric cars, and the main risk of electric mobility is its higher resource consumption in the car-production phase, mainly triggered by the additional production efforts for Li-Ion batteries. We conclude with a list of possible measures for maximizing the benefits and minimizing the risks related to electric mobility.

State of Research

The "ecological footprint" per capita in industrialized countries is already significantly above a sustainable limit, and individual consumption in transitional countries is rapidly increasing (Wackernagel 1996). However, there is a long way from a general environmental understanding to an individual change in behaviour. This gap is especially wide in the case of individual motorized mobility, where external costs and impacts on the society are high, and the benefits are gained for the individual. Consequently, the motivation for a change is rather low on the level of individuals.

In this context, electric cars are seen as the great hope for a sustainable or at least less-polluting alternative, reducing external costs while still offering the individual benefits (Foxon et al. 2013). The first electric cars to appear on the market are already a success. Generally speaking, electric cars increase the energy efficiency of car travel and reduce dependency on petrol and diesel. They allow for a rather individual and flexible experience of mobility – at least for short distances.

If we look closer, however, critical issues pop up that have the potential of dominating the overall footprint of electric mobility. There are analogies to biofuels and to the hydrogen society, where initial euphoria was followed by disillusionment after comprehensive technology assessments were done (Zehner 2012). Disillusionment was followed by insights on how carefully balanced sets of policy instruments can maximize future opportunities while minimizing risks of such alternative transport technologies. The systematic analysis of technology impacts allows for choosing policy goals and instruments that also account for unintended side effects, so that sustainable development becomes possible.

Electric mobility is on the verge of a market breakthrough. A variety of technical principles and future forecasts are available (Brett et al. 2012). However, only the interaction of all system components will decide in which segment electric-mobility services bring benefits for both the mobility and energy system and society. A comprehensive technology assessment of electric-mobility technologies and penetration scenarios is needed to assess the future opportunities and risks of electric mobility. This paper is based on the technology-assessment study initiated by TA-SWISS (De Haan & Zah 2013).

Methodological Approach

The overall goal of the study was to assess future environmental impacts of the Swiss car fleet, which contains varying numbers of electric cars (reg. 1. Steps for calculating the future impact of mobility scenarios along the full value). As the first step, future development of car components has been considered based on a review of literature. It has been analysed, what relevant technologies for batteries, engines, power electronics and charging devices are already available on the market and how the efficiency, weight and production price of the different components might develop over the next decades (Duleep et al. 2011).

Based on the trends for the single components, future development of the cars has been analysed. For different car categories (3-wheelers, micro, compact and full-size) and different drive trains (conventional, electric, plug-in-hybrid), energy consumption, material composition and weight have been assessed. This information has been combined with future scenarios of power supply (Kirchner et al. 2011) for calculating the full life-cycle assessment of the different car systems (Goedkoop et al. 2008). The analysis was focussed on energy efficiency, greenhouse gas emissions and metals depletion. The analysis differentiated between the stages of production, use, maintenance, end-of-life and energy supply.

Economical and societal impacts are not covered by the Life-Cycle Assessment. Therefore, the socio-economic consequences of electric mobility for Switzerland were analysed by applying a multi-criteria indicator system. The Life-Cycle Assessment deals with a fixed amount of kilometres driven in each of the scenarios. Nevertheless, electric cars could induce additional traffic if the costs associated with them were lower and their reputation was higher than that of conventional cars. Therefore, the so-called rebound-effects of electric cars have been analysed and measures for how to eliminate them were discussed.

Finally, the consequences of future electric-mobility utilization in Switzerland were discussed. The focus lies on the question of how a future mobility system should be designed in order to foster the benefits of electric mobility while minimizing its risks.

Research Findings

Environmental Impacts of Vehicles

Generally speaking, electric cars increase energy efficiency of travel and reduce dependency on conventional fuels, such as petrol and diesel. Thanks to its energy mix, of which a large part comes from hydroelectric power, Switzerland has the right conditions for generating environmentally friendly energy for electric vehicles. Furthermore, the planned major expansion of renewable energy production may be supported by electric vehicles as a form of local energy storage.

However, in order to reap the ecological benefits of alternative fuels, many conditions need to be met. The benchmark against which electric cars are measured is becoming even more rigorous as conventional combustion-engine vehicles are continually technically refined to make them more efficient and ensure lower CO_2 emissions. By 2035, a compact car, which today uses 7.5 litres of petrol per 100 kilometres on average could be using only 4.8 litres; this corresponds to a reduction of more than one third (Figure 17). The same compact car that runs on electricity could cut its energy use from 24 kWh to 16 kWh per 100 kilometres by 2035 through improvements in auxiliary systems, such as heating and battery conditioning. This corresponds to a reduction of around 30 percent in CO_2 emissions.

One major reason why the life-cycle assessment of electric cars is not substantially better than that of conventional vehicles is the environmental pollution during the manufacture of the car: if we take into consideration the entire life cycle, 90 percent of greenhouse gas emissions from battery-powered vehicles are produced during manufacture. This compares with 25 percent for mid-sized cars with combustion engines today, increasing to 40 percent over the long term. During operation, environmental pollution depends on how much fuel the vehicle consumes, or in the case of electric cars, the electricity mix. In comparison with other countries, Switzerland has one of the lowest CO_2 from producing electricity mixes based on hydroelectric and nuclear power. Operating an electric car powered by Swiss electricity therefore produces 70 percent fewer greenhouse gas emissions than a comparable combustion engine vehicle. By contrast, if the electric car is charged using the average EU electricity mix, of which 52 percent comes from fossil fuels, the CO_2 reduction in comparison with a conventional car is reduced to 20 percent. Consequently, environmental and energy policy instruments should be increasingly extended to cover the entire vehicle life cycle. Sustainable electric mobility is only possible if the resource life cycle is closed.

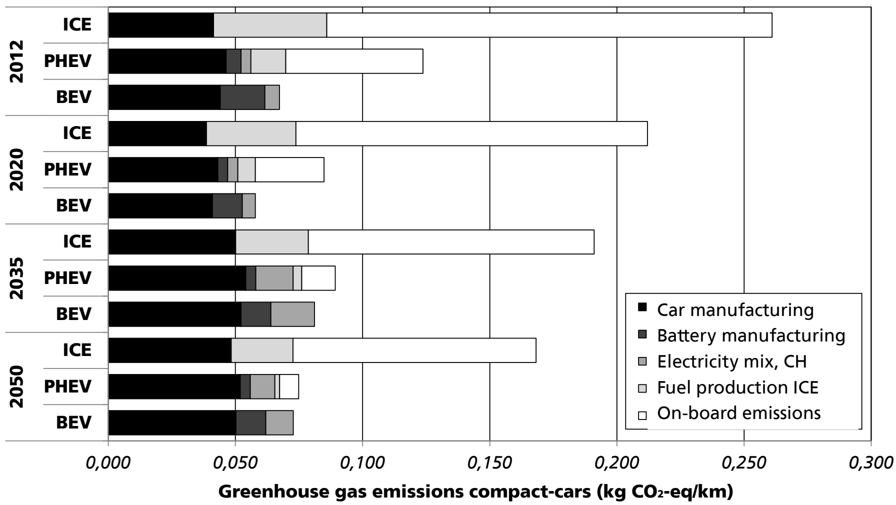

Figure 17: Greenhouse-gas emissions along the full life cycle for the three drive trains examined (ICE = internal combustion engine vehicle, PHEV= plug-in hybrid vehicle, BEV = battery electric vehicle) and for four years (2012/20/35/50). Results are shown for compact cars (Golf-type).

Environmental Impacts of the Swiss Fleet

In order to assess the future impact of electric mobility in Switzerland, this study linked individual cars with the environmental pollution caused by the entire Swiss vehicle fleet. Three scenarios based on the range of possible development paths are applied to model the future expansion of electric mobility in Switzerland. Compared with literature values, the study initially expects a rather slow uptake of electric mobility. Based on these scenarios, we can calculate that, on average, one in ten new cars will run on electricity in 2025 and every other new car will be an electric car in 2035. On the basis of this distribution scenario, we can estimate the expected CO_2 emissions in 2020, 2035 and 2050 (Figure 18). In all the scenarios, there is an almost identical 10-percent reduction in greenhouse-gas emissions from transport by 2020 compared with today, despite a calculated 24-percent increase in mobility. From 2035, there will be major variations between the electric-mobility scenarios: the business-as-usual scenario predicts a 20-percent reduction in greenhouse gases, while the optimistic scenario predicts a 30-percent reduction. The more actively energy-policy measures promote energy efficiency for new cars, the more likely it is that electric mobility will increase. Electric cars have high energy efficiency and small and mid-sized cars in particular are well suited to running on electricity – thanks to advances in battery technology, which will mean increasingly fewer compromises in future. Accordingly, targeted drive-specific support for electric cars does not seem to be necessary.

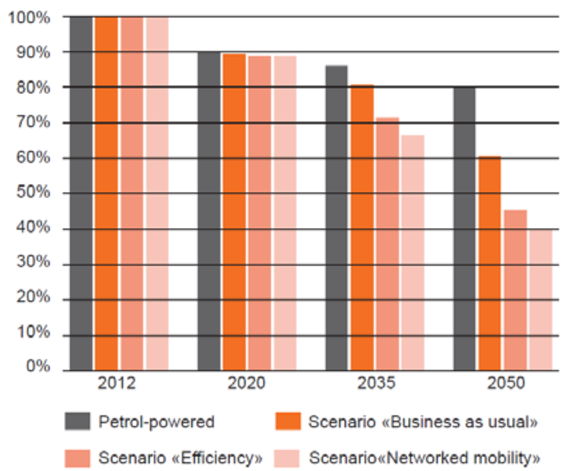

Figure 18: Greenhouse-gas emissions of the total Swiss individual car fleet relative to 2012 for three electric-mobility scenarios and a scenario with no electric mobility at all.

Conclusions

What Are the Most Relevant Results?

The comparison of our results for the three scenarios shows that while differences are not pronounced, they still present a clear picture. From the business-as-usual (BAU) to the efficiency (EFF) scenario and the co-modality (COM) scenario, the environmental burden of the transport system decreases with the increasing share of electric cars. The main benefits include lower air pollution and noise issues. In addition, electric mobility allows for a diversification of energy carriers for the mobility system. Negative aspects of electric cars include their higher resource intensity in the production phase. This gives rise to a shift of environmental burden from the operation to the production phases in the life cycle. This brings new challenges to environmental and energy policies, which have been focussing on the operation phase.

What Problems Are to Be Expected?

Electric cars still are cars, having external costs and impacts as well as individual benefits. Future improvements in battery technology will allow for electric cars to penetrate the car mass market without the need for long-term subsidies. The differences between the three scenarios investigated in this study are too small and not of fundamental nature and hence do not call for technology specific action. One of the most important findings of the present study is thus that electric vehicles should not be subject to technology-specific tax cuts or incentive payments. Instead, efficient vehicles in general should be eligible to tax cuts and/or incentives. Electric cars will benefit under such schemes in general, with the exception of the few electric cars that have low energy efficiency. The target of technology-neutral policy schemes also implies that fossil-fuel taxes will soon be replaced by some kind of road-pricing scheme that covers all types of cars, including electric cars.

Needs for Research with Regard to Political Aspects

Our study shows that considerable rebound risks do exist. These might be both of financial or socio-psychological nature. As electricity for mobility purposes cannot be taxed in the same manner as liquid fuels, road pricing schemes offer the only feasible alternative. However the full rebound effect is yet unknown and requires further research. Most important is the likely exemption of electric cars from the 2020 fleet-average efficiency target value of 95g of CO_2/km for new cars in the European Union. The exemption is performed by attributing zero carbon intensity to electricity used by electric cars. As the 95g of CO_2/km target policy is, in fact, a technical energy-efficiency policy, which focuses on the vehicle itself, electric cars should be included based on the primary energy consumption and not based on the carbon intensity of the power mix, which addresses the fuel instead of the vehicle.

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Towards an Assessment of the Portuguese E-Mobility Case: The Mobi-E

Nuno Boavida, António Brandão Moniz and Manuel Laranja

Abstract

This paper presents a preliminary analysis of a national electric mobility policy, named Mobi-E, by addressing the policy-making process, its social impact and knowledge creation. The paper concludes that the Mobi-E fell short of expectations. In fact, behind the innovation rhetoric, the programme left behind an integration of the electric vehicles in an overarching concept of sustainable mobility, the need to change human behaviour, the dynamics of users' perceptions and knowledge creation. The Mobi-E was also hindered by the financial and economic crisis, a lack of a clear and decisive financial incentive and the inability to involve key communities in electric mobility.

Introduction

In early 2008, the Portuguese government started a working group on electric mobility, aiming to develop infrastructure for street-charging of electric vehicles across the country. The project named Mobi-E was officially launched with the settlement of a special cabinet in mid-2009, and its pilot project ended in June 2011 with the full implementation of 1300 slow-charging stations and 50 fast-charging stations in places of public access. The project also installed a payment system, which connects personal information and communication-technology devices (e.g. tablets, smart phones, etc.) and enables the user to select the most appropriate operation. It also allows for the analysis of a user's mobility costs for optimizing energy consumption.

The research conducted for this work (Boavida 2011) revealed that one group promoted the elaboration of the Portuguese e-mobility policies, and centred the Mobi-E programme on the hardware and software to charge and control the e-car. The group was composed of several companies and was led by the Inteli group (a think tank associated with the Ministry of Economy), which was in charge of the Mobi-E concept and model. Other companies included CEIIA[1] – a public-funded technology centre that developed an e-car prototype, part of the Inteli group, supported by the Ministry of Economy and in charge of the Mobi-E vehicles; the EDP group – the public energy utility, in charge of the integration with the grid; Siemens, Efacec and Martifer – three technology companies, all dealing with the charging solution; and Critical and Novabase – two information technology (IT) companies, in charge of the IT solution.

Although the infrastructure for charging electric vehicles was fully built, the project failed to address the expected consumers. In fact, it can be said that far fewer cars than expected could be observed using the charging points in 2012. That year, an equivalent of only eleven cars, on average, used the public charging infrastructure (Complementary Interview 4, line 212-214).

This research combined literature review, analysis of official documents and interviews designed to deal with the sensitive nature of the information requested and to avoid any suspicion of misuse of information. Thirteen interviews were conducted with policy makers, stakeholders, scholars and experts, which enabled the collection of information from a privileged position, provided space to reveal insights and created confidence for talking to those involved in the programme. These interviews lasted from one hour up to four hours and were conducted between February 2011 and March 2013.

Leapfrogging Development?

It is important to frame the Portuguese policy on electric mobility in the changing international context of its time. During the Mobi-E period in analysis (2008 – 2012), international sales of electric vehicles were significantly concentrated in the world's most developed markets. According to Frost & Sullivan (cited by Beltramello 2012), the major markets for sales of electric vehicles in 2011 were the US (51 %), followed by Europe (24 %) and Japan (20 %). According to the authors, the Chinese market represented only 4 % of the world sales and the Indian around 1 %. Furthermore, the distribution of public charging stations was also centred in the most developed markets. The following figure presents the number of public charging stations and electric-vehicle sales in some countries.

An analysis of the figure shows that in 2011, some countries pushed for the existence of public charging infrastructure without the corresponding sales of electric vehicles. In fact, by the end of 2011, some countries had more charging stations installed than electric vehicles sold in their markets (e.g. UK, Spain, Italy, Portugal, Sweden).[2] This mismatch reveals the push some governments decided to give to promoting electric vehicles in their countries.

Elaborate Studies after the Political Decision

A central question in the development of nations refers to how to use technology to catch the frontrunners (Freeman 1994). Many governments promote technology policies that can create conditions for developing new industries and stimulating their economies. To some of these governments, building an infrastructure for charging future vehicles appeared to be an effort that could promote economic growth and development. However, some critics support the view that for this generation of politicians, the technology is not really a way to modernize society, but a way to "conquer and retain power" (Interview 7, line 397-399). Critics sustained the view that there was a narrow focus on the popular electric car rather than on mobility (Interview 7, line 42), promoted both by the Prime Minister office in a "relatively centralized way" (Interview 9, line 318-319) and by Inteli - the leading company that won the consortium (Interview 7, line 46-47). As expected, the Mobi-E programme was a dynamic process that included a proposal to the Prime-minister cabinet being presented by a consortium of companies in full lobbing mode, to support the political decision of financing the electric car in Portugal (Interview 7, line 207-209). Controversially, an interviewee also reported that the decision was made to benefit the former public electric utility EDP, designing a business model for maintaining its prominence in future markets (Interview 7, line 153-159).

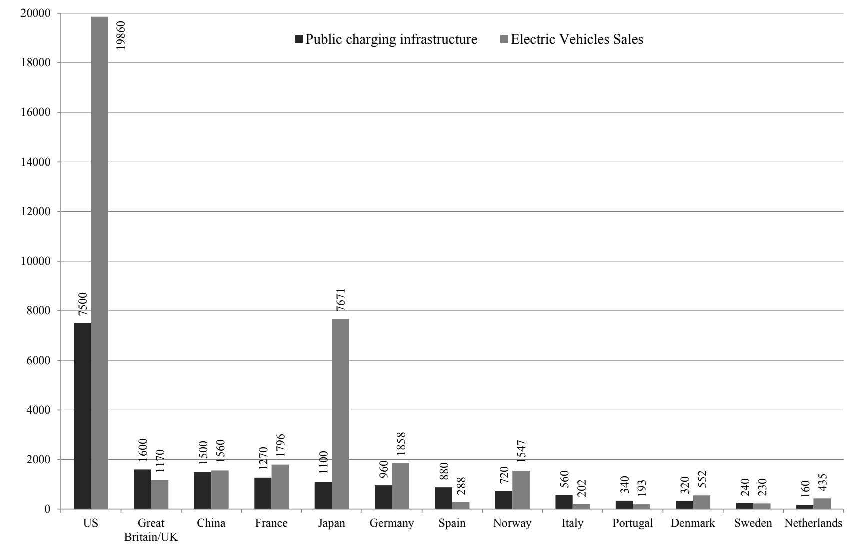

Figure 19: Worldwide public charging infrastructure for electric vehicles and sales in 2011 (based on Frost & Sullivan and OECD, cited by Beltramello 2012)

As expected in this context, some studies were elaborated "a posteriori […] to support the decision that was already taken" (Interview 7, line 88). Another interviewee agreed, stating that "first, the decision was made, and after that the studies were prepared" (Interview 9, line 74-75). Furthermore, an interviewee reported that the decision was based not on the technological effect of the policy but rather on its political and social impact (Interview 9, line 84-86). In the Mobi-E case, the study of technical indicators was conducted after the decision was made (Interview 9, line 88-89).

The effort to elaborate studies to justify a posteriori the decision taken to promote electric cars was naturally hopeless, because governmental forecasts need to be inevitably too optimistic to support such a decision:

1. First, the governmental figures presented to support the Mobi-E programme were out of proportion. In fact, according to the forecast of the Government's coordinator of the office for electric mobility, Portugal intended to have 750 000 electric vehicles in 2020 (Gomes 2010). However, in a scientific study by Paulo Santos from 2009, there would be 600 000 electric vehicles in 2020 only in a "very" optimistic scenario (Santos 2009). Furthermore, the governmental forecast was very optimistic because electric cars represented 80 % of the sales,[3] according to Gomes (2010). The author forecast an optimistic scenario with a penetration rate of 50 % that predicted only 322 027 electric vehicles in 2020 (Gomes 2010). In addition, an interviewee revealed that an analysis of a study from GALP - an EDP competitor – showed quantified reliable information, according to which the penetration forecast for electric vehicles was very slow (Interview 7, line 211-214). Moreover, the European Commission (2010) forecast an optimistic technology scenario where battery electric vehicles/fuel-cells vehicles would have only 5 % market penetration in Europe in 2020.

2. Second, independent forecasts further helped to understand the misjudgement of governmental authorities. For example, an expert from the Portuguese Automotive Business Association (ACAP) reportedly stated that in a very optimistic scenario, 300 000 vehicles of all types of engines were expected to be sold in the year 2020 (Santos 2009). This forecast implied an optimistic increase both supported in the ratio population/sales of cars existent in countries like Belgium and the Netherlands, as well as in the assumption that in 2020 Portugal would reach these countries' economic and social development (Santos 2009).

3. Third, the reality check confirms the manipulative intention of the government. In fact, the pessimistic Gomes scenario forecast 394 electric vehicles in Portugal in 2011 (Gomes 2010). However, there were only 193 electric vehicles in Portugal in 2011 (Frost & Sullivan in Beltramello 2012). Furthermore, Gomes forecast 999 electric vehicles in 2012, but there were only around 300 vehicles on the road (Mobi.europe 2012).

4. Fourth, the present most realistic scenario for 2020 is the non-acceptance of the technology. The most pessimistic scenario of the two pessimistic ones considered in Santos' study predicted a meagre presence of electric vehicles in 2020 with only 80 000 units. Interestingly, the author described this scenario as "catastrophic", given the "significance of public and private investments expected" in 2008, in order to create the infrastructures and fiscal benefits for acquiring electric vehicles. And he added that this was a very unlikely scenario, "justified just by the non-acceptance of this king of

technology in the automotive market" (Santos 2009:44). In fact, some experts also supported this view, stating that hybrids – not electric vehicles – will be penetrating the markets for at least the next ten years.

Social Impact

Although information regarding pre-existing communities oriented at electric mobility is still scarce, there are indicators that support the idea that there was a significant social dynamism around the Portuguese Association of the Electric Vehicle.[4] This association had been receiving state funding for dissemination activities since 1999, and was also behind the public debate on this issue. However, according to interviews and information collected during the development of this work (Boavida 2011), it appears that this group remained on the fringes of the policy-decision centres existent for the Mobi-E programme.

At least in terms of public discourse, the Mobi-E programme did not initially rely on a planned, sustainable transport strategy. In fact, Mobi-E disregarded not only the existing strategies of city councils but also other alternative urban possibilities, such as public transport, car and bike sharing systems, and pedestrian and cycle traffic. Instead, the rhetoric was oriented toward a convenient popular idea: the e-car. In fact, public support often arises in public debates from simple persuasive messages, and the simplicity of the central idea of the urban e-car is a good example (Schwedes et al. 2012). To Schwedes et al, the complexity of the transport reality is an unappealing fact in the competitive construction of a hegemonic public discourse. Furthermore, the authors argued that it was still far from clear whether e-cars could be a part of a sustainable transport strategy. In the German case, for example, the problem started when the e-mobility discourse was pushed away from the discussion on a sustainable transport policy by powerful actors with particular interests, such as the government-protected automotive and energy industries. The authors argued that from a policy perspective, the e-car is only a small part of the technological innovation and should include a strategy to change people's transport behaviour.

There are some indications to conclude that users perceptions were disregarded in Mobi-E programme, which might partially explain its failure. In fact, according to Schippl & Puhe (2012:36), users play a crucial role with regard to the success and failure of transport-related innovations. During this research (Boavida 2011), it was not possible to detect any signs of inquiry about users perceptions before March 2010. By then, a small quantitative study was carried out for the national energy certification and quality-control agency (dataE 2010), and it was about individuals' acquisition intentions and the localization of charging points in Portugal.

Knowledge Creation

International figures confirm the idea that some R&D related to transports was on the agenda of the Portuguese government. In fact, Portugal dedicated a significant part of its R&D budget to energy efficient technologies in transport in 2010, ranking 6th out of 22 in an international comparison calculated by Beltramello (2012).

Nevertheless, it can be stated that despite the controversial decisions process, the Mobi-E programme produced a small impact on knowledge creation in Portugal. First, the project was referred directly[5] in only 12 Master's theses and indirectly[6] in 27 Master's theses. Until now, no PhD thesis was discussed (with such keywords).[7] Furthermore, only a few industrial-property procedures were disclosed (Gouveia 2010), including two patents from universities: one related to an electronic differential published in March 2009 by the Engineering Faculty of the University of Porto. The patent uses techniques of control by field guidance with the identification of engine parameters, improves performance and incorporates a method of energy optimization. The other patent was published in April 2009 and granted to the Engineering Faculty of the Technical University of Lisbon, consisting of a system for charging batteries of electric vehicles.

Second, there were not many Portuguese companies and inventors working previously in the Mobi-E programme with electric vehicles, according to Nuno Gouveia (2010). The author maintains that these actors were working in areas such as cars, vans, electric buses or moulds for plastic injection and electronics, but made no attempt to connect it to the Mobi-E case.

Third, there was only scarce information on research projects concerning electric vehicles integrated in the MIT-Portugal programme and financed by the Portuguese National Science Foundation.[8] For example, according to Gouveia (2010), the research team of one project worked together with companies in areas such as electric engines, suspension parts and steering wheels and brakes in a single system called "Motor in Wheel". This research was included in the Mobi-E programme and was led by the CEIIA car technology centre and by a similar structure in Galicia named CTAG.[9] The work was subdivided in several components, namely modelling the power-control system, laboratory implementation of this system, implementation in a prototype, "hybridization" of the electric vehicle, motor-in-wheel unit project, sustainable composites, smart grids and concepts of flexible project and sustainability analysis. According to the author, the work also involved the building of three prototypes: a control system, a link to connect the vehicle to the Internet and the previously mentioned Motor-in-Wheel. But most importantly, information is scarce on outcomes of the research project although, according to the author, several products and materials were expected, as well as impact studies on the electrical network, problems and technology solutions and a study on sustainability based on the electric car that would test different loads and usage scenarios. Furthermore, companies such as Efacec, Simoldes, MCG and TMG were involved in every part of the research project, according to Gouveia (2010). In addition, Siemens developed two prototypes of home-charging and energy efficiency in buildings. Moreover, the formerly public energy provider, EDP, offered free charging of batteries between 2009 and 2011. Presently, there are five other energy suppliers of electric mobility in Portugal. At the time of the research project, there was also a promise from Renault-Nissan to build a factory for producing batteries for electric vehicles in Portugal. This factory is now producing batteries in the United States (Smyrna, TN).

Conclusions

To conclude, the Mobi-E programme fell short of expectations. The Mobi-E policy-makers' discourse inspired a sense of innovation, sublimity and the hope that technology would help with the solving of problems associated with transport economy and pollution. Behind the rhetoric, however, the Mobi-E programme left behind an integration of the e-car in an overarching concept of sustainable mobility, the need to change human behaviour, the dynamics of users perceptions and knowledge creation. Several other significant problems coincided with the lack of consumer mobilization around the Mobi-E programme. Among them was the financial and economic national crisis, the lack of a clear and decisive financial incentive, the deficiency of public communication and debates, as well as the inability to involve key communities in electric mobility. In this context, further research seems necessary to assess the way policy design was conducted and the existing development strategy.

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Sustainability and Discontinuities in High-Speed Train Futures

A Multilevel-Framework Analysis

Susana Moretto and Antonio Moniz

Abstract

The high-speed train technology transition to sustainability can produce discontinuities between envisaged technologies and resulting societal dynamics. Constructive technology assessment (CTA) multilevel-framework analysis proved to be a relevant tool in identifying such risks by assessing existing research on high-speed train futures. We conclude that the high-speed train technology transition to sustainability can only be beneficial to the industry and users if the existing methodological discontinuities between the endogenous (industry) and exogenous (policy) groups of prospective research are addressed.

Sustainability Pull Force for Transition

In Europe, there has been, for a while now, a shared consensus that the future is sustainability, and that sustainable mobility is a societal grand challenge (COM (2011) 144 final). Since 2001, high-speed trains have been identified as the preferable passenger-transport mode for medium to long distances (COM (2001) 370 final), representing 70 % of the investments announced for the trans-European transport network. Despite its reconfirmation in 2011 (COM (2011) 144 final), decision-making on which new technologies to support has never before been as vulnerable as it is today to landscape uncertainty, regime complexity and niche disruptions. The dynamics of sustainability that makes technology transitions a continuous process reoriented towards societal aspects is very significant.

Sustainability, in the terms Kemp et al. (2007) describe, is a diverse landscape and disperses supra-systemic pull force. In the case of high-speed trains, it exerts a vague pressure in addition to the known pull forces stemming from other transport modes, accelerated technology development (mainly automotive and aeronautics) and ICT; increasingly tight environmental targets; fast-changing mobility patterns; growing market pressure with new entrants; and cost constraints resulting from the global financial crisis. Yet sustainability is the trigger for the high-speed train innovation and the primary driver of competitiveness. It is also an accelerator for the formation of new social arrangements and institutional alignments, further driving away this industry from its traditional tactical decisions and national old-regime arrangements. This way it reinforces the importance of the strategic character of technology decision-making supported by prospective tools.

Emergence of Prospective Exercises

Since 2001, prospective exercises have been emerging in this industry. Within the described circumstances, they have become a design and management requirement, providing support for decision-makers who need to contend with 30 to 40-year lifespans of train vehicles while anticipating known constraints and, more challenging but also necessary, potential unknown constraints that will need to be dealt with in the ten to fifteen years after their decisions are made. According to bibliographic research, the identified reports are STOA scenarios (Schippl, J. et al. 2008), visions, agendas and road maps of the Railway European Technology Platform (ERRAC),[1] the market outlook from the manufacturers' association, UNIFE (BCG 2008), and train manufacturers'[2] internal forecasts and future reports. All of the above has been subject to updates. Warnings, however, have been voiced in the social sciences on possible failures of technocentric visions to acknowledge potential discontinuities between technology and the societal dynamics of sustainability (Robinson and Propp 2011).

Multilevel-Framework Analysis

To prove such risks in this industry, the authors of this paper address the process of the high-speed train socio-technical system, a functional element of constructive technology assessment, through the application of the multilevel-framework model. According to D. K. R. Robinson, the multi-level model, spearheaded in the 1990s by Arie Rip, Rene Kemp and Johan Schot (Rip and Kemp 1998, Schot and Rip 1997), combined different levels of analysis while drawing on the quasi-evolutionary model of technology and innovation (Dosi 1982, Nelson and Winter 1977, Abernathy and Clark 1985, van den Belt and Rip 1987, Van Lente 1993) and relating it to the actor-network theory (Callon and Latour 1981) and the theories of alignment and stabilization (David 1985 and Callon 1993). For the purpose of this study, the authors allocated the found prospective reports to the corresponding arenas of the multilevel-framework model using the criteria of the commissioning stakeholder. The results are described below.

Landscape Arena

Landscape arena is supra systemic to the high-speed train regime, which is framing national governments, institutions of the European Union, centres of knowledge, non-governmental organizations and end-users (Moretto et al. 2012). Also visible are entities from other sector regimes, such as from energy, aeronautics, automotive and materials impacting high-speed trains' technology development.

At this arena, interests and expectations are exogenous to the high-speed train technology regime. Policy institutions are concerned about defining and meeting great societal challenges, associated with policy initiatives (sustainable transport system, decoupling transport growth from its negative environmental impact and energy dependency, boosting competitiveness). End-users (individuals) are concerned about meeting mobility needs (connectivity and accessibility, reduction in travel time and seamless journeys). Non-governmental organizations and centres of knowledge are looking at specific interests within their areas of action.

These actors are capable of producing framework changes. They can occur in different forms, such as "regular, hyper-turbulent, specific shock, disruptive and avalanche" (Geels & Schot 2007, p. 404). In this industry, they proved capable producing changes at regime level (in terms of approaches towards technology decision-making and supply-chain alignments) by impacting high-speed trains' technology transitions from one generation to the next one.

Within the landscape arena, there are foresight exercises commissioned by policy actors and contracted out to external bodies with the purpose of political guidance regarding which technology to support in order to meet the grand challenge of sustainable mobility. One example is the STOA report (Schippl 2008). The STOA report was commissioned by the European Parliament to present scenarios on the future of medium to long distance transport systems. From the bibliographic references and the list of stakeholders participating in their workshops, no evidence was found of links with the other prospective exercises produced at the regime level. Instead, report citations and invited stakeholders appeared to come from policy and research institutions acting within the landscape, such as the European Transport Conference and the European Commission Eurobarometer. This way it can be considered an exogenous assessment of the future – in relation to the other reports found at regime level, which produces endogenous visions (as will be explained). STOA was found to be the sole report in which scenarios are based on an intended combination of quantitative and qualitative indicators in order to address the societal dynamics of sustainability, using backcasting, aligned with constructive technology assessment.

Regime Arena

Regime arena covers the technology supply-chain system of mutually dependent relations, variable, between stakeholders. It is at the regime level where knowledge is transferred between stakeholders from different sub-regimes (Moretto et al. 2012).

At the top of the regime arena, the sub-regime of public goods and services is visible. Stakeholders located there are train operators, leasing companies and new entrants in railway operations. They are service companies that establish the train-vehicle specifications required to run a train in a dedicated national or international high-speed rail corridor or just buy or lease trains off the shelf. According to the data released by the UIC (2013), there are over 20 high-speed train operators in Europe. They range from a private open-access operator, such as the Nouvo Transporto Viaggiatore (NTV) in Italy, to franchising schemes, such as Virgin Trains in the UK, to consortia of national railway companies such as Eurostar or Thalys and commercial branches of those same national operators, such as SNCF or Deutsche Bahn (DB).

The liberalization of the European railway has pushed aside train operators from controlling the technology decision-making process by transferring it to manufacturers. Operators now focus on the service aspect of the business, with almost no technology ownership. This is even more evident in leasing companies and new entrants from other sectors, which mainly look for standardized trains and have no demands or competences for technology development or design. Overall, interests and expectations from these stakeholders are to overcome technical operational problems, compliance with the track-infrastructure and regulations (interoperability, safety, modularity, homologation, energy, weight, noise emissions, end-of life, maintenance) as well as attractiveness to passengers (speed, comfort, availability, ticketing prices).

These actors may cause technological "regular changes" to the framework conditions, but are likely to be confined to the regime arena while tending to resist events that change the status quo. Such contrasts with their vulnerability to landscape "turbulences, specific shocks and disruptions", such as, for example, the European railway packages and changes in mobility patterns.

Continuing within the regime arena, at a medium layer, there is also the sub-regime of the production of goods. Stakeholders here are the assemblers of high-speed train technology (the vehicle manufacturer) capable of providing turnkey projects. In Europe, they are Alstom Transport (French), Ansaldo (Italian), Siemens Mobility (German), Talgo (Spanish).[3] These firms are global players in today's railway open markets but possess strong national identities still reflected by decades of nationalized business conditions.

High-speed train manufacturers are the owners of technologies, which they inherited, in most of the cases, from national operator companies. Their overall interests and expectations are the reduction of costs, compliance with regulations and attractiveness to customers and most recently to end-users (such as access to markets, low costs in development and manufacturing, standardization, modularization, safety, recyclability and end of life, energy savings, weight, noise abatement, power distribution, wheel and rail contact fatigue, interiors, materials, aerodynamics).

Also, in this sub-regime, manufacturers might introduce "regular changes" from landscape pressures, but most importantly, they can also cause technologically "disruptive" changes to gain strategic markets. They are subject to "avalanche" pressures from the sub-regime of knowledge providers and, in particular situations, from the niche arena. However, due to the large and complex technology system, it is a demanding, costly and time-consuming task for train assemblers to integrate disruptive technologies in vehicles. An invisible force can also be felt from potential new entrants, such as manufacturers from other parts of the world or component suppliers with increasing technology capacities resulting from outsourcing or their market scales.

At the bottom of the regime arena, there is the sub-regime of knowledge providers. Stakeholders there cover different tiers of the technology supply-chain, ranging from tier one of component suppliers of the high-speed train technology sub-systems, such as Knorr-

Bremse (pneumatic, hydraulic and electronic braking systems), Bosch (coolers and cooling systems, hydraulic travel drivers), Voith (wheel sets, couplings, gears, cooling systems) MTU (engines), Efacec (telecommunication systems, power supply systems) Bochumer Verein and Bonatrans (wheel sets), Faiveley (air conditioning, couplers, electromechanic door and gate systems), Saft (accumulators, industrial cells and supercapacitors), Selectron (control systems), to the tier two and above, such as Amorim Corck Composits (bio-composits for car-body sandwich panels, floor and isolation from noise and vibration). This sub-regime also includes knowledge suppliers arising from university spin-offs.

In Europe, component suppliers from tier one might even pair with their clients, the technology assemblers, for turnover and technology capabilities. In the past decade, the increase in outsourcing from train manufacturers saw them assume greater say in technology development. As a result, those firms have become capable of producing pressures and changes that have shifted from “regular” to “disruptive” to the arenas of regime and niche. While at the same time, they have become more vulnerable to landscape changes. An invisible force comes into play in this case as well. It stems from potential new entrants and also from firms’ alliances and acquisitions.

The main interests and expectations of component suppliers of technology and know-how are similar and might be confused with those of train manufacturers, i.e. reduction of costs, compliance with regulations, reliability and attractiveness to customers. This occurs because they are specialized suppliers of particular technology sub-systems for high-speed trains. They are subject to tight quality-standards requirements and certification procedures imposed by vehicle assemblers. With this purpose in mind, the International Railway Industry Standard (IRIS) was formed in 2005.[4]

Within the regime arena, stakeholders tend to cluster in professional associations on the European level, acting like clubs with shared visions, perceptions and interests. During the past two decades, they have multiplied and professionalized. The associations include the UIC (International Union of Railways: rail operators, leasers and infrastructure managers) and UNIFE (Union of European Railway Industries: manufacturers and component suppliers of vehicles and infrastructure). More target-oriented interest associations include the ERWA (European Rail Wheel Association of Manufacturers), EIM (European Rail Infrastructure Managers), CER (Community of the European Railways and Infrastructure; the policy wing of the UIC), ETF (European Transport Workers Federation) and the EPITOLA (European Passenger Train and Traction Operating Lessors Association). National associations also need to be considered. For example, the FIF (French Railway Industry Association), RIA (United Kingdom Railway Industry Association and the VDB (German Railway Industry Association).

Each of those listed associations serves specific groups of stakeholders, which sometimes overlap in members and missions. Others, such as the ERRAC (European Rail Research Advisory Council), combine all the existing associations plus landscape stakeholders, such as member-states representatives and end-users, sharing the same goal of an integrated rail research area in order to foster innovation in the rail sector. Three types of prospective exercises are to be found in the regime arena. The first type is visions and road maps, such as ERRAC[5] visions (ERRAC 2001, 2007), produced on the regime level by the railway community, combining interests and expectations of sub-regimes plus actors from the landscape and niche arenas. Forecasting exercises, such as the UNIFE market outlook 2020 (BCG 2008), commissioned to consultants on the sub-regime level by the association of manufacturers, serve as a means of a joint anticipation of market trends and future technology needs. There are also individual market outlooks and forecasts, such as Siemens' from 2006 and 2009, which have the same character as the ones above and differ only in the fact that they are the results of nothing but stakeholder interest in anticipating its future positioning in the market and defend its interests and expectations.

The reports have in common a techno-centric vision of the future, contrasting with the STOA report. They are inclusive of each other's prospective exercises. Which means that the UNIFE market outlook integrates data from its members' internal forecasting exercises and combines them together on the sub-regime level. The ERRAC visions in turn integrate the professional associations' forecasts in the specific area of research and innovation in regime arena. The higher the level on which the prospective exercises are produced in the technology innovation-chain, the greater the engagement of the various stakeholders. However, the above seems to disregard the results of exogenous prospective exercises, such as the STOA report. Only Siemens clearly referred to other sector's Delphi results as from Energy. Moreover, their methodology reflected the commissioning of stakeholders' life-cycle cost approach based on quantitative indicators, thus bypassing qualitative elements inherent to the societal dynamics of sustainability.

Niche Arena

In the niche arena, the stakeholders are the academia and private research institutions, spin-offs and SMEs, all of which are providers of basic and frontier research with a potential for application in the railway-vehicle technology system and sub-systems. The stakeholders vary quite a bit, as the institutions do not dedicate their efforts exclusively to railways. The EurNEX European Rail Research Network of Excellence is a joint initiative driven by operators and industries supported by the European Commission. Its aim is to group such different scientific actors from all over Europe in the area of transport and mobility. Its members include the Chalmers University of Technology, Technical University of Lisbon, Technical University of Berlin, Newcastle University, Politechnical University of Madrid, University of Valenciennes, Technical University of Viena, and the Czech Railway Research Institute, to name a few. It was interesting to find spin-off companies, such as INECO (a transport engineering firm), in this group.

This type of stakeholders is classified as advanced-knowledge providers but falls within the specific niche arena (therefore outside any regimes). However, the boundary between the two types in the specific case of high-speed trains is very blurred as the stakeholders who are advanced-knowledge providers, are motivated by problems from existing sub-regimes.

Specifically, radical novelties, even if stabilized, do not easily break through in the regime arena in the railway business. Only if a window of opportunity arises from pressures from the landscape arena, then radical novelties are implemented and new entrants can enter.

The high technology content and complexity of high-speed trains combines different areas, such as mechanical engineering, computations, materials, managerial expertise, and finance, to name a few. Moreover, due to the large scale of the technology system and the traditional protectionism towards information sharing, in many cases, the technology has evolved from already tested and matured solutions in regime arena rather than from breakthrough research in the niche arena.

In contrast with the other two arenas, no prospective exercises were found. In fact, the stakeholders from this arena are brought into the regime or landscape-level discussions to undertake the studies or are invited to take part in the collective elaboration of visions. That is clearly the case of the ERRAC visions or the STOA report.

Conclusions

Using the constructive technology assessment multilevel-framework analysis, it was observed that the prospective-research reports reflect the situation in the arenas from the commissioning stakeholders' view, therefore using different methodological approaches to meet specific purposes. The two main groups of reports can be distinguished as follows: a) producing exogenous visions and b) endogenous visions.

The exogenous approaches can be referenced as STOA studies commissioned by landscape stakeholders. STOA introduces the necessary qualitative indicators to the construction of scenarios, thus addressing the societal dynamics of sustainability used in combination with quantitative indicators by means of anticipation (e.g. reflections supporting strategic-policy technology decision-making). The endogenous technocentric visions, such as the ERRAC and UNIFE market outlooks and industry forecasts, are commissioned by regime stakeholders. They appear to be locked to the industry's quantitative life-cycle-assessment methodologies. However, they are still far from addressing the non-measurable societal dynamics of sustainability. Reports are produced by means of not only anticipation but also of influence and a collective generator of knowledge-sharing and co-developments.

The high-speed train's technology transition to sustainability can only bring benefit if the existing methodological discrepancies (socio-technical system arenas and typology indicators) are overcome between the two groups of prospective researchers, and a constructive technology-assessment tool is introduced in the industry. All of this gains relevance if the high socio-economic impact that high-speed trains have is considered. European institutions could promote the grounds necessary for a functioning interchange.[6]

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PART V

FACING NEW AND EMERGING TECHNOLOGIES

Articles from the PACITA 2013 Conference Sessions:

Neurodevices (VI)
Health Care and Ageing Society (VIII)
Privacy in the Internet World (X)
Social Media (XI)
Emerging Technologies (XV)
Ethical Aspects of TA (XVII)
TA Meets Young Talents (P-III)
Author Meets Critics (P-IV)

HEALTHCARE INNOVATIONS

Healthcare Innovations in an Ageing Society

The Case of Early Diagnostics for Alzheimer's Disease

Ellen H.M. Moors and Dirk R.M. Lukkien

Abstract

To meet the grand challenge of ageing, early detection of Alzheimer's disease (AD) is a widely shared goal. Studying emerging early AD diagnostics developments through user-producer interaction (UPI) might increase its societal acceptance. Broadening appears to be quite advanced in early AD diagnostics research in the Netherlands. Producers engage stakeholders in informal discussions about early AD diagnostics impacts by linking up with Dutch Alzheimer Cafes. Upstream involvement takes place by encouraging patients to participate in clinical trials, in which their feedback is obtained on the technological performance of early AD diagnostics. Involving patients in research-agenda building is taking place, and new linkages between researchers and patients are built to improve information transfer via intermediary patient organizations, such as the Alzheimer Society.

Introduction

Longer life expectancy and a shift from acute to chronic diseases are exerting pressure on the capability of healthcare systems to meet the needs of the ageing population. Age-related diseases like Alzheimer's disease (AD) will occur more frequently, nursing care needs to be intensified and a broader, mission-oriented innovation policy is increasingly regarded as being critical for effectively meeting these grand societal challenges. Nowadays, AD is the most common cause of dementia, accounting for approximately 60 % of all cases (Sadowsky & Galvin, 2012). As the damage caused by the pathophysiological mechanisms associated with AD is presumed to be irreversible, earlier detection of AD could offer better future prospects for individuals concerned as patients could benefit from drug therapies, better understanding and more time to prepare for a future with AD (Vestergaard et al., 2006). Furthermore, existing medication, and any future disease-modifying agents, are likely to be more effective when administered earlier in the course of the disease (Van Rossum et al., 2010; Sadowsky & Galvin, 2012). Early detection of AD, therefore, is a widely shared goal in current biomedical research, and a search is going on for viable AD biomarkers (Boenink et al., 2011). A number of novel technologies are being developed, called ‘early AD diagnostics’, to enable an earlier and more reliable diagnosis of AD during life based on biomarkers made visible by instruments such as PET, MRI scans and/or CFS-analysis (Handels et al., 2012). The Dutch research consortium, Leiden Alzheimer Research Netherlands (LeARN), amongst others, aims to develop these emerging technologies (CTMM, 2013a).

These new innovations also raise new uncertainties. For example, it remains unclear how desirable future diagnostics are considered by AD patients when treatment is still lacking. Boenink et al. (2011) argue that new biomedical technologies may have a broad set of impacts on medical practice, society and culture, but that society hardly takes these impacts into account when assessing the desirability of a novel technology. Many innovations never make it to daily use in healthcare because they do not fit the needs and values of their targeted users. Therefore, early anticipation of the societal impact of emerging technologies may contribute to more robust and useful technologies. Interaction between users and producers of emerging diagnostic technologies takes place both in laboratory and clinical environments and in the wider society, where the application of healthcare technologies not only meets a medical need but is also accompanied by increased health awareness and growing needs and expectations of citizens due to diagnostic possibilities. While stakeholder involvement in such emerging innovation processes might be beneficial, it remains unclear how to organize it in an effective and efficient way. Uncertainty and flexibility – inherent to emerging technologies - open possibilities for far-reaching stakeholder involvement but at the same time ask for thorough organization of these interactions in the face of ever-changing technology specifications, demands, and configurations of the social network (Rip et al., 1995).

Interaction between the users and producers of biomedical technologies is essential in increasing the success of these innovations in social and economic terms (Moors et al., 2008). Taking into account the preferences of users might facilitate the adoption and implementation of new innovations. Also, the creative potential and experiential knowledge of users might help forming new technologies and putting demands on the agenda of companies and governments (Boon et al., 2011). Moreover, users have a moral right to influence decision-making on innovation processes because it strongly influences their lives (Smits & Boon, 2008). This is especially true for patients considering various treatment options. User-producer interactions (UPI) are indispensable when new technological opportunities are just emerging, which is the case with early AD diagnostics, and are defined by Nahuis et al. (2012, p. 1122) as “interactive learning processes between users and/or producers leading to or aiming at the reduction of uncertainty about the relation between product and demand characteristics”.

Previous studies have reflected on the conditions for effective user-producer interaction in biomedical innovation processes. Smits and Boon (2008), for example, have formulated policy measures to involve users in innovation processes in the pharmaceutical industry in order to improve the quality of innovation processes and increase the acceptance of innovations. In studies of AD, the patient perspective has long been ignored. People with dementia, however, do have the ability to participate in research (Wilkinson, 2002). Empowering patients to take an active role in their own healthcare has been identified as a key factor in the drive to improve health services for patients (Davis et al., 2007). Accordingly, this chapter aims to systematically explore the interactions between users and producers of early AD diagnostics developments in the Netherlands.

The next section briefly describes the methodological approach, followed by the research findings and a conclusion part.

Methodology

Interaction between users and producers (UPI) can increase chances for successful innovations, both in social and in economic terms. It is difficult, however, to fully understand user needs and preferences. After all, users are not always able to articulate their needs, preferences or interests because they might be not fully aware of all latent or future possibilities of a new technology or do not want to share their creative ideas and opinions (Griffin, 1996). Studying user-producer interaction processes helps to identify user needs and preferences and strengthen the role of users in the innovation process (Oudshoorn et al., 2003; Moors et al., 2008). Nahuis et al. (2012) have distinguished various types of UPI in innovation processes, as shown in Table 1. They argue that different contexts demand different types of UPI. These various types of UPI serve as heuristics to methodically explore which interactions take place between users and producers during the development of early AD diagnostics in the Netherlands.

The research is based on qualitative data regarding different interactions between users and producers during the development of early AD diagnostics. Additionally, results are taken into account about improving the ways of involving users. The Dutch LeARN project aims at developing tools for early diagnosis of AD and provides an important source of information. LeARN is funded by the Dutch Centre for Translational Molecular Medicine (CTMM), which is dedicated to enabling earlier and more precise diagnosis of various diseases (e.g. cancer and diabetes) and to the design of personalized therapies (CTMM, 2011). Developments within the CTMM concerning other diseases might also provide insights on user-producer interactions in the context of early AD diagnostics (Handels et al., 2012). Users and producers have different backgrounds and their interactions can be facilitated by intermediary organizations (Boon et al., 2011). Patient organizations for AD represent and promote AD patients' interests and joint research. Therefore, data is also collected about how such intermediary organizations are involved in UPI during the development of early AD diagnostics.

The data is obtained from both scientific literature and from written public sources. The scientific databases Scopus, Google Scholar and PubMed are used for data gathering.

Search terms that are used in these databases are: LeARN, CTMM, biomarkers, PET, MRI, CSF, in vivo, early detect*, early diagn*, Alzheimer's disease, AD, user, patient, involv*, engag*, UPI, user-producer interaction, technology assessment, feedback, clinical trials, decision-making, needs, preferences and combinations of these. Public sources that are consulted include the website of the CTMM, annual reports of the CTMM, the website of the Dutch Research Council NWO and websites of Alzheimer organizations such as Alzheimer's Society and Alzheimer Nederland.

The seven types of UPI described by Nahuis et al. (2012) serve as sensitizing concepts to explore which types of UPI take place in the context of early AD diagnostics. This analytic framework helps to distinguish the different interactions found in this research. Table 11 shows the operationalization of the various UPI concepts.

Type of UPI	Description of UPI types
Broadening	Considering broad societal aspects at early stages of technological development
Constructing linkages	Constructing linkages between users and producers to make the transmission of information more effective
Characterizing users	Giving a representation of who the supposed users are and what they want
Upstream involvement	Users becoming participants in research, design and development, and agenda building
First user enrolment	The selection and enrolment of the first users of new technologies
Feedback	-Focusing on technological performance -Encouraging users and teaching them how to use the technology
Downstream innovation	Users coming up with creative ideas for product development or making improvements themselves

Table 11: Operationalization of the various types of UPI (based on Nahuis et al., 2012)

Research Findings

The process of broadening has been recognized as important for user involvement and put into practice during the development of early AD diagnostics in the Netherlands. Early Medical Technology Assessment (MTA) is a mandatory part of every CTMM research project (CTMM, 2010). The purpose of an MTA is to estimate the effects of medical technologies on the current and future state of health in the patients involved. Besides the analysis of costs and benefits, MTA takes social, ethical and legal considerations into account, indicating that broadening takes place (CTMM, 2013b). The Dutch Research Council, NWO, supports the LeARN project and involves stakeholders in the deliberation and decision-making on the social acceptability and moral desirability of developments in new AD diagnostic technologies (NWO, 2013). This indicates that NWO adds to the process of broadening in the context of early AD diagnostics. The study of Boenink et al. (2011), supported by NWO, uses the LeARN project for a case study and describes ‘possible’ sociotechnical futures that reflect on the broad range of potential impacts of technological development in the field of early AD diagnostics. They also predicted the public desirability of these impacts. These scenarios allow for a discussion of what the problems and needs surrounding AD are, and how the attempt to early detect AD influences those problems and needs. Such discussions can be organized with stakeholders in various engagement activities. Boenink et al. (2011) describe two methods to elicit stakeholders’ responses. One method is to convene “focus groups” – homogeneous groups of a particular type of stakeholders - to list the conditions that future developments of early AD diagnostics should satisfy for a specific group of stakeholders to accept these developments. Another method is bringing different stakeholders together in a larger, interactive, multistakeholder setting. In such a setting, ultimate conclusions may not just seek to further the interests of one specific group but are based on widely shared values. Cuijpers et al. (2011) presented the current landscape of AD in the Netherlands to get an overview of the various stakeholders and their interests and issues. Besides, they argue that Technology Assessment (TA) does not only take place within formal TA studies but, although not systematic or complete, assessment and anticipation are constantly going on as a part of societal processes. Alzheimer Cafes (ACs) – monthly informal meetings for persons with dementia, their partners, family or caregivers – are then regarded as discursive spaces for informal TA (Rip, 1986) to voice, exchange and assess multiple futures of AD and its diagnostics instruments on an informal basis. Currently, there are over 200 ACs across the Netherlands and the concept is also copied in other countries (Alzheimer Nederland, 2013a). The informal assessment of multiple futures of early AD diagnostics in ACs is an indication that broadening is taking place in the context of early AD diagnostics.

Upstream involvement of users seems to take place in research on early AD diagnostics. First, CTMM tried to facilitate a much greater patient involvement by encouraging them to sign up for future clinical trials (CTMM, 2011). Different Alzheimer patient organizations also encourage patients to participate in clinical trials (Alzheimer Nederland, 2013b; Alzheimer’s Association, 2013). For example, Alzheimer Nederland encourages AD patients to participate in research by providing blood samples, brain scans or cerebrospinal fluid for joint research activities at the eight university medical centres in the Netherlands (Alzheimer Nederland, 2013b).

Caron-Flinterman et al. (2007) argue that patients and patient organizations, although highly involved in the biomedical research field as end-user groups, are less influential in terms of decision-making on biomedical research in the Netherlands. Formal decision-making on biomedical research agendas is mainly done by experts. Recent studies, however, show that patients actually are involved in decision-making on research agendas; first, CTMM is trying to enable larger patient involvement by actively consulting patients’ opinions on the future direction of translational research (CTMM, 2011). Second, the Research Network of the Alzheimer’s Society in the Netherlands involves users in agenda building by working with people with dementia and carers to select the best dementia research projects for funding (Alzheimer's Society, 2013b). 225 volunteers are involved, working with leading scientists to set the research agenda of the Alzheimer's Society. The Alzheimer's Society is involved in developing new brain scanning techniques for more accurate ways to diagnose dementia (Alzheimer's Society, 2013c). As patients' preferences for research directions are consulted through the Research Network, patients might have an important voice in the involvement in this research. The Dutch Health Council (RGO) has consulted the Dutch government on how to consider the needs of patients and caregivers in the development of research agendas, which indicates that its importance is recognized. This might lead to even stronger user involvement in decision-making on biomedical research (RGO, 2007).

In the first stages of the development of early AD diagnostics, feedback needs to be obtained from AD patients. All diagnostic agents must undergo extensive preclinical and clinical testing before regulatory approval is granted (Frangioni, 2006). In clinical trials, patients provide feedback on the technological performance of diagnostics. They only provide information about the diagnostic value of the technology (RGO, 2011; CTMM, 2013a). Gibson et al. (2004) argue that higher-quality feedback could be obtained through investigating the opinions, experiences and practices of patients during trials by using qualitative methods, such as observational studies, in-depth interviews and textual analyses of written records. The adoption of qualitative methods within clinical trials, when combined effectively with quantitative measures, would allow both researchers and practitioners to gain a better understanding of the improvements that treatments or services provide, and how these improvements are experienced by patients with dementia themselves. By using this feedback, the relevance of outcomes to patients could be improved. Rather than robustly confirming existing hypotheses, qualitative methods can often generate new ideas for further research and provide insights into the experiences of users and carers not immediately accessible through quantitative methods.

CTMM recognized that when patients get involved in translational research, a common language needs to be found that both the researchers and the patients understand (CTMM, 2011). Therefore, they explored the idea of connecting patients and researchers, both associated with the same disease, in one-on-one informal discussions. They argue that this is an adequate way for researchers to find ways of explaining their research in terms that lay people can understand (CTMM, 2011). This illustrates that CTMM constructs linkages between patients and researchers, through which information can more effectively pass. Also, the engagement activities described by Boenink et al. (2011) demand adequate linkages between users and producers. The Alzheimer Cafes also include novel linkages between the researchers, medical experts and patients, and potential/future patients and caregivers to exchange thoughts. Additionally, intermediary user organizations, such as the patient organization Alzheimer Nederland are important linkages between users and producers involved in organizing feedback through encouraging participation in clinical trials. Such intermediary organizations are important when users are involved in agenda building for biomedical research, for example in the Research Network of the Alzheimer's

Society. Boon et al. (2011) argue that intermediary user organizations can facilitate the interactions between users and other actors in several ways. They can function as ‘network assemblages’ that help to link up networks of patients, clinicians and potential researchers. Or they facilitate boundary conditions and resources of research, such as access to patients for the recruitment of clinical trials.

In summary, the results show that considering broad societal aspects in early technology development is already fairly advanced in research on early AD diagnostics in the Netherlands. Furthermore, researchers could engage various stakeholders (e.g. patients, caregivers) in the informal deliberation of impacts of early AD diagnostics, e.g. by linking up with Alzheimer Cafes. During clinical trials, feedback is obtained from patients on technological performance criteria of early diagnostics. Upstream involvement takes place through encouraging patients to participate in clinical trials. Furthermore, new linkages between researchers and patients and their caregivers are constructed to make the communication of information more effective.

Conclusions and discussion

Adequate linkages between users and producers seem to be important for emerging healthcare innovations, such as early Alzheimer’s disease diagnostics. Patient organizations, such as the Alzheimer’s Society, play an important intermediary role between users/patients and researchers. Alzheimer Cafes are important places for concerted stakeholder interaction where controversies about early AD diagnostics are articulated, and informal Technology Assessment takes place.

Such concerted stakeholder interactions consist of adaptations of current behaviours of the various stakeholders involved in early AD diagnostics to stimulate healthcare innovation and are the outcome of an alignment process, in which shared research agenda building, feedback and broadening processes play an important role.

Nowadays, there is a lot of attention on the expected but largely uncertain contribution of early diagnostics to healthcare innovations. It would be helpful to manage our expectations based on scenario building and policy coordination (Propp et al., 2009). This research provided insights on how the needs and preferences of patients are taken into account during the innovation process of early AD diagnostics. It investigated how desirable effects of early AD diagnostics can be enhanced and undesirable societal effects prevented, thus leading to ways of responsible diagnostics innovations (Cuijpers et al., 2013). This in turn will reduce the risk of future social and moral controversy and/or low uptake of early AD diagnostics.

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Robotics and Autonomous Devices in Healthcare

A Technology Assessment Study of Opportunities and Risks

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Abstract

The interdisciplinary "Robotics and Autonomous Devices in Healthcare" study shows the current status and future trends of robotics in healthcare. It assesses opportunities and risks in view of a technically feasible, economically achievable and ethically desirable use of robotics in healthcare. An analysis of opportunities and risks led to the conclusion that insufficient regulation, for instance in liability law, data protection and ethics, would lead to risks for people dealing with such devices in research, testing and practice. Evidently, a proactive and coordinated policy framework is required to minimize the risks of the use of robotics in the healthcare environment and to allow stakeholders to benefit fully from its opportunities and advantages.

State of the Art of Research

In industry, robots have long been widespread. They do routine work, e.g. in the assembly of automobiles. Given the shortage of personnel in the health sector (Obsan 2009), demographic developments, such as an ageing population (Bundesamt für Statistik 2010), changes in family structure (Bundesamt für Statistik 2010) and growing economic pressure, are opening up a potential for the use of robots and autonomous devices in healthcare (Straub/Hartwig 2011). More and more robots are in use that assist surgeons during operations and therapists in rehabilitation. According to Hein (Hein 2009), over 6.5 million robots are in use worldwide and in the Swiss health sector alone more than 3 000 robots were used in 2008, mainly for surgeries and rehabilitation. Experts predict that the market potential is still growing (Hein 2009; Wildi 2008). Especially since an increase in the retirement age is being discussed, and solutions need to be found for strenuous tasks for older professionals in healthcare (Born 2001). Robotics will be a key technology for the 21st century (Decker 2002). Politicians and decision-makers are, therefore, confronted with important issues. In addition to desirable and undesirable impacts of the use of robots in healthcare, opportunities and risks have to be considered. The purpose of this interdisciplinary project, “Robotics and Autonomous Devices in Healthcare” (Becker et al. 2013), is to identify opportunities and risks in view of a technically feasible, economically achievable and ethically justifiable use of robotics in healthcare. Furthermore, the study offers future scenarios for robot application and policy recommendations for politicians and other decision makers.

Methodological Approach

In the “Robotics and Autonomous Devices in Healthcare” project, different methods were used to identify current and future trends as well as opportunities and risks in the development and use of robots in healthcare. To analyse current developments, prototypes and use of robots in practice, a literature review was carried out. Search criteria included the following aspects: medical, economical, technical, ethical, acceptance and trends linked to the term robotics.

Using the method of focus-group discussions, we assessed needs, hopes and concerns of stakeholders like physicians, therapists, managers of healthcare organizations, producers of robots for healthcare, patients and care-givers aged between 30 and 70 years. The members of the three focus groups based their discussions on the requirements that they would have for using robots from their own perspective.

We used the scenario method (Steinmüller 1997) to illustrate what consequences specific political strategies could have on the development of technologies and their use. Possible future developments up to the year 2025 were evaluated. Three narrative scenarios were written to define the attitudes: reactive, proactive, and coordinated. Each scenario was based on a story of a central character with a chronic disease or a handicap that leads to the use of various robots in daily life. The principal characters varied in personal and medical characteristics as well as the devices employed. Furthermore, framework conditions and social developments were considered.

Based on all findings, opportunities and risks of robot use in healthcare were deduced and recommendations for politicians were formulated.

Research Findings

The literature review showed that the field of robotics is characterized by diversity and a wide-spread complexity of devices. Many products exist only as prototypes and are still in development, and insights into their everyday usability are still limited. Furthermore, there is a lack of knowledge about actual benefits and costs in long-term use of robots in healthcare and about positive and negative effects on stakeholders and society. Therefore, a particular need exists for research in non-technical areas, such as sociology, psychology, ethics, law and economics. Most of the identified models can be classified into three groups according to their functions:

1. Training aids and aids for movement, for the purpose of mobility and autonomy
2. Devices complementing or facilitating people's life, or serving as their physical proxy
3. Devices accompanying and interacting with people

The focus-group discussions show that all respondents are aware that technology is an essential part of their lives. However, potential users have different attitudes towards robots depending on the degree of autonomy and social interaction of the robots. Minor concerns exist towards passive-assistance robots like rehabilitation robots, medium concerns exist towards service and monitoring systems and major concerns exist about partly autonomous and autonomous devices that can interact with non-professional users.

Differences were found between professional and non-professional users regarding the acceptance of robots. Non-professional users are interested in individual and practical benefits. On the one hand, they hope to gain more autonomy, independence and participation in their daily live through robots; on the other hand, they fear a loss of human contact. They also see their freedom of choice, the access to technology and a sufficient data protection at risk.

Professional users discussed ethical and psycho-social aspects of robot use and the impact of robotics on their working conditions and professional identity. Professional users accept support by robots under the condition of improved effectiveness and quality of health. A key requirement brought forward by the interviewees is that humans should remain the focus, and direct human contact and interpersonal relationship should not be replaced by technology. Professionals have ethical concerns if technology is applied to particularly vulnerable people who cannot express their consent (e.g. dementia patients, autistic children). Furthermore, professionals articulate some concerns about workforce reductions and layoffs.

Both user groups desire technology to be used to support and relieve users and not act as a substitute for humans. Replacement and reduction of human contact represent the greatest fears regarding robots.

The question of technical feasibility regarding robots in healthcare in the next 15 years cannot be answered definitely as too many factors influence the development and dispersion of robots. Seven key factors were identified in the study:

1. Usability from a professional and non-professional user perspective and their
2. Acceptance of products
3. Economic aspects like cost-effectiveness and funding

4. Clarification of legal and ethical questions
5. Social aspects and technical development
6. Influenced by e.g. investment into research and development
7. Conditions of certification etc.

Political changes, incidences with robots or accidental inventions may accelerate or decelerate technical progress and market penetration. A humanoid, flexible and autonomous robot that is a competent servant and replaces humans will remain a vision of engineers for the next 15 years (Bioethikkommission beim Bundeskanzleramt 2009). However there are some promising products entering the market that are technically less autonomous and complex but still reliable in supporting users in different tasks e.g. transporting, lifting, communicating, cleaning, training etc.

Regarding the economic aspects of robot use in healthcare, no evidence could be found to prove that robots can reduce costs in the health system. Because most tasks in care are complex, individual and non-repetitive, robots can only replace humans in few areas such as transport, medication administration, monitoring etc. If robots are mostly supporting health professionals, an increase instead of a decrease in costs is conceivable. Health-technology assessments are needed to investigate the cost-effectiveness of robots. Long-term effects for users, facilities and the society as a whole have to been taken into account.

If robots enter the market in the coming years, they will be able to effect political and social change. So far, professional and non-professional users have been aware of demographic changes and the shortage of health professionals in Switzerland. They generally accept technology in their daily life but point out that, above all, a non-technical solution should be realized to increase the number of professionals in healthcare, e.g. by improving the compatibility of family and work, status and income of health professionals or increasing the number of trained health professionals. Discussions in the society are needed to set priorities and standards in healthcare. The interests and needs of vulnerable groups like people with dementia and children have to be carefully considered and respected.

Opportunities and risks can be seen on different levels: individual, institutional and on the level of society. Individuals in need of care and their relatives could gain autonomy, mobility, intensification of training and support in their daily life. Yet, there is also the risk of reduced human contact, of feeling controlled, neglected and overburdened. Professional users could be released from physical strains and routine tasks like lifting, documentation and transport. Telepresence robots could support the communication between experts and patients. However, there are also risks of losing direct contact and a constructive relationship to clients and to experience technology as an additional burden. Reduction of personnel is seen as a risk if telepresence and automation will be used intensively.

On the one hand, robots could support improvements in efficiency within institutions like hospitals and nursing homes, as new treatment concepts increase attractiveness and effectiveness of institutions. On the other hand, a lack of convergence of hardware and software could hinder the implementation. Furthermore, because the cost-effectiveness of the use of robots is unknown, costs may actually increase.

In general, robot use has a positive potential for society: it can create new jobs and professions, support health professionals, improve the quality of healthcare and stabilize healthcare costs through efficiency. However, possible risks need to be considered too: negative effects could result from the replacement of humans: impaired cooperation between patients and professionals increased costs or reduced quality.

The impact of robot use in healthcare is largely dependent on political decisions. Therefore, three potential attitudes of politics and their consequences have been analysed:

A reactive policy would lead to a regulation of technical developments in the healthcare market, resulting in products for big user groups and an orientation on economic interests. The risks are a lack of debate in the society, a lack of user acceptance and product developments that serve market interests instead of social needs. Furthermore, legal issues (e.g. liability, insurance, data protection, patient rights) and ethical considerations, unclear financing, lack of knowledge (e.g. utility, usability, effectiveness and cost-effectiveness, long-term consequences) and barriers in the environment and technology convergence (Butter 2008) are further issues and uncertainties leading to risks.

A proactive policy could clarify legal issues and support ethical debates and, therefore, control risks.

A proactive and coordinated policy could additionally foster interdisciplinary research and debates on robot use, priority setting and standards based on knowledge of consequences. Furthermore, it could improve the physical and social environment for robot use and create advantages for the local industry on the international market. The risks are a division in society between robot supporters and robot opponents as a result of the debate and political conflicts, a neglect of other relevant alternatives in research as well as an over-regulation and rejection of robot use in the population.

Conclusions

Robots and autonomous devices are already a social reality. In the coming years, their importance will increase significantly in the healthcare sector. The study identified some social developments and problems arising from an increased use of robots in healthcare to be expected in the coming years.

Our results show that, for people dealing with robots in research, testing and practice, there is a lack of regulation, for instance, in liability law, data protection and ethics. An attitude of hesitation and reaction translates into a willingness to accept these risks. Measures, such as a clarification of liability laws and data protection, are therefore necessary and cannot be postponed to an indefinite future. We therefore recommend a proactive and coordinated policy framework to minimize the risks of the use of robotics in the healthcare environment and to allow society to fully benefit from the opportunities and advantages it presents.

Necessary requirements comprise legal adjustments in liability law and data protection as well as the assessment of and the compliance with ethical regulations, particularly with regard to persons incapable of giving their informed consent. Further requirements cover the promotion of applied interdisciplinary research, including concerned users and patients, as well as the promotion of technology assessments and the enhancement of public awareness regarding the use of technology in healthcare, to ensure equitable access.

In conclusion, a proactive and coordinated policy has the best potential to minimize risks and realize opportunities of robot use in healthcare. It is important to find an appropriate level and measures of regulation by having stakeholders participate in decision-making.

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Neuromodulation and European Regulation

Mirjam Schuijff and Ira van Keulen

Abstract

Neuromodulation aims to alter neural activity in order to change someone's behaviour or cognition for medical or non-medical reasons. Treatment of diseases or cognitive enhancements are examples of such reasons. Devices for neuromodulation are relatively new, and the market for such technologies is just emerging in the European Union. This article explores whether and in what ways the growing market for neuromodulating devices, in particular EEG neurofeedback, transcranial magnetic stimulation (TMS) and deep brain stimulation (DBS), poses new regulatory and governance challenges to the European Union. Special attention is paid to the safety of the technology and the harmonization of requirements related to bringing neurodevices on the market with respect to promoting trade and innovation.

The article is based on a case study that was originally published as a part of the STOA project 'Making Perfect Life' (2012).[1] The case study is based on desk research, interviews and an expert meeting.

Neuromodulation: A Growing Field

Neuromodulation – using devices that electronically stimulate or assist with stimulating the brain and mental functioning – is a growing field (INS, 2011; MDDI, 2006). There are several reasons for this growth. One is that new, effective drugs have not been developed. Investment in the treatment of psychiatric conditions or neurological conditions, such as stroke, has, at least in some companies, shifted towards neuromodulation instead of psychopharmaceuticals (Miller, 2010). Another reason is that the incidence of neurological and psychiatric conditions is growing and will continue to grow with the ageing population, creating a market for the devices. The final reason is that novel neuromodulation devices are easier and cheaper to bring on the European market than new drugs (as there are less stringent European regulations).

EEG Neurofeedback

EEG neurofeedback is a non-invasive neuromodulation technology. It uses EEG equipment that trains people to self-regulate their brain wave patterns, influencing their cognition or behaviour. To do so, their brain activity is recorded by a few EEG electrodes and displayed in real time. People then train themselves to adjust their brain activity to resemble the optimal brain wave pattern (also displayed) (Van As et al., 2010). Even though EEG neurofeedback is being offered as a treatment for, among others, ADHD, epilepsy, autism and learning disabilities, its efficacy is disputed (except in the case of ADHD (Arns et al., 2009)) (Van As et al., 2010). The risks, side effects and adverse events that are associated with EEG neurofeedback range from relatively mild (such as anxiety or insomnia) to severe (inducing epileptic seizures). The main expected technological developments of EEG neurofeedback are related to easier to use equipment and better recordings of the measured brain activity. More research into the conditions for which EEG neurofeedback can be used and the treatment protocols to do so is also expected.

Transcranial Magnetic Stimulation

Transcranial magnetic stimulation (TMS) is a non-invasive technology for neuromodulation. A coil held next to the head generates a magnetic field which induces an electrical field in the brain, altering the brain activity near the skull. TMS is used for research, diagnostic and treatment purposes. TMS as a therapy is most widely studied (and found to be effective) for treatment resistant depression. The use of TMS for the treatment of other conditions is being studied (Health Council of the Netherlands (HCN), 2008). Unlike research or diagnostic purposes, TMS for treatment consists of repeated sessions (rTMS) (HCN, 2008; Rossi et al., 2009). Side effects and adverse events are relatively rare but include seizures, psychiatric complications (hypomania for example) as well as headaches and hearing loss. The expected technological development of TMS entails mainly new applications for the technology (can TMS treat more diseases or assist cognitive enhancement?). The technology itself is not expected to develop a lot.

Deep Brain Stimulation

Deep brain stimulation is an invasive technology for neuromodulation. Electrodes are implanted deep inside the brain at specific targeted areas. The electrodes are connected to a pulse generator implanted in the chest or abdomen by leads. DBS alters brain activity and is most commonly used to treat the tremor symptoms of Parkinson's disease. Experimental treatments include psychiatric conditions, such as severe depression or obsessive compulsive disorder. DBS can have a lot of side effects. Since DBS implantation requires surgery, risks include bleeding or infection. Side effects include changes in perception or mood (Synofzik & Schlaepfer, 2011). Because of the risks involved, DBS is a last-resort therapy. Two expected developments in the field of DBS are combining DBS with a system for drug delivery and developing closed-loop stimulation (targeted stimulation only when necessary, e.g. for episodic conditions like epilepsy). Both will make DBS therapy more tailor-made and will reduce the side-effects.

Non-medical applications of the neurodevices

All three neuromodulation devices have been associated with non-medical use. Enhancement is the most often mentioned non-medical purpose. Athletic performance (EEG neurofeedback), cognition (EEG neurofeedback, TMS) and mood (DBS) are amongst the capacities that could potentially be enhanced by the technologies. To our knowledge, only EEG neurofeedback is being offered for enhancement purposes (in private clinics such as NeuroCare clinic).[2] TMS for enhancement is currently being investigated (Goebel, 2011). DBS for enhancement is only a theoretical construct, based on accidental findings in (experimental) treatments (Denys, 2011).

EEG neurofeedback (and similar technology) is furthermore being explored by the gaming industry as an alternative (or additional) way of controlling games. Instead of gel-based electrodes used in research or medical practices, EEG neurofeedback electrodes for gaming are the more user friendly – yet poorer functioning – 'dry electrodes'. This means that the electrodes do not have to be 'glued' to the scalp using a paste; rather, most systems use a headset that can be worn directly.

Regulation of Neuromodulation Devices

The medical devices are all devices brought onto the European market with medical intended purposes, including: diagnoses; monitoring of diseases; dealing with injuries or handicaps; replacement of an anatomical feature; control of conception. In Europe, neurodevices are regulated by the Medical Devices Directive (MDD, 93/42/EEC) and the Active Implantable[3] Medical Devices Directive (AIMDD, 90/385/EEC). Both are concerned with protecting the safety of users (patients as well as physicians) on the one hand, and harmonizing the requirements for bringing medical devices onto the market, thereby promoting trade, on the other hand.

Medical devices regulated by the MDD are classified into four categories (I, IIa, IIb and III) based on how risky they potentially are (e.g. hip implants are considered to pose a greater risk than adhesive bandages and are thus given a higher classification). Before a medical (neuro-)device can be placed on the European Market, a medical Conformité Européenne (CE) mark must be affixed, by which the manufacturer declares to be in compliance with the requirements of the medical devices directives. These are specified in the respective Annexes 1 of both directives, Essential Requirements (detailing the General Requirements and the Requirements Regarding Design and Construction). Whether an assessment of a device by a Notified Body is necessary depends on its classification. Notified Bodies are independent organizations that assess novel or altered medical devices. To gain access to the European market, a device only needs to be checked by a Notified Body of the manufacturer's choice. It is not necessary to apply to Notified Bodies in all member states separately. When medical devices are demonstratively in compliance with European regulations and the CE mark is affixed, they can be sold in Europe. Post-market surveillance is governed by the individual member states. A manufacturer needs to establish a post-market surveillance system which includes a mandatory reporting of incidents and adverse events to Competent Authorities. Competent Authorities can – if necessary – take measures against a manufacturer of a faulty or disproportionately risky device.

The classification of the three devices for neuromodulation

EEG neurofeedback technology is a class IIa medical device regulated under the MDD if the intended purpose is a medical one. Not all manufacturers of EEG neurofeedback equipment, however, intend their devices to be used medically. Instead, some claim that their products are intended for relaxation or enhancement. In that case, devices are regulated under the less strict general devices regulations. Nonetheless, these devices can be – and are – used in medical settings for the treatment of diseases.

TMS devices are class IIa medical devices regulated under the MDD. All TMS machines are intended to be used for medical purposes. However, the specific purposes that manufacturers intend their machines for vary quite a lot – insofar as we could establish (there is no publicly accessible database detailing intended purposes, testing and evaluations of medical devices in the EU). Some TMS devices have a very broad range of intended purposes, e.g. MagStim Rapid (a MagStim TMS machine for rTMS): "stimulation of peripheral nerves and the human cortex for diagnostic and research purposes". It is up to clinicians to decide for which indications to use TMS treatment. A broad intended purpose therefore means that TMS treatment can be offered when there is little to no evidence of clinical efficacy or effectiveness diverting patients away from potentially more effective therapies for their conditions. (Also, more established therapies might be cheaper for patients as the non-proven TMS therapy is often not reimbursed.)

DBS is regulated under the AIMDD as well as the Radio and Telecommunications Terminal Equipment Directive (R&TTE, 1999/5/EC). This is because the DBS device is programmed using a physician controller and can be switched on or off with a remote given to the patient.

Regulatory and Governance Issues Regarding Neuromodulation Devices

As we saw above, the three technologies for neuromodulation are used in different practices, e.g. therapy or enhancement. Here we discuss the four socio-technical practices they are used in and then we tackle regulatory and governance challenges of the technologies related to the practices.

All three technologies for neuromodulation – EEG neurofeedback, transcranial magnetic stimulation (TMS) and deep brain stimulation (DBS) – are used in research settings. For example to explore for which conditions they provide effective treatment. TMS is also used to create temporary lesions in the brain in order to see how that effects test subjects' behaviour, cognition or ability to perform a cognitive task. Using EEG neurofeedback, TMS and DBS for research purposes is an established – although not necessarily old or common – practice. The regulation of this practice seems adequate.

Treatment using EEG neurofeedback, TMS or DBS is an established practice. However, it is also expanding. EEG neurofeedback has been said to move from clinics to research labs where studies are conducted concerning the efficacy of the treatment for various conditions. Private clinics offering EEG neurofeedback and TMS make the treatments available for (financially well-off) patient-consumers without any interference of traditional health-care systems and insurance companies. DBS as a treatment is gradually shifting towards earlier implantation (in an earlier stage of the disease).

Where therapies for proven effective therapies are concerned, the therapeutic socio-technical practice is adequately regulated. Regarding commercially-offered, unproven therapies or therapies using devices that have no medical CE mark (as they have no medical intended purpose), questions can be raised whether patients are adequately protected against possibly unsafe equipment and ineffective, costly treatments. Furthermore, reimbursement, training of operators of medical equipment and the development and use of treatment protocols are not regulated under the medical devices directives. There is, consequently, no harmonization of reimbursement of the three devices for neuromodulation between member states. Ultimately, this means that some treatments that are legally available on the European market for medical devices are not equally available for all European citizens in their own countries. Also, there are no European requirements on training or development and use of protocols for the use of the three devices. Training, certification and the development of treatment protocols for the three technologies for neuromodulation is up to the professional groups themselves. However, self-governance among professionals does not guarantees that everyone using the technology takes the training course or follows the protocols. Regarding the three technologies for neuromodulation, reimbursement, training and the use of protocols are governance vacuums.

The final socio-technical practices we will discuss are the gaming and enhancement practices. We discuss them together as they are both emerging practices (except EEG neurofeedback for enhancement purposes, which is older). They also raise similar regulatory and governance questions. In both cases, medical technology (or non-medically intended but functionally equivalent technology) is shifting from traditional practices focussing on the treatment of illnesses to novel practices. In these ‘lifestyle’ practices, the medical technology is used, experimented with or seen as a possible measure to improve performance (e.g. cognitive, artistic or athletic performance) or gaming experience. The medical devices directives are – by definition – focussed on the regulation of market entrance for technologies with medical intended purposes . Equivalent technologies with non-medical intended purposes are not regulated under the medical devices directive. This is worrisome as treatment for enhancement purposes with EEG neurofeedback or TMS generally involves the same safety risks as medical treatments. Yet the devices are not subjected to the same scrutiny before market entry, leading to potential safety hazards.

Conclusions: Policy Recommendations

The sociotechnical practices of the three devices for neuromodulation described above are regulated and governed relatively adequately. The most notable challenges to regulation surround the question of when a device should be seen as a medical device even though its manufacturer might prefer to view it as a non-medical device. Furthermore, additional regulation might be necessary to better regulate emerging gaming and enhancement practices using medical or functionally equivalent devices. This would protect the safety of users in these practices better. Reimbursement could be harmonized across the member states, resulting in a more equal access of patients to devices and a clearer assessment of the expected market for (potential) manufacturers. The final recommendation is that more transparency of medical devices for the general public might be appreciated by patients as well as the general public. Today, it is virtually impossible for patients to determine how a medical device has been tested and what the results of those tests were. There already is a database containing information about medical devices and their assessments, Eudamed, so this could perhaps be made (partially) publicly accessible.

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Health Technology Assessment in the Czech Republic

Czech HTA's Comparative Clinical Efficiency and Cost-Efficiency Research

Vladimír Rogalewicz, Kateřina Kotajná and Jana Jagerová

Abstract

Health Technology Assessment (HTA) comprises a number of methods for assessing effectiveness, appropriateness and cost of health technologies. Thanks to the development of modern science and engineering, the technological basis of healthcare has greatly increased while its (financial) resources have stayed the same. HTA can inform us what care is effective from the point of view of the society as a whole. While HTA is widely utilized in many countries worldwide, this is not the case in the Czech Republic. One of the exceptions are analyses done as student projects at the Czech Technical University where a course of HTA is included in the curriculum. Examples include projects investigating the cost-effectiveness of breast cancer prevention in case of proved BRCA1 or BRCA2 mutations, and clinical and cost effectiveness of two remote navigation systems of catheters as compared to manual manipulation.

Introduction

Medicine has seen revolutionary changes during the last 50 years. Thanks to the development of modern science and engineering, the technological basis of healthcare has improved dramatically both in knowledge and in investments in facilities, devices and drugs. We got used to the fact that clinicians manage to cure (almost) everything. However, no country in the world is rich enough to satisfy all demands its inhabitants have on the healthcare system. On the other hand, life expectancy is getting longer, and the society is ageing, new technologies are expensive, patients are well informed, our lifestyle brings civilization diseases while our demands on the quality of life are growing.

Health Technology Assessment (hereinafter "HTA") was suggested in the 1970s to cope with the problem of a conflict between sources and demands in healthcare. It comprises a number of methods for assessing efficiency, appropriateness and costs of healthcare technologies, i.e. drugs, biopharmaceuticals, devices, equipment and supplies, medical and surgical procedures, support systems and organizational and managerial systems. HTA can inform us what care is efficient from the point of view of the society as a whole. While the goals of technology assessment are to contribute to the formation of public and political opinion on societal aspects of science and technology (TAMI, 2004), the objectives of HTA are narrower and deeper. It aims to gather sufficient clinical and economic evidence to allow us to reach a decision whether technology is worth being utilized in clinics and/or paid from the public (healthcare system) budget.

In the 1970s, when HTA was suggested (following the pattern of Environmental Impact Analysis, EIA), medical technology was not as financially demanding and widely employed in hospitals as it is today. Hence, despite of EIA, HTA did not become a part of any legislation at that time. It was revived two decades later when new, expensive medical technology was widely implemented (MRIs, stents, DaVincis etc.). Specialized HTA agencies appeared at the beginning of the 1990s led by the Unites States and Great Britain. In 1993, the first international society in the field of HTA was established (INAHTA, 2013). Since then, HTA analyses have been required before any decision concerning new medical technologies in many countries.

While HTA is widely developed and institutionalized in many countries worldwide, there has not been much done in the Czech Republic. In this country, a HTA study is required by law in the process of a new drug approval; however, it is not required and usually not carried out in cases of clinical procedures, medical devices or preventive measures. The Ministry of Health initiated some methodology development in 2012, but the process practically stopped in 2013 due to political changes. The State Institute for Drug Control is trying to gain influence, but it does not have any legislative support (with the exception of pharmaceuticals). Thus, HTA is cultivated, for the most part, by small academic groups at the Czech Technical University in Kladno (CzechHTA) and the Masaryk University in Brno (Institute of Biostatistics and Analyses) and by the mostly commercially oriented iHETA (non-profit) and CEEOR (a limited liability company). The development of HTA has little if any support from the Czech authorities, and no progress is generally expected in the near future.

HTA tries to find answers to difficult questions that a lot of people consider ethically incorrect: “How to measure the clinical effect of a particular technology?”, “What is the willingness for paying for medical care among the country population?” or “Which technology is (or is not) behind the society’s material potentials?” Due to the communist education in the recent past, the majority of Czech people have problems with even raising such questions. They were taught that everybody is entitled to the best medical care free of charge. An excellent account of these questions is given in an American textbook with a comprehensive but provocative question in the title: “Who Shall Live?” (Fuchs, 1974). The book first appeared 40 years ago, which shows the delay the Czech society is experiencing in this field.

Is a Preventive Program Always Cost-Efficient?

Since CzechHTA is a research group at the Czech Technical University, many analyses are done in the form of a student project. The results of investigations by students and their professors bring the first deeper view on the effectiveness of Czech healthcare services. To illustrate a possible application of HTA, we will briefly present two such results. The underlying theory can be found, for example, in the books by Schöffski and von der Schulenburg (2012) or Goodman (2007). The first example concerns the cost-effectiveness study of breast-cancer prevention (Kotajná, 2012), which was carried out together with the Department of Oncology of the General University Hospital in Prague.

Almost a quarter of all tumours in women in the Czech Republic are diagnosed as breast cancer. Out of them, a very small part, 5 – 7 %, is caused by a genetic disorder (BRCA1 and BRCA2 mutations) (Balmaña 2011). Patients suspected of having this gene alteration undergo DNA testing, and the whole family joins the screening programme. These patients will eventually become ill with a high probability (approaching one with their increasing age), but the screening can detect cancer in earlier stages, and so the treatment is theoretically not that expensive and the probability of healing is fairly high. The screening programme has only been running for 10 years in the Czech Republic, and it has only included 105 patients. Out of them, 10 were diagnosed with breast cancer. Although the outcome in these women was better than in the general population, the cost per QALY (a parameter combining life expectancy and quality) appeared to be much higher for the patients included in the preventive programme. One of the reasons might have been the size of the sample. The disease did not manifest in the majority of the included women during the 10-year period, although the predicted risk of breast cancer in women with the BRCA1/ BRCA2 gene mutation is 78 % to 83 % by the age of 70.

Due to a lack of real clinical data, it was decided to repeat the calculations using a cohort of virtual patients simulated by the Monte Carlo method based on the probability distributions of the disease incidence and mortality. The underlying data were taken from medical centres and literature (Klijn, 2003; Dušek, 2010). As a result, we obtained a fictional cohort of 331 women (164 with BRCA1 mutation and 167 with BRCA2 mutation). This fictional cohort was used to estimate the average costs of the screening programme. Treatment costs were calculated for each disease stage by the micro-costing method from real patient data (micro-costing is based on collecting actual cost information about each item paid in connection with interventions concerning a particular patient). The outputs of the treatment conditioned by the stage of the disease were studied by Schleinitz at al. (2006).

At first sight, the results of the study are obvious. The cost/QALY ratio (i.e. the ratio of costs and “performance”) appeared to be CZK 523.065 (approx. USD 26.150) in the general population, while it was CZK 788.562 (approx. USD 39.430) in women from the preventive programme. This would speak against the preventive programme that shows lower cost effectiveness. At least it indicates that preventive programmes need not always be advantageous and cost saving from the societal perspective, and that they must be well-thought-out, planned and managed, so that they provide a real benefit.

Navigation Systems Used in Arrhythmology

HTA methods, especially costs analyses, were first used in the pharmacoeconomic research to evaluate the effectiveness of drugs. Today, they are utilized in assessing drugs and clinical interventions, while their implementation for medical devices is rather rare. As CzechHTA is a part of the Faculty of Biomedical Engineering where experts in medical technology are trained, many HTA studies are focussed on medical devices there. An example can be a study dealing with catheter navigation in cardiology. It evaluates both clinical efficiency and cost efficiency of remote navigation systems in performing radiofrequency ablation of atrial fibrillation, compared to manual catheter navigation (Jagerová, 2013). Comparisons were made between remote magnetic navigation, remote robotic navigation and manual catheter navigation. Clinical efficiency was determined by means of a systematic review of published studies. The cost analysis of each type of navigation was implemented in cooperation with the Hospital Na Homolce in Prague, which is a facility where all of the above-listed methods are used. In the cost-effectiveness assessment, the analyses of the costs of each method and the clinical outcome were utilized. The clinical outcomes were determined from the hospital's records (patient files) and published clinical data. The final evaluation was conducted using a multicriterial evaluation of variants. It is a method that allows to take into account several different effects of the navigation systems and combine them in a single number.

Both the cost-effectiveness ratio and the incremental cost-effectiveness ratio (ICER) were calculated for each year during the lifetime of the devices. Although the systems of remote catheter navigation in comparison to manual control are generally associated with higher costs, both of these systems are more cost effective if compared with manual catheter navigation. Among other things, these systems are clearly associated with a significant reduction of X-ray time. By utilizing a remote navigation system, it is possible to make manipulation with catheters easier and more precise. The next step could be a partial or full automation of the whole treatment process. However, the role of a clinician will remain unsubstitutable.

Conclusions

While HTA is well developed in many countries, the Czech Republic is not one of them. Nevertheless, it is obvious that an HTA agency should be established in the Czech Republic in the near future as the situation is ripe for it. The bodies involved in the HTA process need a generally accepted common methodology, so that their results are taken seriously. On the other hand, problems with limited resources and the rapidly growing costs of healthcare will lead to a regular prescribing, in one or another, of a routine utilization of HTA for all (healthcare) investments. The agency will eventually find its position in society. To be strong enough, its form must be made clear, it must find a source and a way of funding, and, last but not least, bring together a handful of experienced and dedicated professionals and give them some time to learn the situation in countries where HTA already has its tradition. The involvement of students (master, doctoral) in such analyses is a good idea as they can form the initial HTA teams after their graduation.

The main thing is to convince medical professionals that HTA would bring more positive than negative effects. Analyses like the two presented above can advance the way HTA reports are accepted. They bring unique results that would not be possible without HTA. The first example shows that it is not true that a preventive programme is always money-saving. The second example introduces a method allowing non-trivial multi-criteria decision-making in the case of new technology procurement. Unified all-European processes would help enormously. A big step towards collaboration across the EU was done recently. The EC Directive 2011/24/EU on the application of patients' rights in cross-border healthcare urges member states to cooperate in HTA data exchange. The governments seem to take it seriously and have started to establish a network of cooperating bodies. This may create the necessary stimulus on the Czech national level.

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Equity in Access to MRI Equipment

A TA Approach Based on the Portuguese Case

Maria João Maia and António Brandão Moniz

Abstract

Making decisions on resource allocation in health care can be a very complex and contested matter. Magnetic Resonance Imaging (MRI), as a health-care technology integrated device, should be seriously considered as an example of those tensions. Its impacts can be accessed through the use of evidence-based decision-making methods, such as Technology Assessment (TA).

There are gaps in providing health care due to geographical imbalances, with some areas unable to provide certain specialized health-care services. This reality can be considered a limitation in the access of the general population to this kind of a clinical examination. TA can play a useful and important role by helping decision-makers explore potential gains that might be achieved with the introduction of a more rational decision-making into health management, namely in MRI allocation.

Introduction

Due to continual constraints in health departments, all decision-making processes should be based on the best evidence research available. In health-care management, medical devices are one critical area, since they can be very expensive, and MRI is a clear example of that. Considering the importance of MRI in the diagnosis and evaluation of some diseases that highly affect the Portuguese population, this technique assumes a rather high importance on thenational level.

Making decisions about resource allocation in health care can be a very complex and contested matter. The allocation of medical technology should be seriously considered and its impacts assessed, based on evidence that can be provided by TA. TA is a form of policy research that examines short and long-term consequences (for example, societal, economic, ethical, legal) of the application of technology (Arnstein, 1977) and Coates (1971,1977) cited in Banta, (2009). TA is considered a scientific and communication process (Europäische Akademie, 2004; Bütschi et al., 2004). When applied to health care, TA[1] is defined as a systematic evaluation of properties, effects or other impacts of health-care interventions. The main purpose of Health Technology Assessment (HTA) is to provide information and help decision-makers with decisions made on the individual or patient level, health-care provider or institution or regional, national and international levels. It may address the direct and intended impacts or consequences of interventions, as well as their indirect and unintended ones. HTA is conducted by interdisciplinary groups using explicit analytical frameworks and drawing on a variety of methods (HTAi and INAHTA, n.d.; INAHTA, 2013).

Since the late 1990s, Portugal has experienced a rapid diffusion on MRI equipment. The access to appropriate medical devices is a fundamental factor in improving the health of populations. In order to accomplish it, all stakeholders should be aware of the importance of decisions related to the development, design, choice, safety, effectiveness and appropriate use, as well as allocation of medical devices, and act accordingly. It is intended that the allocation of health resources is made in such a fair way that every person can access them, equitably. For the purpose of this paper, access is considered on a territorial level, which means that the geographic distribution of health resources should be balanced.

There is a lack of evidences understanding on the application of HTA as a process (decision-making) and as an outcome (care supply, cost, equity ...). This paper aims to bridge the gap between scientific knowledge and policy-making using TA that can emerge as a tool for aiding decision-makers in the organization of health systems. The goal is to promote health policies targeting health gains and reduce health inequalities in the health sector or ensure that decisions and investments are planned and undertaken together, based on a TA basis since the critical element in improving the health-system performance with limited resources is the ability to make policy choices to allocate resources in areas where they can be most effective for improving health and equity, providing the most benefit to the entire Portuguese population.

The Portuguese National Health System

There are seven Regional Health Administration (RHA) units in the Portuguese National Health System (NHS): North, Center, Lisbon and Tejo Valley (LTV), Algarve and also Health Services of the Madeira and Azores Autonomous Regions.

The Portuguese constitution ensures health-care access for all citizens as it ensures a rational and efficient nationwide coverage in terms of human resources and health facilities (Diário da República, 2005). In Portugal, medical devices are regulated by law (Nº 145/2009) and the National Authority of Medicines and Health Products (INFARMED) is the entity responsible for the surveillance of all medical devices (Diário da Républica, 2009).

Since 1988, the Ministry of Health has authorized the procurement and installation of expensive medical technologies in the public and private sectors. In 1995, new legislation lifted the restrictions on MRI scanners. There are currently no effective methods for regulating the distribution of health equipment in the private sector, where most of expensive medical equipment is located (67 %) since it is more flexible and innovative and therefore outstrips the public sector in the acquisition of high-technology equipment. In 1998, Portugal established national and regional ratios for major medical technologies for diagnostic imaging (ACSS, 2011). Since then, new equipment has been introduced and diagnostic-imaging examinations have been increasing. The number of MRI units per million people in Portugal more than doubled between 2003 and 2008, from nearly 4 to almost 9. This was close to the average of the EU 15 countries. In 2010 (latest year available), Portugal had 9.2 MRI scanners per million people, less than the OECD average (12.5 per million inhabitants). However, there is no evidence of any health impact of these increases and therefore no TA study on this issue (OECD, 2012).

MRI exams represent 2.7 % of total exams performed by hospitals because there is no convention (contractual agreements) for this exam.[2] Public hospitals contract with private clinics and hospitals for the use of the equipment, providing a strong incentive for this provision pattern to continue (Barros, Machado, and Simões, 2011).

In Portugal, almost half of the population lives in urban areas. The population is ageing. Recent projections shows that the Portuguese population will most probably stabilize or even decrease between 2008 and 2060 due to the combination of an increase in the number of deaths and a decrease in the number of live births.

Contribution from Health Technology Assessment

HTA aims to provide robust and objective information for decision-making in health care on different levels (Siebert et al. 2002). It can play a valuable role in health care decision-making when it concerns the allocation of MRI equipment.

HTA will enhance potential decision-makers' ability to implement decisions and capture the benefits of an equitable distribution of MRI equipment throughout Portugal.

TA decisions should not neglect how a device improves the life of patients. Decisions that are based solely on costs will ultimately fail patients who depend on access to lifesaving and life-enhancing innovative technologies. For that reason, it should be clear that the purpose of HTA is not to create another technical barrier to trade or simply to delay the entry of new technologies into the market (Siebert et al., 2002).

A full societal perspective should be considered when undertaking HTA to ensure efficient resource allocation on all levels of society. The principal aim of HTA is to provide stakeholders with accessible, usable and evidence-based information to guide their decision-making about the use of technology and efficient allocation of resources. This is why TA has been called "the bridge between evidence and policy-making", and it provides information for health-care decision-makers on macro, meso- and micro-levels (Battista and Hodge 1999).

In a more recent report concerning Portugal's health system, it is stated that Portugal does not have a tradition of HTA, with the exception of pharmaceutical products (Barros, Machado, and Simões, 2011). There are some emerging needs to apply HTA to medical devices in Portugal. The justification for most medical practices, including medical devices allocation, rests on the experience and expertise of clinicians, rather than on objective evidence.

The objective of an institutionalized HTA in Portugal is to support cooperation between national authorities or bodies in order to avoid a duplication of resources and information. A national HTA institution would, among other things: help to reduce unnecessary duplication of HTA activities; develop and promote good practices in TA methods and processes; facilitate local adaptation of HTA information and act as a contact point to provide a gateway to the HTA community in Europe.

Methodology

Characterization of the Portuguese Population

In order to get the needed information to characterize the Portuguese population (as potential users of the MRI technology), a National Statistical Institute (INE) database was the source chosen to study some indicators. The last Census was done in 2011 (INE, 2012).

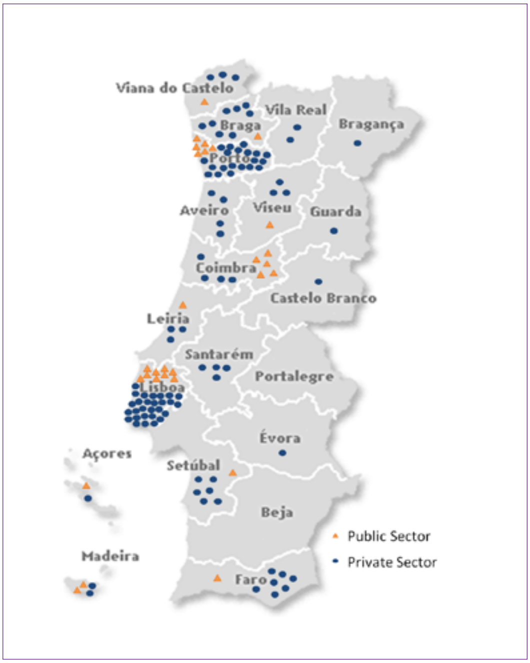

Figure 20: Distribution of MRI equipment in Portugal (by district)

MRI Installed Capacity

A survey on the number of MRIs in Portugal, both within the public and non-public sectors, was carried out (to manufactures, providers and INFARMED) in order to characterize the technology park (numbers and geographical locations). It was combined with a desk research (on Internet data from public and non-public radiology departments). Previously collected data (Maia, 2011; Maia, 2012) were also taken into account.

In the second phase, a two-level analysis will be made: capability analysis – ratio of the number of MRI per million inhabitants, by RHA and competition analysis (market concentration by MRIs and group of providers).

Identification of the Population

The population in this study consists of all radiology departments (public and non-public sectors) that posses at least one MRI scanner in their facility.

Results and Discussion

In 2060, all age groups below 59 years are expected to be smaller in number than they are today. The age group of 85 years or more will represent the major population age group (INE, 2009).

The ageing population is one of the most worrying demographic phenomena in modern societies. The population ageing is worsening and the phenomenon has been occurring widely throughout the country and no longer is just a localized phenomenon in the interior area of the country. The Autonomous Regions have the lowest rates of ageing ratio of the country at 73 in Azores and 91 in Madeira. The regions of Alentejo and Centre are, on the contrary, the most aged with ratios of 178 and 163.

Six firms were identified as competing in the MRI technology marketplace. Regardless of the equipment model, a total of 139 pieces of MRI equipment were identified in Portugal, located mainly on the cost (see Figure 20).

When the situation is analyzed, taking into consideration the average of MRI units per inhabitants (Table 12), Algarve is the leader, followed by LVT and Madeira.

Concerning the resident population, Alentejo appears in the 4th place and has only 1 MRI scanner installed. The North is the most populated and comes in the 5th place in terms of installed pieces of equipment.

HRA	Ratio MRI/Inhab.	Total %	Public %	Non-Public %
Algarve	56376	6.3	3.5	7.1
LVT	65625	34.4	34.5	34.3
Madeira	66946	3.1	6.9	2.0
Total	82517	100	100	100
Centre	86213	21.1	24.14	20.2
North	87850	32.8	27.6	34.3
Azores	123386	1.6	3.5	1.0
Alentejo	757302	0.8	0	1.0

Table 12: MRI equipment distribution in Portugal (by ratio and sector)

In terms of investment, the non-public sector is leading the overall market with 77.3 % (99 MRI units) against 22.7 % (29 MRI units) from the public sector. Note that both sectors invest almost in the same geographical areas since the LVT, North and Centre regions are the ones with more MRI units and Alentejo and Azores with the fewest.

In terms of proportion, there is a more equitable distribution between MRI equipment installed in public vs. non-public facilities in Madeira and Azores since there are an equal number of MRI units installed. But for the rest of the regions, a great discrepancy is clearly evident. The LVT area has 44 units: 77.3 % (34 units) in the non-public sector and 22.7 % (10) in the public, and in the North, 81 % (34) units are in the non-public sector and only 19 % (8) are in the public sector. Alentejo is the only region that does not possess a single non-public unit and only one in the public sector.

Conclusions and Recommendations

Portugal is an ageing society. MRI can be especially useful and needed in health-care services. Portuguese national data concerning MRI equipment are scarce. Official data are limited and out of date. Until now, no research has been done that would focus on this issue.

The MRI equipment park was surveyed on the national level, and 139 units were identified. Geographically, along the coast line, it is possible to identify niches of MRI equipment, with higher concentrations in the Lisbon and Porto districts. In the lower country, they tend to be scarce and in some regions, non-existent.

It is also evident that the core of MRI equipment is well established in the non-public sector (less than a quarter is in the public sector).To put these results into perspective, some questions must inevitable be asked, such as: why are the regions with the largest average shares of MRI units per inhabitant in the 5th (Algarve), 2nd (LVT) and 6th (Madeira) places population-wise? Are the answers related to the fact that all these three regions invest more in tourism? Indeed, these numbers should be taken into consideration when it comes to equality in access to MRI equipment by the Portuguese population.

When analyzing carefully the ratio of MRI equipment per million people, it can be concluded that this ratio can also be used as an indicator of geographic misdistribution from district to district. Since this ratio does not include the geographic dimension of access, it should not be used as an indicator of relative access.

There are gaps in providing health care due to geographical imbalances, with some areas unable to provide certain specialized health-care services., For example, the interior of the country does not provide all medical specialities. Portugal has a large independent private sector, which provides diagnostic and therapeutic services to NHS users on the basis of a contract (conventions). However, there is no convention from the NHS when concerning MRI exams. Therefore, this reality can be considered a limitation in the access of the general population to this kind of clinical exam.

The sustainability of NHS is coming under numerous strains, as the pressure of health-care budgets and the risk of diseases rise. This is the result of health inequalities and the ageing of the population.

Decision-makers should feel the pressure to balance the allocation of resources and to promote national use of the resources when holding discussions concerning this issue. They need to evaluate the effectiveness and efficiency of existing MRI equipment and take into account variable costs and limited resources available during the decision-making process for the acquisition and allocation of such technology.

HTA can play a useful and important role in helping the decision-makers to explore potential gains that might be achieved by introducing a more rational decision-making process into health-care management. HTA should emerge as a tool to aid decision-makers in the organization and financing of health systems, acting as a bridge between research and policy-making. Stakeholders should make evidence-based decisions, i.e., decisions that use the best current evidences from not only medical research but also scientific. A support network between different agencies to avoid duplications of resources and information should be created. HTA can also help in this matter.

The major questions are: How can (H)TA contribute as an input to decision-making (regarding equality in access to MRI equipment)? By creating a link or a bridge between a policy and a research domain? How? By taking a specific policy question as a starting point and transforming it into several HTA questions, which can be answered trough systematic reviews and analyses of research results. The institutionalization of HTA will allow for a national policy with broad guidelines oriented at the implementation, evaluation, incorporation and management of technologies in the health system in a balanced way.

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EMERGING TECHNOLOGIES AND ETHICS

Science, Technology and the State: Implications for Governance of Synthetic Biology and Emerging Technologies

Harald König, Daniel Frank and Reinhard Heil

Abstract

New biological systems and organisms designed to satisfy human needs are the main goals of the emerging field of synthetic biology. While the technology could solve pressing environmental and health issues, concerns about ecological, security or socio-economic risks were raised. Here, we point to interrelations of science, technology development and the state. These may undermine the emergence of innovation and safety cultures required to foster new opportunities and to responsibly govern potential transformations linked to synthetic biology and other emerging technologies.

Programmatic concepts for constructing technologies appear to be the results of these interrelations rather than solutions to the challenges they cause. We propose the need for cultures that can stimulate experimentation and evolution of these technologies in ways beneficial to society, guided by overriding ethical values. This concept also includes an explorative political culture.

Introduction

Synthetic biology does not constitute a strictly defined field but may be best described as an engineering approach aimed at redesigning or newly constructing biology-derived ‘parts’, systems and entire organisms. It integrates different disciplines and knowledge derived from molecular biology, chemistry, mathematical modelling and computer-aided design, as well as the concept of generating and using interchangeable ‘biological parts’, which is often seen as the hallmark of synthetic biology (NBT 2009). Hopes regarding societal benefits linked to synthetic biology include chemicals and new generations of biofuels from renewable sources with lower greenhouse-gas emissions (McEwen/Atsumi 2012; Robertson et al. 2011), new therapies for diseases (Weber/Fussenegger 2012) and novel and rapidly deployable vaccines (Kindsmuller/Wagner 2011) – all of which could contribute to a potential bioeconomical revolution (OECD 2009). On the other hand, potential risks for human health or the environment (biosafety), dual-use issues (biosecurity) and socio-economic risks (e.g. food and water security, land ‘grab‘) were pointed out (Buyx/Tait 2011; Dana et al. 2012; ETCgroup 2007; UNICRI 2012). Furthermore, ethical and other philosophical concerns about the effects of synthetic biology on the notions of life have been discussed (Boldt/Muller 2008). Against this backdrop, we have sought to identify conditions and potential schemes for governance in synthetic biology that may contribute to knowledge-based policy-making. We started to map potential societal benefits and risks of synthetic biology and to delineate dimensions of these benefits and risks (König et al. 2013). Given the various layers of issues identified as well as the uncertainty and unpredictability regarding the exact nature of innovations and economic developments arising from an emerging field, we have argued that policies need to be informed by the most pluralistic expertise and perspectives available (König et al. 2013).

We propose here that even if conditions could be created under which it would be possible to obtain appropriate pluralistic input of this type, mere policy-informing schemes would not suffice. For there may be fundamental challenges underlying relations between science, technology development and the state that have the potential to undermine efficient knowledge-based policy output. These challenges, and the uncertainties associated with nascent technologies, lead us to postulate the need for exploration-based governance cultures. These should drive evolutionary change in a manner beneficial to society by a framework of overriding societal aims and ethical values.

Dimensions of Benefits and Risks

We previously mapped evidence and arguments to synthetic biology approaches, to biotechnological and biomedical applications as well as to their possible benefits and risks.[1] The work suggests a broad spectrum of approaches connected with synthetic biology concepts. These range from simple genetic circuitries to the assembly of novel metabolic pathways or synthesized viral genomes. Furthermore, they can be a part of different application schemes, including the production of chemicals in closed systems by genetically engineered microorganisms (GEMs); approaches involving the release of GEMs; or the use of genome synthesis to generate viral vaccines (Khalil/Collins 2010; König et al. 2013).

In keeping with these diversities, the actual benefits and risks appear to depend on issues linked to different layers (König et al. 2013). Thus, general aspects of application schemes can matter rather than issues directly related to synthetic biology. These include possible negative impacts on biodiversity or water and food security caused by the planting of energy crops as feedstock for the conversion to biofuels or chemicals by GEMs. Though these aspects are not qualitatively new, a more lucrative conversion to biofuels by “synthetic” organisms may greatly increase the scale of the planting of energy crops and aggravate these problems. Likewise, broad patents and patent thickets, which may increase in number due to synthetic biology (Rutz 2009), are not a completely new phenomenon – they are already known from the biopharmaceutical industry (van Zimmeren et al. 2011). In addition to these rather 'general' issues, there are issues more specifically associated with synthetic biology because of its potential to increase the degree to which biological systems could be modified – culminating in "completely synthetic" organisms in the future. This may result in new challenges in the assessment of such organisms with regard to biosafety, since similarities with donor and recipient organisms will become smaller. Furthermore, advances in generating synthetic genes and genomes or in constructing new metabolic pathways might facilitate the generation and the malicious use of (new) pathogens (UNICRI 2012). These developments as well as the possibility that synthesized 'bioparts' – and their envisioned straightforward combination into new biological functions via computational design – may make synthetic biology accessible to a broader spectrum of actors (i.e. beyond nation-states), are at the heart of biosecurity concerns linked to synthetic biology (UNICRI 2012).

In addition to these two main dimensions of potential benefits and risks, another aspect that has to be addressed by any governance is synthetic biology's potential global impact. This may be driven by requirements for large-scale biomass production – a prerequisite for a new transforming bioeconomy – that would have to largely come from the global South, at least if dependent on plant feedstocks (Berndes et al. 2003). Moreover, knowledge, expertise and equipment in biosciences and biotechnology appear to proliferate rapidly (Tucker 2011; UNICRI 2012).

Finally, any assumption about future benefits and risks needs to been seen in the light of high uncertainty, given the unpredictability of the exact nature of future innovations and applications from emerging fields like synthetic biology.

Getting the Input Right – and Why This May Not Suffice

Given these uncertainties and the various layers of issues underlying the potential benefits and risks, the development of effective governance should benefit from being informed by the most pluralistic expertise and perspectives available. In addition to knowledge from experts on different scientific disciplines, knowledge and perspectives based on dialogue with and participation of all potentially affected actors (including all stakeholders and the public) should be a valuable part of such pluralistic information. Reflecting on and subsequently creating conditions and (infra)structures that can encourage and empower these various actors to participate in such a mutual learning and information-generating process would therefore be vital to this approach.

However, even if the right conditions could be created to obtain appropriate pluralistic input of this type, we propose that this would not be enough to generate the desired efficient policy output. Policies are ultimately determined by a state's (or a union of states') political system, including governments, parliaments and regulatory agencies. Shortcomings or failures in political systems can thus be at the heart of inefficient policy output. For instance, these may be linked with insufficient independence of regulatory agencies due to phenomena such as regulatory capture, a process through which agencies are manipulated by special interests they are supposed to control (Bó 2006; Shapiro 2012). Most dramatically, possible consequences for public good have recently been revealed by the official investigation into the disaster of the Fukushima Daiichi power plant (Diet 2012). Regarding synthetic biology development in Europe, it may be worth noting that poor conflict-of-interest management at the European Food Safety Authority (EFSA), including 'revolving doors' situations (i.e. that regulators come from industry sectors they are supposed to regulate, or end up there), has recently been criticized by civil-society organizations (CEO 2012), the European Court of Auditors and the European Parliament (ECA 2012; EP 2012). The EFSA is a centrepiece of the European Union's environmental-risk assessments related to feed and food, including genetically modified organisms. Further factors for an inefficient policy output may be economic and financial interests of states and governments. These may be linked to 'national innovation systems' and state-supported technology development, including investments in demonstrator plants (OECD 2011) or stakes in companies through government-supported venture capital (Da Rin et al. 2011; Economist 2012). Similarly, state-owned industries can give rise to state actors regulating their 'own' ventures (Pargendler 2012; Wooldridge 2012), e.g. in the energy sector, which is expected to harbour big economic potential for synthetic biology (OECD 2009; OECD 2011). Finally, it appears that national bioeconomical and military defence interests have been factors that prevented the adoption of compliance measures in the Biological Weapons Convention (BWC) (Tucker 2010). The BWC would also cover weapons and toxins based on synthetic biology.[2]

These challenges, possibly inherent to governmental schemes for science and technology development on the national (and supranational) level, are associated with pitfalls that may ultimately interfere with the development of societal benefits from emerging technologies. Such pitfalls include an early emergence of a dominant set of methodologies and technologies, e.g. due to top-down prioritization and support (such as subsidies) for specific approaches or technologies, such as nuclear energy (Morton 2012) or certain biofuels (or biofuel feedstocks) (OECD 2011). Likewise, strategic political interventions to foster specific technology sectors can be susceptible to lobbying and capture, including safety regulations (Diet 2012; Shapiro 2012; Sukhdev 2012a).

Thus, these issues that stem from relationships between state actors, vested interests and technology development could add to the challenges raised by the multiple dimensions of potential benefits and risks outlined above. They need to be taken into account in any knowledge-based governance strategy for synthetic biology and other emerging science and technologies.

Conclusions: Implications for Governance, Responsibility and Technology Assessment

We suggest that there are crucial challenges regarding policy output that are linked to impacts by vested interests from within and outside political systems. These may have the potential to undermine the emergence of innovation and safety cultures that could be most appropriate to solve grand societal challenge – and to responsibly govern potential transformations linked to synthetic biology and other emerging technologies. In view of these political issues and the low predictability of innovations and economic developments (Johnson 2010; Lane 2009; Makridakis et al. 2009), politics-driven and programmatic strategies to 'construct' specific research fields, technologies or innovation trajectories may not offer the most appropriate solution. Potentially capture-prone, such strategies might even reach back to reinforce these political issues.

Rather, it might be necessary to build cultures that facilitate and guide an evolution of emerging science and technologies in ways beneficial to society. Corresponding innovation and safety cultures should strive to limit top-down prioritizations of specific sectors, increase creativity and experimentation and allow for an evolution-like process to lead to the most appropriate solutions.[3] This process, involving competing pluralistic approaches and perspectives, should be guided by a framework of overriding societal aims and ethical values. The main dimension of responsibility should consist in caring for this framework's constituents, its responsiveness and its shaping power. It is this (value-based) "responsibility" that should guide experimentation and that would need contributions from various actors. Both empirical data and practitioners' experience suggest that increased creativity and diverse experimentation - related to both science/technology and services/ business models - can increase the probability of breakthrough discoveries and innovations, which could contribute to the solving of grand societal challenges (Azoulay et al. 2011; Fortin/Currie 2013; Isenberg 2013; Khosla 2011). Similarly, safety cultures would be based on broad explorations in risk assessment and management, involving pluralistic approaches, knowledge and perspectives. Prospects to recognize risks and to find possibilities to deal with these in ways acceptable for different societal actors may thus increase [(Stirling 2012) and references therein].

Much of the prerequisites for mobilizing and effectively utilizing the pluralism in approaches, perspectives and knowledge that underlies such cultures will depend on political systems, though. Hence, reflection on and exploration of political deliberation and decision-making processes – and thus political culture – will be an important part of what we would like to call cultures of responsible experimentation (CORE). A critical area for experimentation in politics could be the search for complementary pathways to mitigate shortcomings, linked to political and corporate systems as well as their interrelations that can negatively affect policy output. Such pathways may encompass mechanisms to curb regulatory capture, e.g. by more pluralistic control in selecting members of agencies (including approval of appointments by the legislature) (Bó 2006) or by increasing agencies' transparency (ECA 2012; Shapiro 2012). Other mechanisms could rely on proposed measures (including the disclosure of corporate externalities) to allow corporations to compete on the basis of innovations that advance resource conservation and respect social standards. Such measures may also further empower consumers to make responsible and directive choices (Sukhdev 2012a; Sukhdev 2012b). Finally, experimental approaches for a closer coupling of public participation and decision-making processes could be a part of such complementing pathways. An explorative political culture and the implementation of such pathways will likely need various societal actors. Bold and visionary political and business leaders that can inspire peers could play an important role. Ideally, however, such experimental pathways would also produce economic and social benefits for a broad range of individuals in societies; providing stimuli from civil society on governments and other policy-making bodies to implement them.

If vested interests in emerging science and (potential key) technologies and shortcomings of political systems were factors that could significantly affect technology development and its societal impacts, this would also pose a significant challenge for technology assessment (TA). Especially for TA institutions that are a part of governmental science organizations or heavily depend on funding from state actors: TA would have to assess the hands that feed it. Potential dependencies and the danger of an "assessive capture" – under which TA could be potentially affected by the players it is supposed to assess – could undermine the value of TA for public good as well as public trust in TA. Simply excluding these political issues from TA might not be an option though; since it may entail the same consequences. In order to cope with this dilemma, TA and its institutionalization may need more experimentation.

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Precautionary Design of Nanomaterials and Nanoproducts

A Design-Oriented Approach in the Frame of TA

Michael Steinfeldt

Abstract

Steering technological development by means of political intervention is either impossible or possible only to a very limited extent in complex modern societies. In spite of this, the course of such development is anything but chaotic. It is rather the interaction of various players, which usually leads to a development path of new technologies, such as nanotechnologies. The early phase of nanotechnology development offers, in theory, a great deal of potential for steering development in the direction of sustainability and for realizing environmental relief potentials. These expectations are based on nuclear efficiency and on the use of self-organization principles of the nanoscaled materials. This path dependence can and must be accompanied in a formative way by appropriate methods and approaches (e.g. by means of CTA or real-time TA).

There is a need for specific preliminary assessment tools and for a rational implementation of the 'precautionary principle' based on sound scientific data and knowledge indicating justifiable concern. For the precautionary design of engineered nanomaterials and nanoproducts, a comprehensive approach is derived from existing approaches and includes precautionary risk aspects, resource aspects and environmental impact categories. This paper presents the first assessment results concerning different nanomaterials and associated products.

Introduction

The development of nanotechnology, especially of next generation nanotechnology, is still in an early phase. Here we have the Collingridge dilemma between design options and the availability of reliable impact knowledge (Collingridge 1980). On the one side, there is a great uncertainty and a lack of knowledge at an early stage in the product development cycle of nanomaterials, and impacts cannot be easily predicted. On the other side, control or change is difficult when the technology has become entrenched.

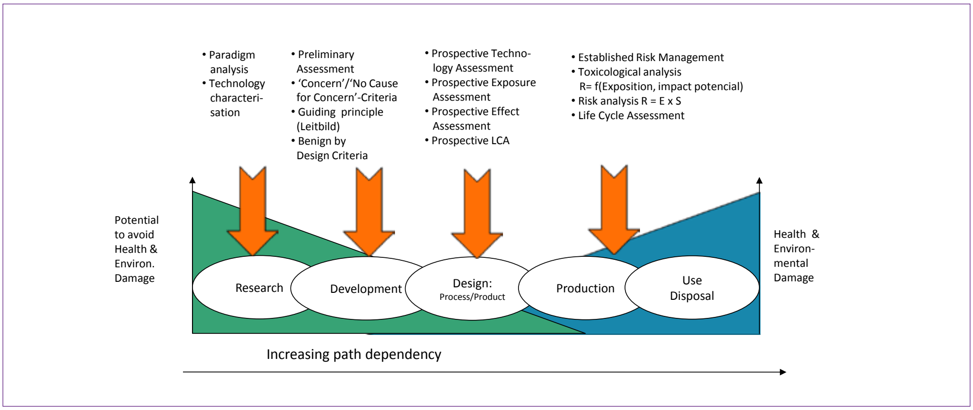

Figure 21: Approaches to technology assessment and engineering design according to the phases of innovation

The significance of independent paths of technological development over the course of time, and the opportunities that these offer for the early identification of adverse effects on the environment and our health, and in-turn, for the timely assertion of influence, are depicted in the illustration.

The illustration demonstrates that throughout the entire process – from basic and applied research through development, use and disposal phases – appropriate precautionary options can and must be developed for each phase. In each of the various phases, various players are (collectively) involved and responsible. The development of precautionary options and the integration of resource aspects can already begin in the basic research phase (research into the consequences of scientific development), the results of which can subsequently lead to research and development efforts in the area of applied research. The early stages offer the greatest opportunity, relatively speaking, to avoid potential environmental and health risks.

In view of the enormous prognosis problem of prospective technology assessments, the importance of the concurrent approaches to specific development of nanotechnology or products and processes based on it must be emphasized. Related approaches, such as constructive technology assessment and real-time technology assessment, are to be considered. In this context, an approach is presented below for the precautionary design of newly engineered nanomaterials and nanoproducts.

Approach for the Precautionary Design of Newly Engineered Nanomaterials and Nanoproducts

For the precautionary design of engineered nanomaterials and nanoproducts, a comprehensive approach is now derived from existing approaches and is supplemented with environmental impact categories of Life-Cycle Assessment. This concept includes precautionary risk aspects, resource aspects and specific environmental impact categories.

In recent years, approaches to precautionary design of various kinds have been developed and tested. The German Advisory Council on the Environment (SRU) has investigated the application of the precautionary principle to a new technology by the example of nanomaterials (SRU 2011). The 'German NanoKommission' has recently developed such an approach for a 'preliminary assessment' of engineered nanomaterials (NanoKommission 2009). The second dialogue phase of the German NanoKommission (NanoKommission 2010a) guidelines has been developed for collecting data and comparing benefit and risk aspects of nanoproducts. In the context of the Swiss Action Plan Synthetic Nanomaterials, a precautionary matrix for products and applications has been developed (BAG/BAFU 2011).

The aspects of the criticality of materials have been explored around the world in scientific studies (National Research Council 2008, European Commission 2010a and b, OECD 2010, Buchert et al 2009, Erdmann et al 2011). The broad concept of the raw material criticality includes both the supply risks on the one hand and the vulnerability of a system (e.g. companies, industry, economy, global) to a potential supply disruption on the other.

The methodology of Life Cycle Assessment (LCA) is the most extensively developed and standardized methodology for assessing the environmental aspects and potential impacts throughout a product's life from raw material acquisition through production ('gradle to gate'), and/or use and recycling, and/or disposal (i.e., cradle-to-grave) (DIN EN ISO 14040 2006).

Categories and aspects	Data quality	Source
Precautionary risk aspects		
Precautionary need (risk potential) of humans	Semi-quantitative	Swiss precautionary matrix for synthetic nanomaterials (BAG/BAFU 2011)
Precautionary need (risk potential) of the environment	Semi-quantitative	Swiss precautionary matrix for synthetic nanomaterials (BAG/BAFU 2011)
Precautionary need (potential) of incident	Semi-quantitative	German Öl Sustainability check, orientation on Swiss precautionary matrix
Resource aspects		
Criticality	Semi-quantitative	EU concept of criticality (European Commission 2010a and b)
Abiotic resource requirement	Quantitative	LCA methodology (DIN EN ISO 14040 2006; CML 2001)
Energy requirement	Quantitative	LCA methodology (DIN EN ISO 14040 2006; CML 2001)
Other environmental impact categories		
Global warming potential	Quantitative	LCA methodology (DIN EN ISO 14040 2006; CML 2001)
Human toxicity potential, but not nanospecific	Quantitative	LCA methodology (DIN EN ISO 14040 2006; CML 2001)
Eco-toxicity potential, but not nanospecific	Quantitative	LCA methodology (DIN EN ISO 14040 2006; CML 2001)

Table 13: Approach to precautionary design and to improved recyclability of engineered nanomaterials

An important aim of this approach was to select criteria to be determined quantitatively and/ or semi-quatitatively if possible (Steinfeldt 2013b).

Description of the Indicators for the Selected Categories and Aspects

The indicator "Precautionary need (risk potential) of humans or the environment" analyses whether the use of the nanomaterials or nano-containing products under study can result in a risk to human health or the environment. When carrying out a preliminary assessment of the risks to human beings and the environmental sphere, a semi-quantitative determination in accordance with the precautionary matrix for synthetic nanomaterials of the Swiss Federal Office of Public Health (BAG/BAFU 2011b) should be done.

As a result of the assessment, the precautionary matrix for synthetic nanomaterials produces a total score that allows for a general classification of the nanospecific need for action:

Score	Classification	Importance
0 - 20	A	The nanospecific need for action can be rated as low even without further clarification.
> 20	B	Nanospecific action is needed. Existing measures should be reviewed, further clarification undertaken and, if necessary, measures to reduce the risk associated with manufacturing, use and disposal implemented in the interests of precaution.

Table 14: Classification of the precautionary need (BAG/BAFU, 2011b 30)

The indicator "Precautionary need (potential) of incident" analyses the potential for hazardous incidents during the manufacturing of nanoparticles and nanoproducts. When carrying out a preliminary assessment of the incident aspects, a semi-quantitative determination should be done in accordance with the 'Incident aspects' indicator of the Nano-Sustainability check of the German Öko-Institut (Möller et al 2012).

Pursuant to the Hazardous Incident Ordinance, a "hazardous incident" is considered to be an occurrence, such as a major emission, fire or explosion, resulting from a disturbance of the specified normal operation and leading to a serious danger within or outside the operational area or the plant. The approach of this indicator is oriented at the Swiss precautionary matrix.

The indicator "Criticality" is grounded in the EU-Criticality-Study of 41 minerals and metals based on a relative concept of criticality (European Commission 2010). Two types of risks are examined:

1. The "supply risk", taking into account the political-economic stability of the producing countries, the level of concentration of production, the potential for substitution and the recycling rate; and
2. The "environmental country risk", assessing the risks that measures might be taken by countries with weak environmental performance in order to protect the environment and, in doing so, endanger the supply of raw materials to the EU (European Commission 2010a 5)

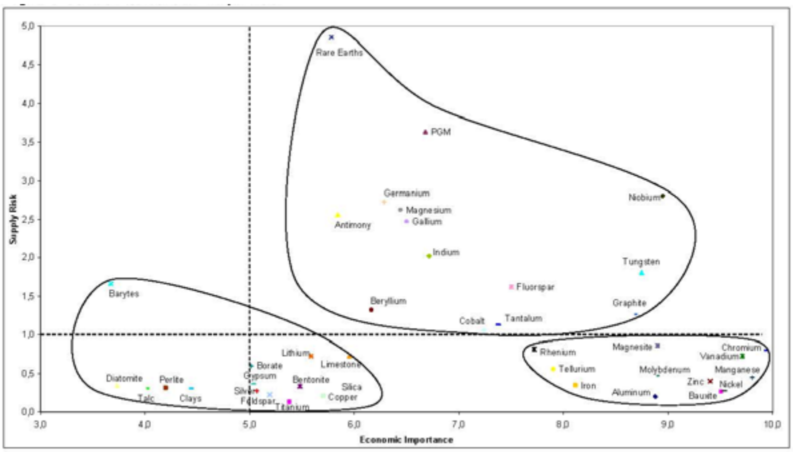

Figure 22: Economic importance and supply risk of 41 materials with sub-clusters (European Commission 2010a 34)

The Y-axis reflects the positioning of the materials in relation to the supply risks and the Y-axis in relation to the supply risks that have been identified. The results of this study of the criticality of materials are a good basis for the classification of criticality of materials in the following table.

Criticality	Position in the figure
0	Not reviewed
Low	Relatively lower economic importance (<6.0) and relatively lower supply risks (<1.0)
Medium	High degree of economic importance (>7.5) and relatively low(er) level of supply risk (<1.0)
High	Relatively high economic importance (>5) and high relative supply risk (>1.0)

Table 15: Classification of criticality of materials

Selected specific environmental impact categories (Guinee et al. 2001)

The “Abiotic resource requirement” indicator refers to the exhaustion of natural resources, such as iron or copper ore, which are regarded as non-living. The depletion of abiotic resources implies that the resources are consumed through physical disintegration or dissipation. The characterization factor is the potential of abiotic depletion of the extraction of those minerals and fossil fuels. The unit of the characterization factor is kg of antimony equivalents per kg of extracted mineral.

The “Energy requirement” indicator is a quantitative parameter expressing the cumulative energy input of the nanomaterial and relative to a defined usable unit (functional unit, e.g.

1 kg of nanomaterial). The cumulative energy demand (CED) represents the sum of all primary energy inputs [MJ primary energy] made in the course of the life cycle of the production of a nanomaterial.

The “Global warming potential” (GWP) indicator is the mass-based equivalent of the radiative forcing of greenhouse gases based on the specific forcing of CO_2. The unit of the characterization factor is kg of carbon dioxide (CO_2) equivalents per kg of emission.

The “Human toxicity potential“ indicator (not nanospecific) covers the impacts on human health of toxic substances present in the environment. The effect is induced by a dose of the pollutant received (inhaled or ingested) by an individual person and not by its concentration in the environment. Characterization factors are expressed as 1.4-dichlorobenzene equivalents per kg of emission. No generally accepted impact model currently exists for an integration of this indicator into the nano-specific emissions.

The “Eco-toxicity potential” indicator, which is specific to “Marine aquatic ecotoxicity”, refers to the impact on (marine) ecosystems as a result of emissions of toxic substances to air, water and soil. Characterization factors are expressed as 1.4-dichlorobenzene equivalents per kg of emission. No generally accepted impact model currently exists for an integration of this indicator into the nano-specific emissions.

Four nanomaterials (Multi-walled carbon nanotubes (MWCNT), nano Zinc oxide, Nanocellulose and nano Titanium dioxide) and associated products have been studied and the results are presented in the following example.

Prospective MWCNT case study in epoxy plates as rotor blades

Many scientists around the world conduct research on new CNT composite materials with better properties than conventional materials, such as epoxy materials. The possible benefit of the prospective MWCNT composite material is an increase of the production product reliability and lifetime, which translates into an increase of the production efficiency of renewable energy of the wind power plant. The highly compressed results of the evaluation of the categories for this case study are presented in the following table (Steinfeldt 2013a).

Categories and aspects	**Score**	**Classification**	**Comments**
Precautionary risk aspects	**Production and manufacturing process**		
Precautionary need (risk potential) of humans: Workers Workers (worst case) Consumers	 203 225 203	 B B B	The score is quite high. The potential effects of activity and stability of the MWCNT have the biggest impact on this score.
Precautionary need (risk potential) into the environment	225	B	
Precautionary need (potential) of incident: Workers Population	 205 10	 B A	The score is quite high. The potential effects of activity and stability of the MWCNT have the biggest impact on this score.

Precautionary risk aspects	MWCNT in the product		
Precautionary need (risk potential) of humans: Workers Workers (worst case) Consumers	 0 0 0	 A A A	
Precautionary need (risk potential) into the environment	225	B	The score is quite high. The potential effects of activity and stability of the MWCNT have the biggest impact on this score.
Precautionary need (potential) of incident: Workers Population	 102 6	 B A	The score is quite high. The potential effects of activity and stability of the MWCNT have the biggest impact on this score.
Resource aspects	**For the production of the nanoparticles**		
Criticality	0		No critical
Abiotic resource requirement	0.070	kg Antimon-Eq/kg	
Other environmental impact categories			
Energy requirement	164.7	MJ-Eq/kg	
Global warming potential	4.405	kg CO_2-Eq/kg	
Human toxicity potential, but not nanospecific	0.842	kg 1.4-DCB/kg	
Eco-toxicity potential, but not nanospecific	2.845	kg 1.4-DCB/kg	

Table 16: Evaluation of the indicators for the MWCNT case study in epoxy plates as rotor blades

The evaluation of the "Precautionary need (risk potential) of humans and the environment" and "Precautionary need (potential) of incident (for workers)" indicators shows very high scores for the assessment of the production and manufacturing process and the B classification It means that nanospecific risks cannot be ruled out. Further clarification regarding the risk potential and, if necessary, measures to reduce the risk associated with the development, manufacturing, use and disposal implemented in the interests of precaution should be undertaken. The reason for this very high score is, on the one side, the assumed potential effects (very high activity and stability of MWCNT (months)) and, on the other side, the realistic high production mass flow and its possible output into the environment (over 500 kg). However, for the use phase of MWCNT in the product, the "Precautionary need (risk potential) of humans" indicator is zero. The reason for this score is the assumption that MWCNT stable wrapped and not mobile in the product into the polymer matrix. This illustrates the wide range of possible scores.

Criticality of the raw material is not relevant; and the depletion of abiotic resources is also quite low. For the other environmental impact categories, it can be determined that they are medium when compared to other nanomaterials. Besides, the energy consumption is quite high.

The early phase of nanotechnology development offers, in theory, a great deal of potential for steering development in the direction of sustainability and realizingenvironmental relief potentials. These expectations are based on nuclear efficiency and on the use of self-organization principles. This path dependence can and must be accompanied in a formative way by appropriate methods and approaches (e.g. by means of CTA or real-time TA). In the context of prospective technology assessment, a comprehensive approach for the precautionary design of engineered nanomaterials and nanoproducts is derived from existing approaches and is supplemented with environmental impact categories of Life-Cycle Assessment. An important aim of this approach was to select the criteria to be determined quantitatively and/or semi-quantitatively if possible.

Based on the investigated case studies, it could be shown that the developed approach allows for a differentiated consideration of precautionary design aspects, resource aspects and environmental impact categories as the basis of sustainable nanoproducts.

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Assessing Ethics in an Emerging Bio-Technology Field

The Cases of Medical Stem-Cell Research and Genetic Screening in China

Ole Döring

Abstract

This paper offers a philosophical reflection of and ethical exploration into the cultural ramifications of stem-cell and genetic screening technologies as examples of emerging fields in a different cultural setting and with an empirical interest in China. This glimpse into a work in progress shows how questions of the governance of medical technology, in the context of bioethics, can inspire research in bio-technological ethics assessment and related comparative studies. The recommended cultural turn in the scientific assessment of bio-technology provides us with an innovative structure of the field. It can be used as an empirically robust and theoretically plastic procedural framework to pre-arrange and prepare the scientific inquiry and discourse on technology in society.

Approaching Intricacy

In the following text, I attempt a combined philosophical reflection of and ethical exploration into the cultural ramifications of stem-cell and genetic screening technologies as emerging fields in a different cultural setting, such as China. This discussion will offer observations from an ongoing research programme over two decades and methodological considerations about the assessment and comparative study of these questions.

Writing about an emerging technology field might sound like a straightforward task in principle. It seems as if the emerging entity or technology were a purpose-built product: designed, understood and controlled by the producers, according to well established protocols and raising no real issues, only, perhaps, some academic issues.[1] This notion holds even where the technology in question utilizes, copies or transforms biological entities or functions to create an arguably new category of man-made bio-technological facts, such as hybrid bio-facts.[2] Internal complexities of the technology pose technical questions.

But what about the meaning and value of technology? It is an even more complex undertaking to assess the related developments in ethics, inasmuch ethics depend on a consideration of contextual variables (such as culture, social-economic embeddedness, regulatory regime) and, at the same time, are less clearly standardized than technology.

The question of approach and methodology hinges upon the definition of the "field" within which this technology is actually emerging and on what counts as relevant features of emergence, which is needed to distinguish it from a random and insignificant appearance. Therefore, if the "field" is, for instance, a lab, the initial observation tentatively holds true; since this field can be described as an extension of the production process, it essentially means the genetic co-founders of the product in its hard scientific and technical sense. On the other hand, when the "field" extends to the context of an application in society, the eutrophic cascades of knowledge, utility and social impact increase the co-authors' collective of meaning and thus tend to eschew attempts at control, assessment and even the grasp of the demiurge.

This second notion of the "field" (which can be reconstructed in terms of culture) requires a specific framework that needs to be furnished to restructure and explain the developments as such, and to elucidate how the developments relate to experiences and scientific beliefs, e.g. in Europe. Obviously, such a framework has to work its way through the relevant "fields" and cannot rely on a mere external description, thus implying an objective point of view. Instead, a discoursive and recoursive methodology is called for that transforms dogmatic and statutory modes of assessment into procedural enquiry and circumspective consideration ("Abwägung").

In the context of globalization and the transformation of societies that is very much driven, but not necessarily legitimized or advanced, by economic and engineering interests, the meaning of technology is not clearly defined by science and technology developers, or, if it is, for certain usages, this definition requires translational efforts in order to make sense as it matters in contingent practice. In other words, by naming an entity, in defining its functionality or purpose, the intention of the designer or producer does not prescribe its full range of meaning and practicality. This caveat alludes to patterns of actual usage and infrastructural setting, as well as moral and ontological connotations of the embedding "field". Once the technology is out of the "box" of the lab or the producer's domain, it is difficult to exercise effective control over the consequences it might engender. This is how regulation becomes necessarily a share of work between those who have authored it and others who regulate the authorized range of practice, comprising technical standards, social norms of acceptability, public discourse, education and capability building, administrative handling, governance policy and ethical and legal prescription.

These limits and conversions of control and governability become even more severe where the emphasis lies on emerging technologies in the sense that these technologies have just entered their life-cycle as innovations while their embedding conditions, including R&D systems, education systems, schemes of application and marketization and others, are concurrently undergoing significant processes of transformation. Moreover, this shifting dynamic can typically coincide with the role of these technologies as drivers of social development, such as in the areas of health, science and economy.

In addition to the above-mentioned considered methodology, this train of thought suggests that transdisciplinary cooperation between empirical and conceptual, natural and social and normative and human sciences is a constitutional requirement for proper study design. This is just a hint of the ambitious claim in the venture to assess ethics and cultures with regard to technology. Thus, the globalization of technology challenges the ways in which we are used to organize and conceptualize our scientific work. Therefore, the objective of appraisal of ethics in an emerging field in China is firstly a matter of science culture and only secondarily a regional matter. Namely, and this is the dialectic point of the argument, a cultural turn in science is required if we want to advance the scientific quality of science.

Entering the Field

In assessing science and technology, we have "just started to realize that the 'international community' is not one monolithic authority but rather a round table of various members, China is still a novice struggling to grasp the grammar of global communication".[3] At the same time, it is obvious that China's role cannot be reduced to a patient observer of the rules of this grammar. Rather, China's scientists, regulators and other co-producers actively use and transform the grammar and semantics of ethics and science & technology in order to express their relational standpoints (e.g. as a "novice") and contribute as co-authors to the development of the emerging "round table" community.

Notably the real development can fail to live up to the value-adding potential of this cultural heritage as a tribute to the cost of "catch-up modernisation" or cultural transplantation. This can occur, for example, when the German holistic concept of "Wissenschaft" is translated into the English word "science", without re-adjustment, so that it changes the ways in which it makes sense, instead of carrying the conceptual wealth of the original, which can take place either in the form of a distortion or a shift of meaning.[4] For instance, since the end of Imperial China (around 1911),"science" has been translated as kexue[5] in Chinese: namely the "study of proper divisions", that is, a combination of analytic and normative aspects of cognitively arranging objects in patterns of proper relations,[6] or, even less holistic, practical down-to-earth orientation, or, plain "scientism".[7] On the other hand, there are the classical Confucian programmes of "ge wu zhi zhi" (to extend knowledge through the "investigation of things") or "zheng ming" (rectification of names) and even "xue" (the/to study). In their colloquial and their classical sense, they offer the conceptual depth, holistic vision, traditional foothold and humanitarian ambition capable of strengthening the non-instrumental, idealistic and humanistic motives that make science the genuine, sovereign and sincere venture for exploring knowledge. This Confucian framework bears closer affinity to "Wissenschaft" and can better support a science culture of reflected criticism, reason-guided enlightenment and cultivation than non-reflected "science".

However, since the adoption of the perceived "Western" and the abandonment of Confucian epistemology in post-Imperial Chinese society, owing to an epigonic inculturation of the related terminology, China has become conceptually vulnerable and exposed to the reductionist trends in globalized science and ethics, namely to compartmentalization, instrumentalization and alienation of the holistic, humanistic and critical science in favour of "high-level" pragmatism or simply powerful interests.[8] This trend is forming China, as it has much of the world. Obviously, these contingencies do not make it impossible to express what can be captured through the German "Wissenschaft" but make it easier, especially for lay people or those without profound education in humanities, to be misled into a reduced understanding or dim expectations of the standards of science. To my knowledge, there has yet to be a systematic study that would explore the history and cultural impact of these differences and develop strategies for making this disposition capable of understanding and of performing science beyond borders. Such an injection of constructive critique could stimulate a powerful cultural resource of epistemic and ethical humanism to benefit the advancement of technology assessment as an interface of humanities, social sciences and the "hard sciences".

Measuring the Field

In the light of this problematic lingual and conceptual constellation, the approach of a considered discoursive-recursive exploration is suggested that starts with an empirical and problem-oriented description of the field and is designed to reduce the load of theoretical pre-assumptions, such as about cultural import.[9] Clarification of the latter is an expected outcome, not the point of departure. Notably, as the recursive mode in the explanatory approach indicates, this outcome can then serve as a reference in ensuing steps in the study process.

Such a structural mapping exercise can be illustrated through examples of two emerging technologies, namely (a) stem-cell technology and (b) genetic screening technology. The case of China provides a welcome opportunity to reflect on the import of contextual factors as they are presenting themselves – not so because China was "a distinct cultural entity", but rather because China is an exemplary case of a highly complex and dynamically emerging "field" that combines emerging technologies and cultural contingency. The characteristics of the emergence of this "field within a field" offer rich opportunities for the study of the fabric and structural configurations of the pragmatics, valuation and the meaning of these technologies. This theoretical analysis is in line with the findings of pilot studies that have taken up this task in a manner of programmatic pragmatism.[10]

Initial guiding questions for both fields within the field are: what are the chief ethical concerns, how are they prioritized and managed and how are they cogitated? For example:

- How are concerns about the well-being of human research trial subjects, the interests of cell or tissue donors or patients in PND and counselling described and valued in comparison with other concerns, such as the moral status of an unborn human life or the expected added benefit for society and economy?

- Who are the proponents and drivers of the field and what are their interests?
- What is the influence of stakeholders or professional groups?
- What does the material tell us about the values, the anthropologies etc. of our systems?
- How are related fundamental or metaphysical matters addressed?

Such inquiries initiate re-iterative processes of investigation, discourse, interpretation, building of hypotheses and re-assessment. This paper cannot answer these questions but can clarify the related theoretical and methodological implications. Obviously, working in this field can provide us with the knowledge of what we are talking about in a manner that is instructive for policy-making, and hence is a foundational requirement if we want to enter into meaningful and sound comparative studies or ethical reflections without prejudice or blind speculation.[11]

(a) ***Stem-cell technology*** raises specific questions in relation to its context. What is the technology actually doing, what are the real hard and soft consequences and how is this perceived?

If we accept, hypothetically, that the specialty of stem-cell technology is an attempt at an effective and efficient manipulation on the fundamental functional level of biology and, with hereditary impact on the organism or lineage, beyond feasibility and procedural matters, we are ethically concerned with the production, management and interpretation of the resulting stock knowledge ("Verfügungswissen)" and the power of disposal ("Verfügungsmacht)." Moreover, the added research value of this technology lies in its implications for interpretive primacy ("Deutungshoheit") which is intrinsically problematic because it cannot be derived from the interpretation of the knowledge of the technology itself, but from what it affects.

What science can take from the assessment of this bio-technology in its cultural field justifies no license for general moral claims. Because there is no pre-defined co-author for the meaning of what stem-cell technology actually does to humanity, it must remain substantially undetermined in general terms and can only make moral sense for the subject, according to its cultural creativity (such as of moral sense or ontological meaning). Therefore, it requires both the identification and involvement of faculties that are capable of dealing with these contingent matters and the constructive engagement of both (idealized) parties in providing comprehensive meaning. As we have learned from the debates about human-embryo research and in-vitro fertilization, there is no possible objective and abstract truth regarding the moral status of certain entities, such as a human embryo. The moral matter can only be left for a pluralistic process to manage the related affairs sustainably, reasonably and peacefully, not to determine the matter as such. In such questions, ethics offers procedural ways of handling uncertainty, aiming not for moral consensus or generally binding truth but for robust conditions to lead good lives. Hence, at closer inspection, the object of the assessment, in the case of stem-cell technology, changes structurally from a matter to a quality affair.

(b) ***Genetic screening technology***, on the other hand, raises sufficiently distinct issues while being embedded within the same structures of the social and cultural sounding board. It makes us ask, what are we actually doing with this technology, what are we using it for? The emphasis here lies on social practice, reflecting on what kind of knowledge this technology could provide us with, and what are the real options for us for utilizing it. The challenge is how to organize the translational process properly, from the procurement of data, their presentation and interpretation in medical terms, towards an eutrophic cascade of complex or simple applications and assessments.

The data gained through screening will be employed for descriptive and diagnostic purposes primarily related to matters of health and well-being and secondarily to economic, social and political deliberations. With proper research on the epistemic, communicative, evaluative and other translational affairs in the process of "diagnosis", genetic screening technology has the potential to enhance our interpretive competence and power of disposal, but it leaves us with an uncertainty about the associated stock knowledge. It requires us to make sense of genetic information, especially, how far it is constituted by science or by other means, such as social interactions, aesthetics or morals.

From a cultural perspective, in the case of genetic screening, again, we can observe a structural change from a matter to a quality-affair. The commonality with stem-cell technology lies in the shared context of biology and humanity. The differences result from the involved levels of power: the first is concerned with the power to manipulate, the second with the power to interpret our lives in relation to our biotic substance. In both cases, related value judgements must be grounded in reasons beyond ontology, so as to avoid the natural fallacy.

Conclusions

This paper was written after the "author meets critics" session of the PACITA conference in Prague, 2013. I have chosen to change the strategy of the argument. Instead of using the book,[12] with which I am mostly happy as an excellent empirical study, to criticize what I regard as a misleading approach borrowed from Ulrich Beck, I found it more constructive to introduce a different methodology and theory to assess bio-technology in a cultural perspective that has evolved mostly in the context of bioethics and medical ethics. On the level of abstraction presented here, the discussion of specific Chinese themes has to be left aside. I am confident that the reader will find it easy to infer from this to such contextualizations.[13]

In the sketch above, I have described what we can gain from a cultural turn in the scientific assessment of bio-technology through this approach. Generally speaking, it provides us with an innovative structure of the field. It can be used as an empirically robust and theoretically plastic framework for pre-arranging and preparing scientific inquiries and discourses on technology in society. The result of these processes of enquiry, especially any determination of regulation or moral evaluation, is a social and political affair, not science. It is important, however, to understand that all the involved factors are relevant as scientific research objectives when assessing the ethics in an emerging bio-technology field. So, eventually, this approach is crucial for the translational work of making science sustainably practical.

It offers a procedural account of methods for capturing the meaning and value of technology, without resorting to either relativism or dogmatism. Such is a sound base for policy advice. In particular, it enhances the accuracy of our analytic tools and the precision of the observations about the characteristics of bio-technology in social and cultural bearings, with the ability to focus on both wider and narrow clusters of contingency. We highlight the importance of hermeneutic[14] studies for translational problems and make them theoretically and methodically accessible. This helps science and policy makers to identify the relevant questions, stakeholders, potential lines of conflict and strategies for consolation. It makes sense of the diversity of regulatory approaches in view of governance strategies. Last but not least, it inspires designs for inter- and trans-disciplinary cooperation towards technology assessment.

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Why Autonomous Unmanned Aerial Vehicles Will Lose the War

Marie-des-Neiges Ruffo

Abstract

This article seeks to answer the question of the impact of autonomous Unmanned Aerial Vehicles (UAVs), i.e. without human supervision or presence on the battlefield, in the overall success of war. UAVs have already proved critical for police surveillance or for the purpose of assisted rescue and unmanned search operations (such as those examined in the ICARUS project supported under the European Framework Programme for Research on security). If the long-term benefit of UAVs is demonstrated in a civilian framework, their role becomes questionable as soon as their "autonomy" is considered. To assess the risks arising from the growing autonomy of machines in the civilian world, it is worth looking into the experience the military gained from the battlefield. The war situation is so extreme that it can be a testbed for robust civilian use when the UAV technology is freed from human control and becomes autonomous. Translating results from the military to the civilian sector makes sense since the stakes of modern warfare involve safety and security as well as complex urban operations. Is it still relevant for humans to control the machine? Although it may appear as progress, the full autonomy of UAVs without any human supervision is generally not the best solution, as the military's experience illustrates.

Introduction

From the Palaeolithic spear-thrower, the crossbow and the canon until today's UAVs, people have endeavoured to increase the range of their weapons. The greater the firing range, the better the hope of escaping the enemy's riposte. Today's UAV Predators are piloted from Arkansas. They participate in contact actions in Afghanistan. By increasing the distance between the operators and the battlefield, one could hope to reduce the number of casualties in one's ranks, among other benefits. To reduce risks even more and improve efficiency, why should the UAVs not become autonomous? Would deploying autonomous UAVs make the western myth of zero casualties possible? Even if they can help win battles, can autonomous UAVs lose a war? Our argumentation raises doubts about the UAVs' ability to lead, on their own and with efficiency, a war to its reasonable term: peace.

Obedience, Uncertainty and Unpredictability

Are autonomous combat UAVs adapted to the context of asymmetric wars, to terrorist actions, to guerilla warfare? Would an element of surprise not be more important for a UAV, admittedly autonomous but obeying a determined computer programme, than for an officer able to improvise on the spot?

And what if the success of a mission required disobeying a part of the orders implemented in the UAV's software? Would it not be more beneficial if a human military officer were present to take this kind of decision? Blind obedience is not always a virtue, as Lord Fisher summarized when speaking about Admiral Jellicoe having missed the opportunity to destroy the German fleet at the battle of Jutland in 1916: "he has all Nelson's qualities but one: he doesn't know how to disobey" (C. de Gaulle, 1932, p 8).

Robots, however could disobey, but this is not necessarily better. Most of the time they obey blindly as the good robotic machines they are. However, this kind of obedience can raise doubts in the case of autonomous UAVs. The media reported in 2009 that a MQ-9 Reaper went out of control near the Afghanistan border and had to be shot down by a jet fighter. The safety process imposing the UAV to return to the military base in case of a loss of signal from the operator did not work.

Taking this case into account, it seems useful to keep some operational human beings as fast reaction forces to face technological vagaries. The aforementioned example was related to a tele-operated UAV, but how to determine in an autonomous robot what behaviour belongs to his legitimate liberty of action, which would be unpredictable, and what constitutes erroneous behaviour?

The unpredictability of complex systems, associated with their susceptibility to errors and the unpredictability of the environment, would mandate, for reasons of security and safety, that a human were constantly present in the loop or had the possibility to intervene in the loop. In absence of this, fratricidal firing or firing on innocent civilians by autonomous UAVs could occur. This would have public opinion consequences.

If a robot is supposed to blindly obey, it is assumed that the totality of its programming has been fixed upstream. The major drawback is thus the need to determine beforehand all the possible types of behaviours, admittedly more or less varying but always predetermined nonetheless. Programmers have to envisage all scenarios and all desirable answers of a programme. This is only possible in a limited framework with full knowledge and control of all variables as in the automated assembly line of a car plant.

But war is not a closed field: the unexpected is the rule. This truth is known since Euripides who wrote that "the expected will not be achieved and to the unexpected a God opens the path". Clausewitz developed a theory for the notion of "friction" in war (still popular today with our contemporaries: "shit happens"). Even after the fact it is often difficult to determine which decision would have been the best one on the battlefield. How then could we pretend to determine them before the battle?

The programmer faces a contradiction: they must programme a robot in a general way, and this robot will be operated in the most uncertain situations. A totally autonomous robot, i.e. one totally programmed upstream, is vulnerable to the unexpected and runs the risk of never "sticking" to reality, always diverging from abstract plans.

Solutions are technically possible but their complexity is not necessarily workable in practice. Experts, such as Ronald Arkin, propose to equip these systems with software based on a utilitarian concept of ethics. A calculation and a scale setting the number of civilians in the vicinity would determine if the robot shoots or not. One could wonder if a single civilian killed in the middle of armed rebels is not already too much. This approach is a reduction of reality. General Vincent Desportes, in his 2007 book Décider dans l'incertitude (Deciding in uncertainty), opposes this kind of thinking, "a military decision will never be the product of a mathematical calculation: the decision will always require intuition and the capability to grasp the essence of a situation at a glance synthesizing a lot of circumstances" (V. Deportes, 2007, p 78). This would mean that the essence of situations can only escape autonomous robots.

If one has to combat uncertainty, the art of war teaches to exploit it too. The secret of success sometimes lies in the proverb "fortune favours the brave", which is well understood by the Special Forces whose regiment has the "Who Dares Wins" motto. One should be able to seize the opportunity. But can we possibly programme a robot to be daring? How can we make it recognize what a unique opportunity it is? If one cannot predict its action, nor determine whether its behaviour is due to the proper functioning of its systems or to a system failure, to what extent can we have confidence in the machine?

A service person deserves the confidence of their superiors and subordinates because they participate in a common culture and are therefore predictable. Would it be possible to "programme" such a culture in a robot in order to guide its future decisions? The answer lies beyond the technology.

Strategic Interest and Side Effects

Can these technological marvels help to "win the battle of the hearts and the minds of the people" as General McChrystal recommended for Afghanistan? Would they be able to "feel" the local population's reactions or would they be socially inept? Would they not provoke more hostility than a soldier in uniform who still remains a fellow creature? Would we seriously consider winning a war or maintaining peace without putting (human) boots on the ground? Would we consider concluding a sustainable peace with enemies who struggled under machines and not against conventional opponents? Especially when we know that carpet bombings did not bring an end to the Vietnam War or WW2? What kind of respect would there be towards the nation and the culture of a hidden opponent?

The Pakistani reactions following American strikes using remotely-operated UAVs illustrate the magnitude of possible local reactions against future autonomous UAVs. David Rode, the American journalist kidnapped by the Talibans in 2008 and detained for more than 7 months in North and South Waziristan, gives this insight: « Our Afghan and Pakistani Taliban guards despised the drones and disparaged them as a cowardly way for America to wage war. The 2009 surge in drone attacks in Pakistan prompted our guards to hate Obama even more than they hated Bush" (D. Rhode, 2012). One would wonder if this type of technology, far from making war "more rational", does not provoke the adversary to be more aggressive. Rhode reported that following one of the UAV strikes, "one of our guards suggested I be taken to the site of the attack and ritually beheaded" (D. Rhode, 2012).

If the autonomous UAVs took part in an increase of power, would they make war shorter? Ardant du Picq in 1860 and Richard Holmes in 1985 demonstrated that men have a tendency to voluntarily miss a human target. Led by automated UAVs, war would probably be more efficient and bloody, and thus more violent. Peter W. Singer, the author of Wired for War, reports that a Navy sniper qualified the Forster-Miller SWORD model as "nasty" for its shooting precision. Facing such efficiency, an opponent might reasonably choose a "guerilla" response, to which our open democracies are particularly exposed. Considering that, would not this type of weapon risk to prolong war rather than shorten it?

The exclusive use of autonomous UAVs is not an absolute solution to conflicts. Their efficiency can have another paradoxical effect on their duration. Rhode reports that "Exaggerated Taliban claims of civilian deaths are widely believed by the Pakistanis, who see the strikes as a flagrant violation of the United States' purported support for human rights. Analysts believe that killing a senior militant in a drone strike is a tactical victory but a loss over the long term because it weakens public support for an American-backed crackdown on militancy in Pakistan, which many analysts think is essential" (D. Rhode, 2012).

It is a truth that the French General Benoît Royal underlines in his book L'éthique du soldat français (Ethics of the French soldier): "There is more to gain by being an example than by being violent". If one cannot set an exemple in the use of technology, one can dread that making UAVs autonomous would amount to being violent.

As the UAV's behaviour can exploit exhaustive information, one can expect that such a machine would make better decisions than an officer. A UAV is supposed to process more information in a shorter time than a human being, without tiredness, anger or fright. However, it is questionable whether the machine would be able to exhaustively collect all available data. In this sense, absolute exhaustiveness is impossible and a total loss of time. Clausewitz said that "waiting to be totally informed to take a decision is choosing the manoeuvre a posteriori, the one that leaves the enemy with the total freedom of action". And even if the robot could manage to compute the most complete information in real time, would this not imply that we are forgetting that rather basing conclusions on all available information, any decision-making process requires distinguishing the non-essential data from the essential data? This ability is fundamental in the carrying out of a command: how should this be taught to a robot? Similarly, how to teach a robot to identify a target without errors? (If human errors are accepted with difficulty, how acceptable would be those of a machine?). In matters of intelligence and consequent decision-making, “certainty is quite more a matter of comprehension than of data,” according to Desportes. Technology, even autonomous, has its limits.

The ill effects of the best technologies are numerous and generally unavoidable. Let’s mention, among others, the increase of speed and costs. The immediacy of response does not ensure its quality. It is increasingly justifiable to take the time to perform a deeper analysis of a situation. The drawback of working in real time is that it makes decisions more vulnerable to the unexpected. It would be a mistake to think that the daze of warfare disappears with speed. There is also the problem of economy: While western nations support important research and bear development costs, Iraqi computer hackers could make use of videos of the American UAVs using software that costs USD 26. Desportes stresses that far from being an absolute advantage, technology would, in reality, have an “equalizing” power. The opponent would be able to take advantage of the flaws and weaknesses of the technology while figuring out how to protect itself from its impact. Thus, if the use of machines brings us back in the enemy’s reach, only the human element remains to make a difference. In this perspective, suppressing the human element in favour of UAVs does not appear to be the right path.

The last adverse effect is perhaps still to be feared: Could this technology threaten our internal security? Even if until now it only seemed like fiction, let’s hope that reality never catches up. Daniel Suarez based his thriller Kill decision on the possibility of “anonymous” UAV strikes. It would be unfortunate if these technologies could deliver the means to make us vulnerable within our own borders. Fiction aside, the possibility to buy a Parrot UAV for a few hundred Euro or to easily develop one’s own weaponry is a likely scenario.

Conclusions

Thinking that we will remove uncertainty because we will control the behaviour of robots is an illusion. At war, one commands, but one cannot pretend to control. Napoleon, whose strategic mind is beyond question, organized his armies in minute detail. Before the battle, however, he would present his marshals with very simple objectives and give them a free hand to reach them. In summary, he gave his top officers space to analyse and act decisively. Interestingly, he would generally take over the lead only once uncertainty was reduced.

Be it the daze of war, the uncertainty, the “friction” due to time constraints or the population’s reaction, there are timeless principles that even our technological revolution cannot fully erase. The risk would be to forget their very existence, fascinated as we are by the novelty and the prospects of our technological prowess, thus disowning human experience. If robotics is a promising tool to improve our future, it should not be disconnected from the human element. The success of war, i.e. peace, or our own security in a broader TA approach, depends on this constant machine-human cooperation.

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Towards Machine Ethics

Oliver Bendel with contributions by Gwendolin Wilke

Abstract

In this paper, the field of machine ethics is explored. Firstly, the concept and the classification of machine ethics are clarified. Secondly, the main topics of machine ethics are described; a distinction is made between different kinds of systems and situations in which they act. Thirdly, three classical normative models are described and estimated relating to their suitability for machine processing. It was found that all of these models can be used in machine ethics and be combined with the case-based and observation-based approach.

Introduction

In this paper, the young field of machine ethics is explored. The main question is whether and how it is possible to implement morality into (partly) autonomous machines. The answer (or the attempt at an answer) is based on the review of existing literature, own classifications, considerations and derivatives. The paper is structured as follows: Firstly, both the concept and the classification of machine ethics are clarified. Secondly, the main topics of machine ethics are described, distinguishing between different kinds of systems and situations in which they act. Thirdly, the paper tries to answer the question of whether, and if so, then how, it is possible to implement the classical normative models of ethics to machine ethics, and which models are preferable. The paper concludes with a summary and an outlook in the context of ethics and technology assessment.

Concept and Systematization of Machine Ethics

For this paper, "Machine Ethics" by Michael and Susan Leigh Anderson as editors (2011) and "Robot Ethics: The Ethical and Social Implications of Robotics" by Patrick Lin, Keith Abney and George A. Bekey as editors (2012) were evaluated. In summation, it can be said that some authors refer critically to Isaac Asimov and his famous Three Laws of Robotics[1] and reflect upon the basic meanings and implications of machine ethics (cf. Clarke 2011). Some authors discuss deontological or teleological normative models with respect to the use for machine morality. James Gips focusses on virtue ethics (cf. Gips 2011). Bruce M. McLaren promotes a case-based reasoning (cf. McLaren 2011), and Marcello Guarini gives a neural network approach (cf. Gurarini 2011).

Machine ethics can be seen as a part of information ethics (which includes computer ethics, net ethics and new media ethics) and technology ethics (cf. Bendel 2012a). From this point of view, it is only another field of applied ethics. Because a machine is a subject of morality, machine ethics can also be understood as a counterpart to human ethics (cf. Bendel 2012b). From this perspective, machine ethics is a new form of ethics. This paper pleads for the second definition.

Normal ethics deals with the morality of human beings; therefore, we call it human ethics to be more precise. Machine ethics pays attention to the morality of machines. Not all technical systems can possess morality, and, of course, one can ask if technical systems can possess morality at all. Without any doubt, most (partly) autonomous machines are able to decide and act, and some decisions and actions have moral implications and can be qualified as right or wrong. So, a kind of morality may be granted.

Technology assessment (TA) is concerned with the consequences of technical developments. This is also the case with information ethics and with machine ethics. Some topics of TA have moral dimensions. It could be valuable for the discipline to keep an eye on machine ethics to take new considerations and developments into account.

Different Types, Tasks and Situations

In order to analyse the different normative ethical models with respect to their applicability to machine ethics, it is necessary to categorize the different types of machines, their main tasks and the situations they would typically encounter.

We can distinguish between different types of autonomous machines, such as agents, chat bots, algorithmic trading computers, robots of different types and unmanned ground or aerial vehicles (abbreviated as UGV and UAV or UCAV). Some are only partially autonomous (acting under human command) while others are completely autonomous within their area of action. These autonomous machines have quite different tasks and they act in quite different situations.

Further, we can distinguish between 1) systems that act and decide, 2) systems that show emotions and 3) systems that can communicate in a natural language. In the first case, the action of the machine is morally relevant. A UAV, to give an example, detects a terrorist who is surrounded by innocent civilians. Should the UAV kill the terrorist and risk killing some of the civilians? Or should it wait and risk later victims? In the second case, the behaviour of the machine is relevant. For example, imagine a very ugly man who meets a service robot. Should the robot be obviously disgusted by the man? Or should it be charming and give compliments, contrary to the truth? In the third case, the propositions of the machine are relevant. For example, a girl tells a chat bot that she wants to kill herself. Should the chat bot cheer her up, or should it give her an emergency call number?

Furthermore, it is useful to distinguish between various types of situations. We must identify their content, their coordinates and their cultural, economic, political and legal contexts. We have to draw a distinction between situations in which machines must act fast or not so fast and in which things, animals or people are affected. There is also a difference between closed situations (computer games) and open situations (real-world situations), between simple situations (an accident in the desert with two persons) and complex situations (an accident in a town with several people and machines involved), as well as between situations in the present (which can be easily analysed) and in the future (which cannot be easily analysed in all cases because there are uncertainties involved). Last but not least, the moral substance may be different depending on the actors: a decision in an accident does not need to necessarily be a moral question for a human being, e.g. in case he or she can only act or react instinctively or reflexively, but for a machine, it can be a moral question due to its ability to make rapid decisions after an evaluation of the alternatives.

Normative Models for Machine Ethics

There exist a number of normative models in ethics, each containing various tendencies. According to Pieper (cf. Pieper 2007, 270), seven fundamental models can be distinguished, the transcendental, the existential and the eudemonistic approach, the contracting theory and the traditional, the materialistic and the life-world model. Due to space restrictions, this paper focusses only on the most auspicious models, namely the deontological, teleological and the traditional approach. These are also favourites in current literature, as mentioned above. We will briefly discuss possible approaches to implementing the models. We also will sketch some of the major implications based on the categorization given in chapter 3.

1. In the deontological model, duties are the point of departure. Duties can be translated into rules. It is possible to distinguish between rules and meta rules. For example, a rule might have the form “Don’t lie!”, whereas a meta rule would have the form of Kant’s categorical imperative: “Act only according to that maxim whereby you can, at the same time, will that it should become a universal law.”

A machine can follow simple rules. Rule-based systems can be implemented as formal systems (also referred to as axiomatic systems) and, in the case of machine ethics, a set of rules is used to determine which actions are morally allowable and which are not. Since it is not possible to cover every situation by a rule, an inference engine is used to deduce new rules (or recommendations) from a small set of simple rules (called axioms) by combining them. The morality of a machine is comprised of the set of rules that are deducible from the axioms.

Formal systems have an advantage in that properties like decidability and consistency of a system can be examined. If a formal system is decidable, every rule is either morally allowable or not, and the unknown cannot happen. If the formal system is consistent, we can be sure that no two rules can be deduced that contradict each other. In other words, the machine never has “moral doubts” about an action and never encounters a deadlock.

The disadvantage of using classical formal systems is that many of them work only in closed worlds like computer games. What is not known is assumed to be false. This is contrary to real-world situations where rules can conflict, and it is impossible to know everything about the environment. In other words, consistent and decidable formal systems that rely on a closed-world assumption can be used to implement an ideal moral framework for a machine, yet they are not viable for real-world tasks.

In the real world, it is possible that machines can enter a deadlock when two contradicting rules apply to the same situation. Here, a prioritization of rules can be provided in order to restore consistency, as is the case in the Three Laws of Robotics, and meta rules can be useful for evaluating them. Another approach to avoiding a closed-world assumption is to utilize self-learning algorithms, such as case-based reasoning approaches: here, the machine uses “experience” in the form of similar cases that it has encountered in the past or which are collected in databases.

Another aspect to be discussed in the context of rule-based systems is the special role of machines with natural language ability. Assume it is raining heavily in Prague. If a chat bot was informed about this, it could still lie or make a joke, and tell a person, “Blue sky and sunshine in Prague today.” We could easily construct virtual fraud or genius malignus. Perhaps we are interested in attracting tourists by all available means; but normally, we would prefer that the machine does not lie and make jokes.

2. In the context of the teleological model, the consequences of an action are assessed. The machine must anticipate the consequences of an action and what these mean for humans, for animals, for things in the environment, and, finally, for the machine itself. It also must be able to assess whether the action’s consequences are good or bad, or if they are acceptable or not, and this assessment is not absolute: while a decision may be good for one person, it may be bad for another; while it may be good for a group of people or for all of humanity, it may be bad for a minority of people. An implementation approach that allows for the consideration of potentially contradictory subjective interests may be realized by decentralized reasoning approaches, such as agent-based systems. In contrast to this, centralized approaches may be used to assess overall consequences for all involved parties. Matthias Schnyder, a student tutored by the author, developed a formula specifically for the case of a car accident (Schnyder 2013). Here, possible negative consequences for humans, animals and things are distinguished and weighted differently, and the possible overall damage induced by an action is calculated as a weighted sum.

In the teleological model, it is essential that a machine is able to address not only present facts but also possible future states of the world in order to allow for the assessment of an action’s consequences. Therefore, an implementation of morality must provide prospective abilities. When we refer to something in the future, it may be uncertain or vague (cf. Papaioannou 2013). When implementing a moral framework for machines, the inherently imperfect knowledge about the future can be dealt with by calculi of imperfections, such as fuzzy logic, possibility theory or probability theory.

Again, machines that have the ability of natural language are a special case. Lenhard Egger, another student tutored by the author, examined several chat bots and found that most of them react by being uninterested or negative to sentences like “Should I kill myself?” and

“I want to kill people!” (Egger 2013). Only one chat bot gave a helpful answer in combination with a telephone number to the fictional suicidal person. It seems to be very important that machines are able to communicate in an adequate way and to say the right things at the right time. The developers need to know that propositions of people of this type may result in destructive acts and implement strategies for avoiding them.

3. In the context of machine ethics, the traditional model may mean that a machine needs to acquire virtues such as wisdom, justice, courage and temperance and develops a character that includes a set of them. The “morally right” action implicitly follows from this character, i.e. from the interaction of virtues. Similarly to the rule-based approach, its virtues may be prioritized or formed in a special way in order to adjust them to the intended character of the machine. Another more flexible approach is to use adaptive or self-learning systems, such as machines with genetic algorithms, agent-based systems or neural networks. Agents, robots or UAVs can learn while watching their environment and analyse human conversations with the help of peripheral devices. Learning capacities in any sense seem to be fundamental for the development of character, especially for one which should lead to “right” actions. However, a human character also includes assertiveness, empathy and intuition. It is a reasonable assumption that it is difficult to create something beyond a “virtue machine”.

It has become apparent that classical normative approaches can be used with certain restrictions in the context of machine ethics and combined with the case-based and observation-based approaches. (Bendel 2012a) mentions that human beings may act as reference persons, and social media may serve as moral input. Perhaps a combination of all these approaches will be successful.

Conclusions

The author is sceptical about the possibility of implementing a complex moral code in a machine in a satisfactory manner (whereas simple moral machines seem to be realistic). Moreover, the requirements of machine processing could be different from system to system (and even from situation to situation), and an approach that works well in one environment may fail in another. However, there will be a substantial interest from industry and the military, which would like to bring their solutions onto the market or to areas of conflict. Philosophical issues will also need to be considered. To say it from the philosophical point of view: machine ethics will be the touchstone of ethics in general.

Will it be also the touchstone of technology assessment? It would be an exaggeration to say that. What is certain is that technology assessment has to integrate new fields and ask fundamental questions now: In what form should technology exist in the future? Do we want to have autonomous systems at all? In all fields of application? Do we want to have machines that think and feel? That behave morally, as subjects of morality, and that are even objects of morality some day?

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PRIVACY ASPECTS

Locating, Tracking and Tracing

From Geographic Space to Cyberspace and Back

Lorenz M. Hilty, Britta Oertel, Michaela Evers-Wölk and Kurt Pärli

Abstract

Technologies for tracking and tracing objects and people are becoming ubiquitous. The possibility to determine the location of a person (either in real-time or ex-post) often emerges as a side-effect of other activities the person is performing, such as making a phone call, using the Internet or taking a picture. It is the combination of two factors which creates considerable societal risks in addition to the obvious advantages and opportunities afforded by the positioning technologies: a drop in the voluntary nature of our use of these technologies and the increasing amount of personal data in circulation. By using a qualitative risk-assessment approach developed in an earlier TA-SWISS study, the project team identified the need for political action in several areas (from surveillance and child protection to critical infrastructures) and formulated recommendations for legislative bodies and stakeholders for minimizing the societal risks of these technologies.

Introduction: Technologies for Tracking and Tracing

An increasing amount of technologies are being used that involve information about the location of objects or persons. In addition to the widely known geolocation by satellites via GPS, at least 12 other technologies are in use today that make it possible to determine the location of devices and indirectly that of their users, such as GSM/UMTS,/LTE, WLAN, RFID, optical and even acoustical technologies (for details, see Hilty et al. 2012). This may be happening in real time (tracking) or following a delay, depending on the technology (tracing); it may happen with a degree of precision ranging from a few kilometers to a few centimeters and either with or without the knowledge of the persons affected. The mix of technologies in use today bears much greater privacy risks than passive RFID technology used to tag objects with smart labels, which stirred a public debate almost a decade ago (Oertel et al. 2005).

Because tracking and tracing can be technically implemented with increasing convenience and decreasing cost, more and more location data are being generated and stored. When the results of many positioning processes are combined, movement profiles or even relationship profiles can be prepared for individual persons. In addition to navigation, there are numerous other application areas of localization technologies: location-based services, micromarketing, calculation of fees and insurance premiums, surveillance of individuals (for health reasons or in law enforcement), emergency missions, documentation and forensic evidence.

From the standpoint of the person being located, this happens often as a side-effect of another function the person wants to use:

- All mobile devices with integrated GPS receivers (such as smartphones) can determine their position with a high degree of precision; many apps build upon this; the user is not always aware whether their localization data are visible to third parties when they use an app or a service.
- Mobile phones that do not even feature GPS receivers can also be localized by mobile providers. Just knowing in which cell the device is operating provides for a rough localization. A more precise localization of mobile phones without GPS is also possible by triangulation.
- When a user is accessing information on the Internet, servers can roughly estimate the location of the user. Whenever Internet access is via a WiFi hotspot, an even more precise localization is possible.
- When buildings or fee-based zones are accessed using electronic identification or when electronic payments are made, data are also generated that document the location and movement of persons.
- Images showing persons or vehicles may document locations. More and more digital cameras are equipped with GPS receivers and mark digital image data with geotags that specify time and location; video surveillance cameras are becoming more powerful and less conspicuous. Parallel to this development, image processing algorithms are being improved so as to enable authorities to mine collections of images automatically for faces or license-plate numbers.

Identifying Potential Areas of Societal Conflict

Localization technologies are in the process of assuming a dominant position in our lives and just as well-accepted as the telephone or the Internet. These devices are becoming an “external location memory” that stores an ever-increasing amount of records about our acts and when and where we performed them.

In the future, it will become difficult to imagine everyday mobility – both individual and in public transport – without localization systems. Likewise, acting in social networks on Internet platforms will be increasingly associated with the physical location of the user. New location-based business models will result from that. Advertising focussed on location, time and the individual will become normal.

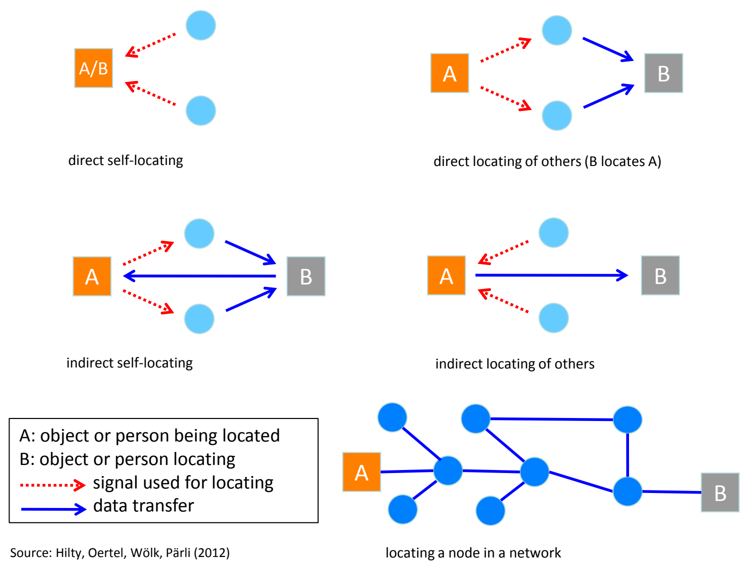

Figure 23: Basic types of determining the location of objects or people (Hilty et al. 2012)

Localization technologies offer many societal opportunities, e.g. for promoting public transportation (easier to find connections and to pay for them), for emergency and rescue operations, for personal security and orientation at unfamiliar locations, for meeting friends and perhaps even for making friends among strangers. They may even provide a technological basis for the vision of a sustainable information society that has been around for a decade (Dompke et al. 2004; Hilty et al. 2005; Som et al. 2009; Berleur et al. 2010; Hilty et al. 2013).

However, as localization technologies become more readily accepted, society will become more dependent on them. The technologies are becoming new critical infrastructures whose malfunction or collapse can have far-reaching consequences comparable to a breakdown of the telephone network. Manipulated localization information may have even more serious consequences than a lack of information because it can misguide vehicles, persons and freight.

It is mainly the combination of the following two factors, which creates considerable societal risks in addition to the obvious advantages and opportunities afforded by localization technologies. The factors are:

1. ***A drop in the voluntary nature of our use of localization technologies:*** If a person does not wish to be located even today, he or she has to do without a mobile phone and many Internet functions, in extreme cases, even without electronic access and payment systems – thus becoming excluded from many aspects of personal and professional life.
2. ***The increasing amount of personal data in circulation*** due to the increasing generation, transmission, storage and processing of localization data: the public or private-sector organizations that process such data can combine them into tracking and relationship profiles. Far-reaching profiles of persons and groups can be assembled by combining that with other data, in particular geographic data.

The combination of these two aspects – the drop in the voluntary nature and the increasing amount of data – holds a potential for societal conflict because the difficulties of the individual that exist today in getting his or her right to informational self-determination respected might later intensify to a critical mass. The lack of transparency in the processing steps used, which are frequently not associated with a person until after the fact, is increasing the risk of personal and data protection violations.

Conclusions: Need for Political Action in Switzerland

The TA-SWISS study "Localized and Identified – How Localization Technologies Are Changing Our Lives" (Hilty et al. 2012) examined the technologies, applications and Swiss legal-framework conditions of localization technologies, including the situation in the European Union whenever relevant. In keeping with the themes of Mobility and Social networks, the possible impacts (both the opportunities and the risks) are discussed and evaluated as regards their societal relevance. By using a qualitative risk-assessment approach developed in an earlier TA-SWISS study (Hilty et al. 2004, 2005; Som et al. 2004), the project team identified the need for political action in the following areas:

- For the technical surveillance of people in dependency relationships, especially employees, persons needing protection and children
- In Child Protection Measures pertaining to the participation of adolescents in social networks with localization functions
- In defending the informational self-determination of the individual vis-à-vis the state and private-sector enterprises; this is a matter of maintaining control over one's own data and avoiding the thoughtless surrendering of basic rights
- In limiting the retention of localization data, because in many cases it can be associated with persons after the fact, possibly jeopardizing their rights to privacy ("right to be forgotten")
- As regards the permissibility of the Terms of Service used by the providers of software packages and services with localization functions, some of which violate current law

- Taking seriously the model function of government offices in implementing data-protection principles, whenever they use localization technologies to perform their own duties more efficiently
- To recognize the security of localization systems as a new critical infrastructure and to protect the populace against those forms of cyber-criminality that are facilitated by localization technologies

From this list, a set of recommendations was derived. The general recommendations aim to further develop the legal framework:

- There is an urgent need for introducing more efficient ways to sanction violations in the data-protection rules intended to effectively prevent the misuse of personally identifiable data (the localization data of persons in particular).
- Measures are needed to improve the enforcement of data-protection principles in the international context.
- Because localization systems are developing into critical infrastructures for the Swiss population, they must be protected from malfunctions, breakdown or destruction.
- Many people have difficulty understanding the operation of software products and services processing localization data; this makes a certification necessary, so that software products become more reliable and transparent.
- The widely discussed “right to be forgotten” for personal data is of special importance in the case of localization data; therefore, a legal anchoring of this right should be investigated thoroughly.
- Empirical social-science research is needed, so that the real handling of localization technologies in everyday life and the social-development dynamics of sharing relations and dependencies can be better understood. Such an understanding is the basis for effective regulation.

In addition to the general recommendations that aim to establish legal guideposts for the on-going development and use of localization technologies in compliance with basic law, the study articulates special recommendations for specific areas:

- Improving the public’s understanding of the Terms of Service of social networks
- Directions and a clearer regulation of the permissibility of localization in the workplace
- Integration of the topic of localization in measures for the promotion of media literacy of adolescents
- Introduction of effective ways of establishing the legal age of users of Internet services with localization functions

- The accession of Switzerland to the Council of Europe Convention on the Protection of Children from Sexual Exploitation and Abuse
- Exercising the model function that governments have in the application of localization technologies
- Bringing the use of crowd sourcing (cooperation of many volunteers) in road traffic into a compliance with data protection principles
- A uniform regulation of video surveillance
- An extension of the principle of the so-called Robinson List ("don't send me any advertising") to digital media, especially location-based marketing

The recommendations of this TA study are not intended to hinder the use of localization technologies or to underplay their many advantages; instead, they are intended to help recognize and minimize the risks of these technologies at an early stage – only then will society succeed in in exploiting the opportunities of localization technologies and in deriving sustainable benefit from them.

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Privacy Aspects of Social Networks

An Overview

Stefan Strauß and Michael Nentwich

Abstract

The recent enormous and growing spread of social network sites puts privacy impacts of the widespread use of these novel online communication platforms centre stage. The various information flows are not under full control of the users and can be and are exploited for commercial and other purposes by the providers and some authorities. Therefore, the concept of informational self-determination is under strain and all privacy types, as conceptualized by Clarke (2006) and Finn et al. (2013), are affected. Current developments reinforce the trend towards more serious privacy threats, such as social plugins, the increasing role of biometrics and the significant growth in mobile computing.

Introduction

Despite their relative novelty, social network sites (SNS) have very quickly become a global phenomenon of contemporary society. Starting in the late 1990s as niche applications on the World Wide Web and following a boost in 2003 and the occurrence of Facebook in 2004, SNS have been gaining a rather high profile. Nowadays, SNS can be seen as a part of social mainstream shaping the Internet experience of many users worldwide; at present, major players like the ubiquitous Facebook or Google+, count several hundred million users. In addition to the major operators, a variety of specialized network sites exist with different usage contexts ranging from dating or friend-seeking (e.g. Friendster) to professional use, such as job seeking, education or business contacts (e.g. LinkedIn, Xing, ResearchGate, Yammer). SNS rapidly evolve with regard to their usage and the scope of integrated applications. Other services, such as micro-blogging (e.g. Twitter), video platforms (e.g. Youtube), social bookmarking services (e.g. Delicious) or news-aggregation tools (e.g. Reddit), can also be counted among SNS. A prominent definition supports such a wider view: Boyd and Ellison (2007) define SNS as "[…] web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system."

This paper is based on research carried out in the framework of a study for the STOA (Scientific and Technological Options Assessment) committee of the European Parliament.[1] Here we focus on one salient aspect that is increasingly discussed not only in specialist circles like privacy activists or data protection lawyers but also by many users worldwide: What implications for the notion of privacy may the widespread use of SNS have?[2]

SNS and Information Flows

Social network sites provide many different contexts of application with personal information flows. Starting with user profiles, all kinds of contacts, interactions, features used, links, context produced, linked, shared etc., represent a wide array of contextual layers. Potential conflicts can arise between the users' intentions to share personal information and how the information is processed further. Users have quite limited options of controlling how this is done. In many cases, there are no options at all, such as in the case of behavioural ads, web bugs, hidden trackers etc., and users do not know anything about the manner in which the information is used in the SNS and beyond (e.g. behavioural targeting and processing of user data for commercial interests). This low level of user control conflicts with the concept of informational self-determination (ISD), as defined by the German Federal Constitutional Court in 1983.[3] Full ISD could be enjoyed in a situation in which the individual is aware of what personal information is stored and capable of controlling how it is processed. The main aspects of ISD are context and control over that context of personal information flows. As SNS process a great deal of personal information with rich context information, this principle is under constant strain. Users have limited options for ISD. The problem becomes exacerbated with the growing amount of contextual layers carried by embedded applications, features and social plugins because a user's flow of personal information can also reach beyond the SNS environment without the user even knowing.

Not least due to the wide range of embedded applications in SNS, personal information and user content can hardly be distinguished in these new environments. In addition, the boundaries between personal and non-personal data have become permeable because the wide range of non-personal data created in SNS can be used to reveal an individual's identity, leading to the problem of the "identity shadow" (Strauß 2011): the amount of data traces that every step leaves in a digital (or semi-digital) environment is growing and a person's "identity shadow" thus provides further possibilities for identifying and/or de-anonymizing an individual on the basis of his or her data traces. In the process, one's ISD and control over personal information are increasingly undermined. User information, preferences, behaviour, activities, social relationships etc. are explicitly made visible in SNS. The capability of SNS to map social relations on a global level provides deep insights into the identity and behavioural patterns of individuals. A conflict arises between the users' intentions to share information and the way this information is used by the SNS (e.g. behavioural targeting and processing of user data for commercial interests). Privacy settings do not provide protection "since leaking graph information enables transitive loss: insecure friends' profiles can be correlated with a user with a private profile" (Bonneau et al. 2009). Therefore, these quickly evolving technologies increase, in combination with SNS, the possibility of identifying and tracking users in an unprecedented manner.

The data offer an enormous potential and effective observers of online activities in the public and private sectors benefit from further growth of the SNS data. The large amount of personal information available via SNS is valuable for business models based on behavioural advertising and for predicting new trends; security authorities reinforce their efforts to observe online activities and aim at real-time surveillance to identify suspicious behaviour and prevent crimes (such as the recent developments in Europe and the US regarding standardized backdoors in cloud services and virtual applications).

How Privacy Is Affected

Clarke (2006) and Finn et al. (2013) distinguish between different types of privacy in order to substantiate the extent to which privacy is effectively protected and can be affected: the privacy of a person; of behaviour and action; of communication; of data and image; of thoughts and feelings; of location and space; and of association (incl. group privacy). This distinction is important as different kinds of technology available today allow for several types of (potential and real) privacy infringements. The rapid development of technologies and applied techniques makes it even more complicated to identify which types and dimensions of privacy are intruded on by a particular technology. In addition, the boundaries between these different types are fading.

Contemporary SNS use involves several privacy types. Considering the fast evolution and continued diffusion of SNS, a reinforcement of existing privacy impacts as well as an extension to additional privacy types can be expected. We may distinguish how privacy is impacted by regular and emerging SNS use. While current and common SNS use mainly affects types of communication, such as data and image, and also associations and partly also behaviour, future and emerging SNS use is likely to impact on all privacy types mentioned. The following three major developments that are strongly related to SNS and foster the conflation between online and offline spaces in different ways have to be taken into account (taken from Strauß/Nentwich 2013):

1. ***Social plugins:*** With the increasing diffusion of social media, SNS have become attractive environments for the integration of other services and technologies. Social plugins are a major tool of this integration. They enable embedding SNS into other web sites and allow the SNS to absorb data from the space outside the SNS. Social plugins enable the absorption of data from the outside web into the SNS environment and vice versa. This creates additional information on usage patterns that goes beyond the original SNS environment. As the boundaries between the SNS and detached spaces diminish, different online spaces conflate.

2. ***Increasing role of biometrics:*** Face-recognition technologies become more sophisticated and are integrated in SNS contexts. Facebook was the first SNS to enable the tagging of people on photos and the creation of a link to their profiles; in 2011, Google filed for a patent for "facial recognition with social-network aiding". Law enforcement agencies have increased their efforts to use face recognition combined with photos available on the web. This enables linking a person's physical and virtual appearance.
3. ***Mobile computing and significant growth in mobile SNS usage:*** Mobile social media represent a fast-growing market: from 2011 to 2012, the amount of mobile data doubled. Users increasingly access their SNS profiles via mobile devices (smart phones, tablets etc.); mobile apps and location-based services make SNS usage more attractive. This also affects locational privacy and enables an SNS environment to gather data on location and space (e.g. via location tracking) and to gain deeper insights into users' movements and behaviour in the analogue world. Montjoye et al. (2013) highlight the deep privacy impacts of mobile data and demonstrate a way to uniquely identify 95 per cent of individuals by their location data. As mobile computing in general is among the fastest growing markets, protecting locational privacy is one of the main challenges. Together with SNS, the array of privacy impacts further expands.

Quickly evolving smart devices, such as intelligent glasses (e.g. "Google Glass") or other wearable computers in the field of Augmented Reality, represent, to some extent, the next generation of mobile social media and thus reinforce and trigger additional privacy challenges. With an integrated camera, they may enable two-fold tracking: where people are and what they do, a person's movements and actions, and also what this person is looking at. These trends refer to the emerging role of ubiquitous computing (cf. Čas 2011).

Conclusions

Social network sites heavily impact the privacy of their users. The various information flows are not under full control of the users and can be and are exploited for commercial and other purposes by the providers and some authorities. Therefore, the concept of informational self-determination is under strain, and privacy is affected in all forms and dimensions. Social plugins, the increasing role of biometrics and the significant growth in mobile computing further increase the threat to privacy.

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Privacy on the Internet: Commodity vs. Common Good

Sebastian Sevignani

Abstract

Within a political economic perspective on public policy, structural reasons that render privacy a problem on the Internet are explored. Reasons for privacy problems can be found, on the one hand, in dominant practices of how personal data are used on the corporate Internet (section 1) and, on the other hand, in a privacy discourse that is "possessively individualistic" but broadly informs the public-policy process (section 2). Finally, strategies for improvement are identified and concrete legal, self-regulatory and technical implications for public privacy policy are derived (section 3).

Introduction

In this article, I adopt a normative and critical approach to public policy (Dryzek 2006) that takes the standpoint of the less powerful social actors and tries to draw consequences for public policy on the background of a political economic perspective on information and the Internet. In this view, the commodification of privacy ultimately contradicts a society that is oriented at the common good and cherishes the individual and their privacy.

Karl Polany defines commodities "as objects produced for sale on the market; markets, again, are empirically defined as actual contacts between buyers and sellers" (Polany 2001, p. 75). Karl Marx illustrates commodification as a process within which "everything that men had considered as inalienable became an object of exchange, of traffic and could be alienated. [...] It is [...], to speak in terms of political economy, the time when everything, moral or physical, having become a marketable value, is brought to the market to be assessed at its truest value" (Marx 1846-7, p. 30).

A narrower view of commodification would focus on the literal buying and selling of things on markets and a broader meaning of commodification would include things that are treated as if they could be exchanged although they actually cannot. Commodification is a practice and a worldview; "it elides literal and metaphorical markets" (Radin 1996, p. 2), and there is "no sharp divide between action and discourse" (1996, p. 2).

Socio-economic approaches to public policy challenge the idea that all political interests are equally represented in the public sphere and are equally able to shape policy and politics (John 1998, p. 92); rather, social inequalities that are grounded in the economy have important effects on the public sphere (Habermas 1991). Not only are powerful economic players likely to enforce their interests in political processes, the public sphere also is not a neutral battleground but framed by tendency according to powerful interests. There are, however, potentials for agency in public-policy processes that I emphasize in section 3.

In the following I explore structural reasons why privacy becomes a problem on the Internet within a political economic perspective on public policy. Results of a qualitative interview study with Austrian students (N=30; mean = 24.9 years; standard deviation = 3.33 years; two-thirds women and one-third men) about social networking sites (SNS), privacy, and surveillance assist my analysis.

Dominant Practices with Regard to the Use of Personal Data on the Internet

Today, most Internet sites are commercial, and they have to profit if they want to survive. The most common way to turn profit on the Internet is by allowing advertising on web services. Nowadays, the majority of the most popular Internet sites is commercial and applies this business model. Advertising on the Internet is targeted advertising and needs detailed information about users to function (Turow 2005). While people use websites for different reasons, such as getting news, providing information, staying in touch with friends, making new acquaintances or organizing events, they produce a wide range of data. Thereby they are watched very accurately by the sites' owners. Profit-oriented Internet services develop massive systems of user surveillance and store 'literally everything', as, for instance, a Facebook employee has admitted (Wong 2010). Internet users willingly or unwillingly provide commercial Internet services with information that is used for money exchanges with the advertising industry.

Although most of the most popular Internet services are financed by advertising, it is imaginable that users pay directly for them, for instance through subscription or pay-per-use models. Users even could get paid when they allow services to use their data for economic purposes. Sometimes, these options are theoretically as well as politically welcome and based on the argumentation that such business models would give privacy an (economic) value. In all these scenarios, privacy becomes a commodity. Thereby privacy is not necessarily made obsolete or entirely neglected on the commercial Internet, but it is willingly or unwillingly sold and/or paid for.

It is, however, observable that major Internet services actually are involved in something that could be called a privacy crisis. Continuing complaints by users and data protection agencies directed against the leading commercial SNS, Facebook and other commercial Internet services provide evidence for a structural conflict between privacy and surveillance-based business models on the Internet.

The information that users provide to Internet services can be seen as produced by the users in their interactions with others or the platform; users are therefore also producers – the term 'prosumer' expresses this quality. On the corporate Internet, prosumers have a double freedom since they are usually free from the ownership of the Internet services and, at the same time, free to exchange their prosumer product, for instance personal data, with them. Internet corporations profit from prosumer activities and user data through massive systems of surveillance (Fuchs 2011).

The gained profits help sustain and even widen a basal power inequality between the owners of Internet services and the majority of its prosumers. Accumulated financial power is used by Internet corporations to pursue their political and economic interests. According to Forbes' 'The World's Billionaires List 2013', there are seven billionaires among the world's seventy-five richest individuals that can be directly associated with the global top fifteen most-visited web sites.[1] Mark Zuckerberg, the founder, CEO and main stockholder of Facebook, is one of them and could once powerfully announce that the age of privacy is over: "we decided that these would be the social norms now and we just went for it" (Johnson 2010). Since Zuckerberg holds ownership power, he and other owners are able to set the terms of using Internet services; since Facebook is today by far the most popular SNS, his words come with significant effects for users (Castells 2011).

At the same time, however, profit pressure comes into conflict with privacy in surveillance-based Internet business models. Privacy is either declared as obstructive or it must take on the form of a commodity to fit in the corporate Internet. In the following text, I will argue, and public policy implications are evaluated accordingly, that if there is no common control of Internet services, then it is unlikely that there will be actual privacy for society members and that there will be a participatory and democratic evaluation process about what privacy and the freedom of the individual should denote.

Dominant Possessive Individualistic Discourse about Privacy

The starting point of the modern privacy debate was an article by Samuel D. Warren and Louis D. Brandeis published in 1890. They define privacy as the "right to be left alone" (Warren/Brandeis 1984, p. 76), which is identical with the liberal core value of negative freedom (Rössler 2005, pp. 6-7.), and as such it influences most of the subsequent theoretical work on privacy. Informational privacy is today most often defined as control over the flow of information by individuals in order to determine "when, how, and to what extent information about them is communicated to others" (Westin 1967, p. 7). In these theories, privacy is what is subjectively seen as private and no hints are given about what privacy within a good society may be (Wacks 2010, pp. 40-1; Solove 2008, p. 25).

It is no coincidence that a resemblance between privacy and private property has been often remarked (e.g. Goldring 1984). Lawrence Lessig argues that in the age of the Internet, "just as the individual concerned about privacy wants to control who gets access to what and when, the copyright holder wants to control who gets access to what and when" (Lessig 2002, p. 250). Privacy as property would strengthen the individual control of personal data and would prevent privacy invasions that occur when personal data is accessed non-consensually. The privacy-as-commodity approach demands that "everyone possesses information about themselves that would be valuable under some circumstances to others for commercial purposes. Everyone possesses his or her own reputation and data image. In this sense, basing privacy on the value of one's name is egalitarian" (Laudon 1996, p. 102).

Many of our interviewees hold an attitude that could be summarized in the following expression: 'It is me who determines what privacy is; privacy is my right against others, I decide, whether or not, to give up privacy in exchange for benefits'. Most of those, who say that advertising on SNS is not a privacy issue, stress that there was an actual, or at least a potential, informed consent by the user to the SNS's terms and targeted advertising. This influential line of argumentation refers to conscious contractual exchange with the SNS that perfectly preserves individual control over personal data. Consequently, there is no reason to sue Internet services for doing what they have announced.

Like others, I propose to think of these briefly described influential privacy notions as possessively individualistic. They provide the basic categorical means to which all stakeholders in the public-policy process are likely to refer since in a market society it is very useful and appropriate that the individual perceives herself or himself as essentially "the proprietor of his own person and capacities, for which they owe nothing to society" and enters "into self-interested relations with other individuals" (Macpherson 1962, p. 263). The possessively individualistic privacy discourse urges individual decisions instead of societal agreement about what should be deemed private, and it directs public-privacy policy to individualistic solutions (Bennett/Raab 2006; Gandy 2003). My argument is that privacy that is understood in a possessively individualist way is also easy to commodify and to exploit; hence it is itself an aspect of privacy crises since the commodification of personal information demands user surveillance.

Implications for Public-Privacy Policy

In order to avoid structural privacy crises that are driven by the profit motive on the Internet, I argue, on the one hand, in favour of potential benefits that non-commercial Internet services have for users. Such alternative economic practices should, on the other hand, be enriched with alternative ways of thinking about privacy. Two public policy strategies of de-commodification and towards privacy as a common good can be deduced accordingly.

The first strategy aims at strong support for non-market organizational forms of Internet services. Already existing instances, providing role models to be built on, are the relatively well-known social networking sites Diaspora (Sevignani 2013) and Wikipedia. Alternative services, except Wikipedia, are at the same time highly welcome but rarely used by users, as we found out in our study in the context of SNS. Political support, however, could change the usage situation. In this context, a survey conducted by Turow et al. (2009) found out that most Americans do not want marketers tailoring advertisements according to their preferences. In our interviews, we found that once interviewees are aware how exactly advertising works on SNS, most of them also argue that advertising is a privacy invasion. These evidences put into question the assumption that there is an informed consent to advertising by Internet users.

The second strategy, which is suggested here, is a re-thinking of privacy. Conceptualizing privacy as an unalienable civil right instead of a commodity, as it is observable, for instance, in Europe (Whitman 2004), is a first useful step. We found an interesting line of argumentation among our interviewees that breaks with the privacy-as-commodity logic when they say for instance:

"I believe such things ... information should not be for sale. [...] In fact, I would then sell my privacy. I wouldn't do that, but maybe there are people that want to make such easy pickings" (Interviewee 25). Interviewee 9 assents when s/he argues that selling personal data would "basically be a form of selling my own self."

In the discussion of the question whether privacy should or should not be alienable, exchangeable and tradable on markets, it is crucial, however, to understand that in modern market societies, any commodification process itself presupposes rights that cannot be alienated or exchanged (Macpherson 1962; Pateman 2002). From this insight, it becomes understandable that, although useful in ongoing political debates, the conceptualization of privacy as a civil right or liberty might not be sufficient to break with possessive individualism ultimately. The conceptualization of the right to privacy as a civil right tends to coincide with the unalienable right to unconditionally dispose of personal information. Such a notion of privacy, however, does not really block the commodification of personal information since an individual is free to decide to sell privacy. In a social situation, however, where web services are privately owned and highly monopolized, individual decisions to exchange personal information are likely since otherwise users cannot benefit from Internet services.

In contrast, a rethinking of privacy should finally aim at a social conception of privacy that is aware of the unequal material conditions in society and on the Internet. Such social conception still needs to be elaborated on, but it will become the more imaginable and useful the more non-market spheres on the Internet and in society will grow. Our interviews suggest that certain privacy theories emphasising the perspective that individual/private and societal/public goals are not necessarily contradicted but flourish mutually or dialectically (Steeves 2009), and the existing critique of the dominant privacy concept (Bennett/Raab 2006, pp. 14-22) can provide first elements for an alternative, non-possessive individualistic discourse of privacy. Some of our interviewees indeed expressed the attitude that, first, privacy must not be understood as directed against others and society; second, privacy must refer to the importance of mutual respects or recognition; and, third, that the freedoms linked to privacy are dependent on social equality (Marx 2007).

Conclusions: Policy Instruments

Finally, concrete public-policy instruments, which usually include technical, legislative and self-regulatory measures and which are said to be only effective in combination, can be described here briefly.

First, in terms of legislation, the EU initiative for a general data-protection regulation provides important elements that include more rights (particularly stronger sanction opportunities) for independent data-protection agencies, a commitment to data protection by design and by default, as well as the right to be forgotten (Mayer-Schönberg 2009). All these aspects would limit commodification processes of privacy. Thereby it is crucial that exception rules from data protection due to "legitimate interests" are narrowed so that economic interests do not automatically outdo consumer privacy interests. In our interviews, we found that an opt-out option for targeted advertising was clearly welcomed by the overwhelming majority of our interviewees who would even support legislation in this respect. At the same time, a legal commitment to alternative Internet services is needed as a comparable one exists, for instance, for public broadcasting.

Second, when it comes to self-regulation, it is crucial not to limit these measures to corporations and their privacy commitments, standards and seals (Gandy 2003). Self-regulation is possible not only beyond the state but also beyond the market. Civil society initiatives, such as the Electronic Privacy Information Centre (EPIC) or 'Europe vs. Facebook', are worth supporting by users and their critique that economic interests should not automatically outdo privacy rights are worth being taken into account by politicians and corporations. Digital commons, Free Software and alternative Internet services are the actual outcomes of self-regulation and could participate in state funding just like states financially support Internet corporations to attract them within a global competition between countries and regions. It is notable that in our interviews, we observed great support for alternative, non-commercial social media – in a non-material way but also, perhaps surprisingly, monetary support.

Third, privacy-enhancing technologies (PETs), such as automatic disabling of 'like' buttons, which convey user data to commercial social networks, through Internet browser applications are meaningful measures. Digital commons are forms of self-regulation but also have technical aspects. Decentralization of Internet services through peer-to-peer technologies, for instance, can help avoid un-democratic power aggregations in governments and corporations. The alternative SNS, "Diaspora", for instance, promises that no big corporation will ever gain control over user data.

These briefly listed concrete public-policy instruments could help to make alternative, non-commercial Internet services more popular and structural threats to privacy could be simultaneously avoided. The plausibility of possessive individualism on the Internet would decrease and a social notion of privacy would become imaginable, not only theoretically but also practically.

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Privacy by Design for a Mobile Retina Scanner

Philip Schütz and Michael Friedewald

Abstract

This paper wants to outline initial findings of the MARS project, which aims at preparing the ground for a retina scanner technology that will be used in a civil context allowing the authentication and identification of individuals in a privacy- and user-friendly way. The project shows that privacy by design is difficult to realize in practice but indispensable in order to create a security-technology approach that is sustainable, and a product that is both accountable and effective.

Introduction

While the traditional means of identifying oneself – national ID cards, finger prints or biometric photos – have, in recent years, increasingly had their security compromised, the respect and consideration of privacy and data protection has become one of the major flaws in the design of these authentication and security technologies.

Accordingly, this paper outlines the initial findings of the MARS (Mobile Authentication via Retina Scanner) project. The project consortium aims at preparing the ground for a retina scanner technology, which will be used in a civil context and which will allow for the authentication and identification of individuals in a privacy- and user-friendly way.[1] The project adopts the "privacy by design" approach, i.e. privacy issues are taken into account during the process of designing the technology (Cavoukian 2009; Hustinx 2010; van Lieshout et al. 2011). In order to successfully realize this approach, a constant dialogue and interdisciplinary exchange between project partners was envisaged from the start.

The Retina Scanner Technology and Its Application Scenarios

The retina scanner makes use of the unique blood-vessel patterns in the inner layer of tissue within the eye (e.g. Ashbourn 2000). Since these patterns are not only unique but also represent a biometric feature within the body, the retina scan is regarded as one of the most tamper-proof biometric identification methods (von Graevenitz 2006).

The scanner draws on an infrared laser that reflects a black-and-white image of the retina. This raw data is then converted into a template comprising unique identification attributes. In the 'enrolment process', the invisible laser scans the retina. The raw data is then processed in order to immediately create the template against which further authentication inquiries are matched. This template is stored either locally, on the user's device, or centrally in a database on one of the authenticator's servers.[2] Every subsequent authentication process requires another scan in order to match the scan result against the template.

In order to explore and outline practical problems in privacy, data protection, discrimination and user-friendliness, two main usage scenarios, with a mid to long-term perspective, were drafted. One revolves around access control in security contexts, i.e. authentication of security personnel by means of the technology (scenario "security personnel"). The other deals with the use of the technology for authentication purposes in online banking transactions (scenario "online banking"). Both fields of application envisage the miniaturization of the retina scan technology for integration into mobile devices, such as smartphones or tablet computers.

Assessment of Retina Scanning Technology from Different Angles

Based on the drafted scenarios, technology assessment (TA) was carried out. This covered three areas of expertise. First, a comprehensive legal analysis was done. This analysis had a special focus on the conflict between collection and processing of retina data and current and upcoming data-protection laws. Second, an analysis from a medical perspective was conducted. This aimed at assessing the quality of health information that can be deduced from the collected retina data. The legal and medical perspectives were supplemented by a user perspective. The aim here was to assess user acceptance of the retina scanner based on concepts such as ergonomics (practicality, comfortability and convenience), price-performance ratio and added security value, as well as privacy considerations, such as data protection and the concept of 'bodily privacy'.

a) Legal Assessment:

First, it should be acknowledged that the raw data collected in a retina scan are not only personal data – as with other biometric technologies - but may also contain hints as to the user's health status (c.f. 3.2.). Accordingly, the data could therefore be considered (at least partially) health data. Health data fall under a special category of data that is subject to a special regime of protection in national and European data-protection law (e.g. German Data Protection Law/BDSG art. 3, para. 9; Directive 95/46/EC, art. 8; proposed General Data Protection Regulation/GDPR, art. 9). Explicit, informed and voluntary consent from the user is therefore needed in any case of performing a retina scan.

However, the two above scenarios differ in their scope with respect to legal requirements: The security personnel scenario takes place in an employer-employee context. The employees are not free in their choice as to whether to adopt the technology. That is why an agreement with the work council – the body representing the interests of the employees – is advisable, instead of attempting to gain the consent of every single worker.[3] In contrast, in the online-banking scenario, the client of the bank has a choice to either use the technology, go back to traditional means of authentication or change their banking institute.

One important legal aspect that plays a role in the online-banking context is the "burden of proof" issue. This refers to the fact that, when storing and processing the retina data in a completely decentralized way, i.e. on the mobile end device, the burden of proof in the case of identity theft lies exclusively with the bank. In the eyes of the bank, whose original motivation for employing new, more secure, authentication technology is presumably based on the hope that it will be legally less liable in cases of theft, this leads to a reduced incentive to introduce the new technology in the first place.

Ultimately, for a successful deployment of the technology in the future, it is of singular importance to take privacy into account at an early stage of development since the proposed European Data Protection Regulation demands data protection by design and by default (e.g. GDPR, art. 23). Particularly relevant and mandatory for technologies processing biometric or sensitive data, such as health data, will also be the so-called data protection impact assessment (e.g. GDPR, art. 33), which is planned for the end of the MARS project as well.[4]

b) Medical Assessment:

The medical review comes to the conclusion that specific illnesses can be deduced from the infrared images created by a retina scan. These illnesses are, inter alia, diabetes mellitus, macular degenerations, several kinds of vascular diseases, optic disc swelling (Papilledema) and high blood pressure (hypertension). However, there are other diseases a retina scan may hint at. Deviations from the norm could lead to probability assumptions about the health status of a person. According to the review, medical conclusions about the user's ethnicity, as well as drug abuse cannot normally be drawn from a retina scan. Beyond the requirement of high diagnosis accuracy in a medical context, data output of a retina scan with less correlation and reduced likelihood could still be used in other contexts to check on the user's health. From this, conclusions as to the user's life-style and even potentially social status, could be deduced. In the online-banking scenario, the bank takes advantage of the retina data by creating profiles and refining categories of customers in order to, for example, calculate scores for creditworthiness. In the security-personnel scenario, the employer is interested in the health data of his/her (future) employee because it may give him/her the opportunity to make an informed, yet discriminatory, decision in the case of hiring, extending or terminating an employee's contract. Both of these examples show the potential discriminatory effects of the retina scanner technology. Accordingly, the risk of function creep must be dealt with while designing the systems.

c) Assessment from the User Perspective

From a theoretical point of view, the project team identified four major aspects relevant to the user acceptance of retina scanners: ergonomics (practicality, comfortability and convenience aspects), price-performance ratio, added security value and privacy perceptions.[5]

Biometric authentication technologies present the unique opportunity to use one's own body as a key. The convenience aspect of not having to remember a code/password or carrying a token – for example an ID or EC card – might at first sound appealing. However, even beyond the legal requirements in the instance of electronic payment procedures, such as a mandatory combination of at least two authentication instruments (having (EC card), knowing (PIN Code) and/or being (biometric feature)), there are challenges to the acceptance of biometric technologies. These lie in the comfort of their use and in their practicality. In the case of a retina scanner, various technological aspects need to be considered:

1. The wavelength of the infrared laser should allow scanning to take place at a comfortable distance between the user's eye and the hand holding the mobile device.
2. Since the user's pupils contract, and therefore may narrow down the angle of incidence reflected from the retina in bright-light conditions (outdoors), the laser has to be configured accordingly.
3. The scan procedure must be tolerant enough to allow minor movements of the head, blinking and wearing glasses or contact lenses.
4. The probability that the scan fails to detect the correct user (false rejection rate/FRR) should be kept very low.[6]

Beyond the mere technical realization of the retina scanner, acceptance research suggests that user-friendly operation combined with a simple and intuitive design are key for a technology that wants to prevail on the future market. The perceived "soft" factors can be as important as the real, "hard" factors.[7] Difficult to influence, but nevertheless crucial is also a certain 'hipness' factor.

Since a mobile retina scanner does not yet exist, it is difficult to calculate the ***costs*** of production for the mass market. However, as opposed to professional forms of application (military, police, security services), the average customer is not willing to pay significantly more for his/her mobile end device even if it includes a more secure authentication system. Accordingly, retina scanners in a mobile end device for the mass market can only be sold as a low-priced add-on.

In the context of a security technology, the question as to what extent a new technology brings about security benefits (added security value) is, of course, of primary interest to the user. In that regard, a general advantage of the retina scanner is that – contrary to fingerprints, but similar to hand-vein recognition methods – the authentication process is based on an internal biometric feature. As such, it is harder to compromise the integrity of the system or to conduct unnoticed surveillance than it is in the case of external biometrics (which tend to leave more traces), such as fingerprints or the iris.[8] Even physical dissemination of the biometric retina pattern is not possible – amputation leads to the immediate collapse of the retina's blood vessel structure.

Beyond the necessity of a decent FAR (which is often seen as a major indicator for the degree of the technology's security), the privacy perceptions of the user must not be underestimated. As the example of the failed attempt to introduce body scanners at German airports shows, the controllers' initial insensitivity towards passengers' intimacy, shown by leaving the data output (i.e. nude images of the persons scanned) unfiltered, led to the complete refusal of that technology. A later integrated privacy filter could not, however, repair the damage that had already been done to the technology's public image.

In the context of the retina scanner's acceptance, data security, data protection and privacy all play a significant role. Since the medical examination has shown that retina scanner technologies produce sensitive surplus data, comprising potential information about the user's health, the MARS project team has developed certain technical means to deal with that function creep (see the next section).

What is much more difficult to address, is the fuzzy concept of bodily privacy, i.e. the basic human need and sense of physical integrity. This instinctual feeling may limit user acceptance as the retina is a particularly sensitive internal biometric feature. As such, scanning may be perceived as an intrusion into an extremely intimate sphere of the body. The desire for control over one's body as a guarantee of physical integrity and human dignity is not a new challenge with regard to the acceptance of biometric technologies (Mordini/Rebera 2012). From that perspective, the appealing notion of using one's body as a key is Janus-faced. That is why transparent, clear, unambiguous medical evidence that using the retina scanner does not present a risk to the health or the physical integrity of the user is of utmost importance.

Implications for the Design of the Technology (Privacy by Design)

Because collecting health data is not the primary target of the retina scanner technology, it is hard to achieve social acceptance for and creates a greater legal burden on the deploying entity, the MARS consortium found ways to minimize the quantity and quality of surplus data.

The project team followed the concept of de-specialization, which aims at transforming sensitive data, i.e. special categories of data, such as health data, into "normal" personal data. First, the focus of the laser scanning the retina is directed towards the optic nerve region, away from the macula where most disease traces are visible. Since the optic nerve also represents an area of the retina with better authentication opportunities due to a higher density of unique blood-vessel crossings, this represents a win-win situation for privacy and security.

Second, after immediately being converted into a template that cannot be traced back to the original image, the collected raw data of the retina scan is destroyed. It is still subject to discussion, however, as to whether these templates – or a biometric key generated from the template – are to be used for the later matching process.

Regarding the template's or key's storage location, a maximally decentralized strategy is favourable, although this is not advisable in the case of online banking, in which the liability for the consequences of compromised templates, even if they are stored on the mobile end device of the customer, lies with the bank. Otherwise, decentralized storage guarantees a certain degree of control over one's biometric templates and provides fewer opportunities for data processors and associated third parties to access the template data.

However, storing the template on a mobile end device, such as a smartphone in a commonly lax security environment, also increases the risk of compromise. That is why the MARS project team envisages the storage and processing of the template/key in its own, tamper-proof module. In the case of mobile (phone) devices, this means that the processing should be separated from the central processing unit, using its own exclusive encapsulated chip ("black box"). Though it may seem counter-productive at first from an efficiency standpoint (technical redundancies), the physically separated chip ensures optimum data protection.

The question of data transmission is crucial as well. Besides the obvious need for encryption, the focus should be on minimizing the amount of personal data transmitted. If one wants to take privacy by design seriously, transmitting the scanned raw data in order to match it against a sample on a server is – particularly due to the above-mentioned concerns about surplus health data and the data-security risks related to the transmission of data in general – out of the question. Transmitting the template is better, because less sensitive data is involved. The best option in this context would be to do local matching and transmit only the result of this matching when conducting an authentication inquiry.

Conclusions and Outlook

Although the MARS project mainly targets a biometric authentication technology that takes privacy and convenience from the user's perspective into early consideration, the combination between a tangible technological development and an abstract technology assessment poses enormous challenges on both sides: the engineers' and social scientists'. In this respect, inter- and trans-disciplinary research is absolutely crucial. Every stakeholder has to work constantly on this exchange since the various layers and interfaces playing a role in developing the technology, while simultaneously taking the related possible risks to privacy and user acceptance into account, require intense cooperation. Thus, privacy by design is difficult to realize in practice but generally possible.

The MARS project has also shown that privacy and security do not necessarily imply a trade-off. However, in the end, a variety of soft factors, such as convenience and privacy aspects, often decide whether or not biometric security solutions will prevail on the open market.

Furthermore, German national and future European data protection legislation require high technical standards, such as data protection by design and by default. On top of that, data protection impact assessments for biometrics will be mandatory (GDPR, art. 33). More and more of these legal requirements will probably not only be nice-to-have but will be must-have features of new data processing technologies.

While this is often thought of as an additional burden for technology developers, advocates of privacy and data protection like to see these requirements as incentives for the industry to integrate privacy as a quality feature and unique selling point into their technology products.

The fact is that today’s security technologies often lack trust and acceptance in society. Privacy by design could be an approach to win back the end user. However, it has to be closely watched and remains a balancing act that privacy by design is not merely used to give additional legitimacy to the developed product.

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Afterword

Technology Assessment and Parliament – the Indispensible Link

David Cope

It is simply impossible, *a fortiori* because of the space constraints, to provide in this afterword a summary of the leitmotifs of all the papers presented in this volume. I join with Lars Klüver in his introduction and offer my heartiest congratulations to the team who have assembled it for their truly Stakhanovite efforts. It must be, by some margin, the most comprehensive report on 'technology assessment' (TA) ever produced. Thanks must also go to the individual authors of some 50 papers, covering a huge range of specific topic areas and also spiced with more theoretical and synoptic contributions.

The institutionalization of TA in a parliamentary setting dates back almost 50 years, while examples exist of individual studies, commissioned by, or linked to, parliaments that are TAs in all but name produced around 100 or even 150 years ago. Looking at the range of individual topics covered in the earlier pages of this volume, many of them are similar, if not identical, in their focus to the first blossoming of TA studies, particularly those that emerged from this institutionalization half a century ago – medical developments, environmental quality, military technologies and so on.

This is because TA almost invariably finds itself being ineluctably drawn, or positively directed, towards matters that have the character of a 'problematique'. That is, they are, in essence, enduring, (at least until the entire world lives in an all-embracing welfare-maximizing utopia). They arise because, at the end of the day, the deployment of technologies is not costless – so debates continue permanently about, for example, how much should be spent on medical technologies, what is an 'appropriate' level of environmental quality and so on. Intensifying the problematique is that there are usually *distributional* dimensions – distribution of costs and benefits between different social groups, between different parts of a country, between different age groups – and between countries at different stages in their economic and social development.

Conversely, many of the subjects covered by the individual studies in this volume are concerned with applications of science and technology that hardly, if at all, existed when the first thrust for development and use of TA emerged. One thinks of stem-cell research, nanotechnology, genetically modified organisms, synthetic biology and probably above all, the 'networked society'. That these technologies have emerged – and have come to occupy such a pivotal place in today's economies and societies is in one sense a great tribute to the perceptiveness of the early advocates for the development and use of TA. While they cautioned against too mechanistic an application of technological forecasting, they counselled that, although the rate of basic science and associate technological discovery may have peaked earlier in the twentieth century, the capacity of technological applications to have profound economic and social consequences had not, but was likely to be even more pervasive in the future.

It seems to me that the *parliamentary* locus of TA is a critical, if not defining, aspect of its evolution and practice. Of course, there is no reason why institutions outside of a country's parliament should not conduct TA – and many do – examples of which dominate this volume. However, I maintain that parliamentary TA is in a premiere category. The explanations for this parliamentary locus usually refer, correctly, to two driving rationales. One is that a parliament equipped with a TA function on which to draw is better equipped in conducting one of the key roles of parliaments – to examine effectively the operations of executives – governments – and to hold them to account. This rationale draws on the assertion that progressively, more and more of the activities of executives have a science and technology dimension to them. Linked to this first rationale is a second. This is that, invariably, a majority, or even a 'critical mass' of members of parliaments, do not have a formal background in science and technology – and that therefore they have a need for an accredited source of analysis and advice.

This second rationale meshes with a third, which, however, is distinct. This is that a parliamentary locus for conducting TA provides as near to a guarantee of the *independence, objectivity and comprehensiveness* of the output of the TA function as it is possible to achieve. There are several components to this rationale. Clearly, if directly or indirectly employed by a parliament, the TA specialists conducting studies have no other formal loyalty of association that might otherwise consciously or unconsciously constrain or influence their analysis. Second, it is often implicitly assumed that a parliament will have, among its members, the widest range of opinions and perspectives on the subject under investigation. This, either formally, through consultation and draft-output review processes, or simply through the analysts' awareness of this situation, will help to ensure that their research is comprehensive and embraces the fullest range of interpretations of the issue. This independence extends even to separation from official learned societies in individual countries. While quite often these do conduct TA studies, they are, at the end of the day, largely associations of science and technology *practitioners*. They therefore cannot totally free themselves from the 'taint' that they will be inclined to promote, either through calling for more funding, or in other ways, scientific and technological research and development.

There is, of course, a certain irony in the fact that the European TA institutions that are most firmly located in a parliamentary setting, such as the Finnish Committee for the Future, STOA at the European Parliament or my own former office at the UK Parliament, have not been able to be full participants in the PACITA project because of the constraint of guaranteeing their independence. Fortunately, they have not been prevented from participating in PACITA activities.

Overarching this parliamentary locus has been the context that national parliaments (and international in the case of the European Parliament) are the *premier* institution where the most important issues affecting a country's development and the well-being of its people can be thoroughly debated and all implications teased out. A special dimension of this, which attaches to some parliaments more than others, is that parliaments have a particular responsibility to examine and comment on the *longer term* dimensions of development and well-being – and TA, of course, tends to be suffused with a concern with the longer term.

Accepting, however, the primacy of the parliamentary locus leads immediately to a matter that must be addressed. Over the fifty years since parliamentary TA emerged, many, if not most, parliaments have seen a diminution in the intensity of recognition of this national primacy characteristic. There is no space to elaborate in detail. In some cases, intense political conflict has paralyzed any effective search for virtually any common ground. In others, parliaments have suffered a loss of public respect because of financial scandals, as with my own country in and after 2009. In yet other cases, arguments are made that the 'calibre' of parliamentary members has declined over time, resulting in an erosion of effectiveness *vis a vis* the executive. There are also 'higher order' trends, ironically mainly linked to technological developments, that may also have contributed to this undermining of primacy – in particular, the development of broadcast media, and, separately, the emergence of social media.

Some commentators are relaxed about this process, and some indeed even positively welcome it – seeing in it a process of evolution – an adjustment of the procedures whereby a nation examines itself, with a move away from processes based on representation towards ones based on more direct engagement. This has direct implications for *expertise* – and, in particular, the special status of expertise based within, and serving, parliamentary TA functions – and indeed for the wider body of scientific and technological expertise on which those parliamentary TA staff draw in conducting their research and providing their advice. Although, as I elaborate briefly below, I caution against too much 'navel contemplation' by the TA community, I suggest that this is a facet of the institutionalization of TA, as it moves into its second half century, that would repay considerably more attention. The Prague conference began some exploration with a session that I was privileged to chair – on the interactions between TA institutions and individual practitioners and their 'clients' – the parliamentarians who feel the need for, and subsequently make use of (to a greater or lesser extent). I commend Leonhard Hennen for conceiving of the session originally. I hope that its insights, and indeed oversights , can be followed up during the further unfolding of the PACITA project, and in wider thinking.

Finally, let me return to the matter of 'navel contemplation'. I guess like any congregation of specialists, the TA 'community' can sometimes seem a little introspective, self-regarding and indeed perhaps almost presumptuous about its existence, activities and, dare I say, importance. A good antidote to any such tendencies is for TA practitioners to ask, among contacts in the world outside TA, what these contacts understand is meant by 'technology assessment'. Although, at one level, the answer is self-revealing – "well, it means the, er, assessment of, er – technologies!", it invariably becomes clear that we operate in a rather restricted space, whose recognition by wider society is, shall we say, limited.

TA is immanently in a supplicatory relationship with wider society. It has legitimacy, indeed an existential claim, *only if it is seen as having utility by that wider society*. I suggest that at present the awareness by societies of the need for TA remains somewhat inchoate. It may be that the interpretations of what I call the 'Dutch school', succinctly set out in the paper by Wiebe Bijker, exploring the pervasiveness of contemporary "technological culture", provide some indicators to a more fundamental future role for TA, including its practice by institutions outside of the parliamentary setting. Some modifications or reforms of the democratic process will see a new centrality accorded to exploration of the unfolding of technologies. I sometimes worry that this interpretation is based somewhat too greatly on what we might call 'temporal exceptionalism' – a view that the *current* state of the economy and society is somehow unique, utterly distinct and unprecedented. It could be argued that all societies, going back to the time when the first hominid fashioned the first stone tools, have been infused by a "technological culture". I guess the 'proof of the pudding is in the eating', although it will be a meal that society may well consume over a matter of some years before it gives its verdict on the flavour. Let us hope that the verdict will be – "this TA is delicious – may I have a second helping!"

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1) www.eptanetwork.org

2) European Parliament - Science and Technology Options Assessment (STOA)

3) http://www.itas.kit.edu/english/etag.php

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5) The first kind of “joint project” was EUROpTA (1998-1999), which was partly financed by the TSER programme of the European Commission. Other examples include Meeting of Minds (2006), TAMI (2004), PRISE (2006-2008), CIVISTI (2008-2011), DESSI (2011-2013), SurPRISE (2012-2015) and PACITA (2011-2015)

6) For example EUROPTA (2001) and the TAMI project (2004)

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9) This distinction is based on discussions at the PACITA T 2.2 Workshop in Copenhagen, 21 June 2012. To separate the terms addressee and target group, an addressee can be described as the main recipient of the message that can

adopt decisions based on the communication from a project. Target groups are a broader audience of relevant scientific environments, NGOs, interest groups or specific citizen groups.

10) This vision is a result of a workshop held in Karlsruhe 12-13 November 2012. Participants were PACITA partners and other European TA actors.

11) www.technology-assessment.info

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1) Strategic research institutes are R&D organizations that have a crucial influence on R&D activities of a given country in a particular field of knowledge. In Poland, they have the status of National Research Institutes.

2) Incremental technologies are understood to be technologies directed at a gradual improvement introduced to already existing solutions through a systematic implementation of innovative products based on new knowledge. (Mazurkiewicz 2006).

3) Emerging technologies, on the other hand, are considered to be absolutely innovative technical solutions characterized by a sudden development in a given area of knowledge and practice and facilitating the achievement a high competitive rank (Soares et al 1997).

4) These were: Lunar Design (SME),Technology Promotion Association of Thailand and Japan (NGO), Deutsche Telecom, Shell (MNC), KPN Research, (Large domestic market company).

5) Netherlands Organisation for Applied Scientific Research TNO, Technical Research Centre of Finland VTT, Fraunhofer Society, Innventia.

6) In the case of companies, it was a secondary data case-study analysis (reports, company documents, academic papers), in the case of institutes, the secondary data sources were supported by a questionnaire. The questionnaire aimed to analyse the characteristics of foresight initiatives undertaken in these institutes. It was addressed to the managers of foresight units or the managers of foresight projects in the respective research institutes.

7) http://www.foresight.itee.radom.pl/

8) http://www.programstrategiczny-poig.itee.radom.pl/index.php

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1) The Kansai region lies in the southern central region of Japan's main island, Honshu. The region includes the prefectures of Kyoto and Osaka, which are home to many historic sights and former capital cities.

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Footnotes:

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2) The concept of Civil Society is inherently difficult to conceptualize and operationalize (Heidbrader 2012 (Matonytė 2004; Tsitsiklis, van Roy 1996).

3) The outline of Epstein's article illustrates that if CSOs gain credibility in the science community and have a powerful political position they can influence the progress of science. More examples of how CSOs interact with scientists at all steps of the research process can be found mainly in health research (Delisle et al. 2005).

4) This approach is closely related to participatory action research (PAR), which seeks to understand the world by trying to change it. PAR is based on principles of collaboration and reflection (ARGYRIS, SCHON 1989; Whyte 1991). One particular flavour of this is community-based participatory research where scientifically trained experts and community members work in an equal partnership (Minkler, Wallerstein 2003).

5) For detailed illustration of the applied methodology compare (Revel et al. 2013)

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Footnotes:

1) The citizens that participated in the Dialogues were mainly recruited via randomized phone calls. They were asked to give personal information (e.g. age, gender, education) in order to invite a more heterogeneous group of interested people – even if this goal was not always met. Also, it was possible for interested citizens to apply online for the regional Dialogues. In general, the participants were a selected group of representatives of the cities or the region where the Dialogues took place.

2) For more information see homepage: http://www.demografische-chance.de/index.php?id=252

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Footnotes:

1) For the development of the practices and theories of deliberative democracy, see e.g. Elster (1998)

2) For an overview of those processes, see (Anderson/Shahrokh 2009). For a comparison of the costs of different citizen consultation methods, see (Schlove 2010, p 36). Despite its global scope, World Wide Views is the most cost-effective method, measured by the price of one participating citizen.

3) Whilst World Wide Views is the only initiative that has been implemented in practice, others have been proposed, such as the Deliberative Global Citizens' Assembly (Dryzek/Bächtiger/Milewicz, 2011) and Global Citizens' Juries (Baber/Bartlett, 2009).

4) The method has already been used at the national level for a Danish Debate on the Health Care System in 2011 and for a French National Debate on Energy Transition in 2013. It has been used for municipality-based debates about biodiversity in Ontario, Canada, and it is about to be used, with the support of the European Commission, for a trans-European citizen consultation on sustainable consumption in 2014, as a part of the FP7 PACITA project.

5) Information materials and videos for WWViews on Global Warming are available here: http://globalwarming.wwviews.org/node/253.html. For WWViews on Biodiversity materials, see http://biodiversity.wwviews.org/publications/.

6) For a more detailed description of the method and the rationale behind it, see Bedsted/Klüver (2009), Bedsted/Gram/Klüver (2012), Bedsted (2012), and Agger/Jelsøe/Jæger/Phillips (2012)

7) The World Wide Views Alliance (WWViews Alliance) is a global network of partners, including public councils, parliamentary technology assessment institutions, non-governmental civil-society organizations and universities.

8) http://www.cbd.int/doc/meetings/cop/cop-11/official/cop-11-35-en.pdf (accessed 19/01- 2014)

9) Differences between countries and regions can be examined in detail at http://globalwarming.wwviews.org/node/287.html.

10) Results from participating countries can be compared at http://biodiversity.wwviews.org/ . Also available is the Results Report and a video documentary summarizing the key results.

PART IV – Questions of Sustainability

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Footnotes:

1) The term industrialism indicates that industrial prerogatives are hegemonic in all sectors of social and individual life. Their hegemonic character is revealed inter alia by the fact that the core prerogatives are largely effective unconsciously.

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Footnotes:

1) In this paper, we use the term 'mining' broadly to encompass the extraction of a wide range of metal and mineral resources including iron ore, copper, gold, lead and zinc as well as those resources required to meet our growing energy demands - coal, uranium, oil and gas.

2) Biomining is a new approach to extraction that uses microorganisms to leach mineral resources from ore bodies rather than traditional methods that rely on extreme heat or chemical processes.

3) Social licence to operate broadly refers to the level of ongoing acceptance or approval a community provides to a mining operation.

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Footnotes:

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Footnotes:

1) By including smart meters in the conception of smart grids, we follow a rather generalist view on smart-grid energy systems. With reference to Ramchurn et al. 2012, we consider five components primarily relevant for the research focus presented here: Demand-Side Management, Electric Vehicle Management (EVs), Virtual Power Plants (VPPs), The Emergence of Energy Prosumers and Self-Healing Networks. In technical disciplines, definitions of smart grids are often more narrow, i.e limited to the increase in connectivity between grid levels by information and communication technology, for example.

2) For a recent discussion on "socio-technical systems" in the context of energy transitions, see: Büscher/Schippl 2013.

3) From a sociological perspective, we assume the relevance and impact of trust as a social mechanism in terms of its impact: action. Therefore, we emphasize the consequences of trust in the sense that a certain action (smart-meter usage, market activity) takes place, which provokes further action etc.

4) Expert interviews recently conducted within the Systemic Risk Project have brought about this insight. The degree of consumer autonomy against the probability of decisional delegation towards ICT agents is still an open question, although our initial findings from the German case suggest it is unlikely that it would be massively curtailed. However, since frequent monitoring, decision-making and controlling of electricity matters could easily overtax consumers, there is a chance that these tasks might be shifted to ICT agents for autonomous actions in pre-defined boundaries. Still, even the delegation of decision-making requires a decision and would contribute to an increase in consumer reflexivity on energy issues.

5) For a discussion on smart-meter distrust prior to a mass rollout in the Netherlands see: von Schomberg 2013.

6) For the foundation of this argument in attribution theory, see Malle 1999. In attribution research, we find the distinction of cause attribution (explaining behaviour and its consequences with reference to the situation/circumstance) and reason attribution, explaining behaviour and its consequences with reference to the mental state of a person itself.

7) "In other words, controls must be built into the systems which require trust, and those controls must be made quite explicit in them if they are not organized. Trust in the ability of systems to function includes trust in the ability of their internal controls to function" (Luhmann 1979, 57).

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1) It should be noted that the stakeholder dialogue was finalized before most NREAPs were submitted.

2) www.4biomass.eu

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1) The United Nations Framework Convention on Climate Change (UN 1992, article 2) calls for a ...“stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system […].

2) For further details, see the project homepage: http://www.oui-biomasse.info/en/ (ITAS 2013)

3) As we cannot go into further details within this paper, see the basic literature on methods of future and scenario-analyses for deeper information (cf. i.e. Kosow/Gaßner 2009).

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1) This wider perspective incorporates the classification developed in the context of the British "Sustainable Consumption Roundtable". The "4-E-Model" distinguishes between four categories (SDC/NCC 2006); it is a theoretical framework designed to offer assistance when taking sustainable decisions The model shows the connections between approaches which cause changes in values, prin-ciples and context and those which are aimed at altering behaviour (cf. Reid et. al., 2010, 721).

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3) Considering a sales growth rate of 1 %.
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5) Source: “Mobi-e” in Repositório Científico de Acesso Aberto de Portugal, at 11/Jan/2013 and internet, at 11/Fev/2013.
6) Source: “veículo eléctrico” and “carregamento eléctrico” in Repositório Científico de Acesso Aberto de Portugal, at 11/Jan/2013.
7) Source: “Mobi-e”, “veículo eléctrico” and “carregamento eléctrico” in Repositório Científico de Acesso Aberto de Portugal, at 11/Jan/2013.
8) Fundação para a Ciência e Tecnologia
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1) ERRAC European Rail Research Advisory Council has published a series of important and influential documents, such as the "A Joint Strategy for European Rail Research - Vision 2020" (published in 2001), updated by the "Rail Route 2050" (published in 2011); the SRRA Strategic Rail Research Agenda (published in 2002 and updated in 2007); the ERRAC Roadmaps (2012) on "Greening of Surface Transport", "Encouraging Modal Shift and decongestion of transport corridors", "Ensuring sustainable urban transport", "Improving safety and security", "Strengthening Competition".

2) Siemens has been quite active in producing strategic forecasts and making them available to the public. Since 2001, the Siemens group has been issuing a biannual magazine, "Pictures of the Future", in which it communicates the

results of its internal or external forecasts that steer the firms' technology developments. Siemens' strategic forecasts addressing high-speed trains were released in 2006, 2009 and 2010.

3) Despite the relevant presence of Bombardier in Europe, as a Canadian company, it was not listed as European.

4) For more information see www.iris-rail.org.

5) ERRAC comprises 45 representatives from each of the major European rail research stakeholders: manufacturers, operators, infrastructure managers, European Commission, European Union Member States.

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Footnotes:

1) Such a notion is evidently overly simplified; contingency and heteronomy sets on even at the early stages in the process of production of scientific knowledge and technology. See Knorr Cetina 2003; and, on the biopolitical debate, cf. Rose 2006. For the related debate on human cloning, see Roetz 2006.

2) See Karafyllis 2003

3) Zhang 2012: 105.

4) Related German examples are "Bildung" (combining the meaning of training, education and cultivation) or "Heilkunde" (combining the meaning of knowledge and skill to heal and make healthy), both of which have no direct translation in English. (cf. Unschuld 2010) It requires translational effort beyond lexical translation to convey the grammar and semantic substance. Of course, proper understanding is possible even under such circumstances; however, it depends upon a considered account of the propensity of this process to confuse, distort or blur the meaning.

5) Cf. Vittinghoff 1999, Lackner et.al. 2001, Fan 2007, Xu 2005, Liao 2010, Kurtz 2002.

6) Interestingly, "ethics" is translated as "lunlixue", that is, the study of the proper structure of relations, whereas "morality" is seperated into the moral doctrines, "deyu", and social propriety, "li". The shift in perspective represented in these concepts create opportunities for a systematic application of change-of-perspective methods in generating understanding of the matter and form of ethics. Obviously, the German categorical distinction between moral, legal and ethical approaches provides a different pre-structure, both conceptually and methodologically then the Chinese. It could be a fruitful program to work this out under terms of ethical co-production, instead of dominance, yet without committing relativistic fallacies.

7) Schmook o.J., Schneider 2003.

8) Joy Zhang Yueyue, in her work on "cosmopolitarian" science development in the area of stem cells in China, explains how this relates to the making of regulation in China. She offers an analysis of some fundamental problematic features in the Chinese regulatory approach: in particular, the post-hoc pragmatism (Zhang 2012: 50) and inappropriateness of scientific terms (Zhang 2012: 54), which are recommended for closer scrutiny.

9) Cf. the elaborated argument in Döring 2001a and Döring 2001b.

10) E.g. "What we found in both China and Europe was that over the past decades, countries have been actively building up infrastructures of ethical governance as a means of organizing and ensuring the protection of those human subjects who take part in medical research as donors, participants or scientists involved in challenging innovative research. And, in both areas, questions of harmonization and standardization have been among the most challenging. Different, however, were the particular configurations within these systems; differences, which could be traced out within what we came to think of as 'spheres' or 'layers' of ethical governance. Each layer or sphere, and the various ways in which they overlap and interact, forms a part of ethical governance systems or regimes. As such, if we are to understand the specific ethical challenges that arise out of trans-national and cross-cultural biomedical research collaborations, then we must have a clear understanding of what each participating scientist/institution 'brings' to a collaboration." (Wahlberg et al. 2013)

11) The story of cross-cultural bioethics is laden with cases of evasion or ignorance of this fundamental step. Cf. Döring 2006 and 2009.

12) Zhang 2012.

13) Refer to Hennig 2006 and 2009

14) Armin Grunwald has recently identified this as an emerging field to study in the area of technology assessment. Cf. Grunwald 2012: 277.

Why Autonomous Unmanned Aerial Vehicles Will Lose the War, p. 337.

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Footnotes:

1) Asimov wrote in his short story "Runaround" (1942): "A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law. 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws." (Asimov 1950)

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2) This contribution is an abridged and focused version of an article the authors wrote for Science and Public Policy, appeared in issue 6/2013. For further references see that article.

3) Judgment of the First Senate from 15 December 1983, 1 BvR 209/83 et al. – Population Census, BVerfGE 65, 1.

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1) www.alexa.com/topsites, accessed October 10, 213

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Privacy by Design for a Mobile Retina Scanner, p. 365.

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Footnotes:

1) MARS is a civil security research project funded by the German Federal Ministry for Education and Research. The project runs from 01/2012 until 12/2014 and is being investigated by an interdisciplinary team of 11 partners from a variety of different scientific backgrounds – including social sciences, law, medicine and engineering – and from the business sector (banks and security-service providers).

2) The decisions as to centralized versus decentralized data storing, the amount of data processing and how much data will be exchanged (more or less high-resolution scan images) as matching samples all impact the level of privacy invasiveness of the technology, especially from a legal perspective.

3) Whereas consent in an employer-employee relationship is not explicitly prohibited in German data protection law (e.g. BDSG, article 4a), the GDPR formulates that "[c]onsent should not provide a valid legal ground for the processing of personal data, […] where personal data are processed by the employer in the employment context" (e.g. GDPR art. 7, paragraph 4, Recital 34).

4) The European Parliament is still negotiating the General Data Protection Regulation, which was proposed by the EU Commission in January 2012. Although the Albrecht-Report (e.g. draft report of the rapporteur for the Civil Liberties, Justice and Home Affairs (LIBE) Committee of the European Parliament, Jan Philipp Albrecht) confirmed the aforementioned articles, it is not yet quite certain if, when and how the GDPR will pass.

5) Though not yet being conducted, focus groups in which civil society is confronted with the retina scanner technology are planned for a later stage of the MARS project.

6) Users react very negatively towards false rejection. However, the FRR requires a certain balancing act with the false acceptance rate (FAR), i.e. the error rate of taking an impostor as genuine (Xin et al. 2012, p. 6257). In that context, user-friendliness and security are indeed in a trade-off relationship, which is measured by the equal error rate (EER), revealing the overall biometric system performance (ibid.). From a professional banking point of view, biometric authentication procedures should have a FFR of less than 1 %, and a FAR of less than 0.01 % (e.g. Thiel 2002, p. 318).

7) With respect to ease and joy of use, Ashbourn (2000) devotes an entire chapter to "The intuitive GUI" (graphical user interface).

8) With the recently introduced fingerprint reader integrated into the new iPhone 5s, the Chaos Computer Club (a German association of hackers) showed only a few days after the release that a "fingerprint of the phone user, photographed from a glass surface, was enough to create a fake finger that could unlock an iPhone 5s secured with TouchID" (Rieger 2013). Often confused with a retina scan, an iris recognition system (IRS) draws on biometric identification features of the thin, circular structure in the eye, visible from outside. Ten years ago, the German computer magazine c't demonstrated that a high-resolution colour picture of the user's iris could compromise an IRS (Wilkens 2002). Only recently, researchers found a way to reverse-engineer "iris codes to create synthetic eye images that tricked an iris-recognition system into thinking they were authentic" (e.g. Zetter 2012).

Afterword

Technology Assessment and Parliament – the Indispensible Link, p. 373.

1) The word 'oversight' in English has two distinct, and indeed to some extent contradictory, meanings. The first refers to accidentally failing to notice, or to account for, something – thereby committing 'an oversight'. The second meaning is the careful scrutiny of something – to 'exercise oversight'. I am using the word in the first sense here.

ANNEX

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Acronyms

AAL – Autonomous and Ambient Assisted Living
ACs – Alzheimer Cafes
AD – Alzheimer's Disease
BWC – Biological Weapons Convention
CC – Citizens Consultation
CDFT – Citizens Dialogues on Future Technologies
CE – Conformité Européenne
CED – Cumulative Energy Demand
CEO – Chief Executive Officer
CR – Czech Republic
CSO – Civil Society Organisations
CT – Computed Tomography
CTA – Constructive Technology Assessment
CTMM – Dutch Centre for Translational Molecular Medicine
DBS – Deep Brain Stimulation
E3LSA – Economic, Environmental, Ethical, Legal and Social Aspects
EC – European Commission
ECHA – European Chemical Agency
EEG – Electroencephalography
EIA – Environmental Impact Assessment
ELSA – Ethical, Legal and Social Aspects
ELSI – Ethical, Legal and Social Implications
EPTA – European Parliamentary TA Network
ERA – European Research Area
ERRAC – European Rail Research Advisory Council
ETAG – European Technology Assessment Group
EU – European Union
FP7 – EU's 7th Framework Programme
GA – Global Assessment
GDP – Gross Domestic Product
GEMs – Genetically Engineered Microorganisms
GHG – Green-House Gas
GPS – Global Positioning System
GT – Great Transition
GWP – Global Warming Potential
HTA – Health Technology Assessment
ICT – Information and Communication Technologies
IISA – Integrated Inter-Systems Assessment
INAHTA – International Network of Agencies for Health Technology Assessment
IPBES – Intergovernmental Platform on Biodiversity and Ecosystem Services
IPTS – Institute for Prospective Technology Studies (EU)

ISD – Informational Self-Determination
IT – Information Technology
LeARN – Leiden Alzheimer Research Netherlands
MARS – Mobile Authentication via Retina Scanner
MDD – Medical Devices Directive
MP – Member of Parliament
MRI – Magnetic Resonance Imaging
MTA – Medical Technology Assessment
MWCNT – Multi-Walled Carbon Nanotubes
nBAP – National Biomass Action Plan
NGO – Non-Governmental Organization
NHS – National Health Service
NPP – Nuclear Power Plant
nREAP – National Renewable Energy Action Plan
NWO – Dutch Research Council
OECD – Organisation for Economic Co-operation and Development
OTA – Office of Technology Assessment (US)
PACITA – Parliaments and Civil Society in Technology Assessment
PET – Positron Emission Tomography
PETs – Privacy-Enhancing Technologies
PNPP – Polish Nuclear Power Programme
POST – Parliamentary Office of Science and Technology (at the UK Parliament)
PSP – Project-Shaped Participation
PTA – Parliamentary Technology Assessment
pTA – Participatory Technology Assessment
R&D – Research and Development
RDI – Research, Development and Innovation
REACH – Registration, Evaluation, Authorization and Restriction of Chemicals
RES – Renewable Energy Sources
RGO – Dutch Health Council
RTDI – Research, Technology Development and Innovation
S3 – Smart Specialization Strategy
SET – Strategy Energy Technology
SMEs – Small and Medium-Sized Enterprises
SNS – Social Network Sites
SSH – Socio-Economic, Sciences and Humanities
STI – Science, Technology and Innovation
STiPS – Program for Education and Research on Science and Technology in the Public Sphere
STOA – Scientific and Technological Options Assessment (at the EU Parliament)
STS – Science, Technology and Society
SWOT – Strengths, Weaknesses, Opportunities, and Threats
TA – Technology Assessment
TMS – Transcranial Magnetic Stimulation
UAV – Unmanned Aerial Vehicle
UNCED – United Nations Conference on Environment and Development
UNIFE – European Rail Industry Association
URR – Upper Rhine Region

Figures

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PACITA

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ITAS Institute for Technology Assessment and Systems Analysis