Co-inventing innovation:

Comments on the convergence of knowledge and politics

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Abstract

In this article we explore conditions for gender mainstreaming innovation in different policy contexts, Nordic as well as African. We contend that the ability to open up and question the validity of our own scientific-institutional taken-for-granted assumptions and routines is vital for walking the talk of gender mainstreaming as well as addressing grand challenges through innovation. The aim of our explorations is to contribute to the practice of "becoming answerable for what we learn how to see" (Haraway, 1991).

Introduction

At this day and age – following mounting environmental and poverty crises – there is more unease with presenting research and technology as the solution than in the mid-1990s. What is moving up the political agenda and emphasized as key, when it comes to addressing grand and global challenges is innovation.[2] We are

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[2] A possible exemption here might be NordForsk which still seems optimistic about research providing solutions to grand and global challenges: http://nordforsk00.fe.rzob.gocept.net/files/a-nordic-contribution-to-the-grand-challenges-debate

referring both to the European Commission's *Innovation Union 2020*[3] and *The OECD Innovation Strategy*[4] as well as innovation policies in a number of developing countries in Africa and Latin America. Innovation policies are accentuated as of crucial importance for emerging from the current crises by turning "challenges to opportunities" (COM (2011) 48). A systemic approach to innovation is stressed both in the recent innovation strategy from OECD as well as in the "Innovation Union" communications from the European Commission. A broad-based approach to innovation is recommended that takes account of the many factors and actors that influence innovation performance, including demand-side policies. This message is not new to a Nordic audience,[5] and the struggle to move beyond supply-side policies focused on R&D and specific technologies has been on the agenda for quite some time[6]. The limitations of a thematic technology push approach in achieving the necessary flexibility, creativity and cross-disciplinary research needed to address societal challenges like energy, health and food security, climate change are noted by most policy makers in the Nordic countries.[7]

A systems and network approach to innovation is near to hegemonic in innovation research as well as in policy making these days. This entails a valuable focus on how science[8] and technology are accessed, distributed and used. At the same time, a certain black-boxing of the knowledge-processes often comes with a systemic approach to innovation.[9] We argue in this article that if innovation policies in the future shall enable us to "walk the talk" of addressing grand/global challenges, it is vital that the policies also focus, explore and promote change

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3 http://ec.europa.eu/research/innovation-union/index_en.cfm; the so-called "Lund declaration" also deserves mentioning.

4 http://www.oecd.org/pages/0,3417,en_41462537_41454856_1_1_1_1_1,00.html

5 As evidenced by OECD's director for Science, Technology and Industry (STI) Andy Wyckoff's response to a question about what was new in the OECD strategy at a seminar in the Research Council of Norway: "But this is not for you guys" (2011 01 24).

6 See e.g Miettinen 2002, Lundvall 2002

7 Reference to white papers on research and innovation in Nordic countries, e.g. two white papers from Norwegian government; Et nyskapende og bærekraftig Norge (2008), Klima for forskning 2009 (a systemic approach explicitly outlined in ch 9), Sverige??, as well as *Proposals for Finland's National Innovation Strategy* (2008)

8 By 'science' we not only refer to natural sciences (anglo-saxon usage), but social sciences and the humanities as well (wissenshaft as well as vetenskap)

9 In policy-contexts OECD's Technology/Economy Programme (TEP) is often referred to as influential in developing and spreading a systems and network approach to innovation policy. See e.g the synthesis report *Technology and the Economy; The Key Relationships* (OECD 1992). How science and technology develop in the "context of production" is not on the agenda. For a discussion of the concept of "context of production" as emerging in feminist research, see Gulbrandsen (2003).

concerning how science and technology *develop* and is *validated*. This contention draws on our engagements with mainstreaming gender at the turn of the century and is later encouraged through resources we have consulted; mainly in the form of science and technology studies but also increasingly policy studies.[10]Our ambition is to explore whether these resources can help promoting gender mainstreaming in innovation as well as in technoscience[11], our own disciplinary situation. To this end we start by revisiting some of the lessons from our engagements with gender mainstreaming in Nordic and European research and policy contexts in the decade before the turn of the century.[12]

Gender mainstreaming in hindsight

Engaging with gender mainstreaming more than a decade ago confronted us with quite provocating and disturbing questions. The trying transformations we were involved in suggested that we needed to question preconceived perceptions of science, of policies and politics, as well as develop new figurations (Haraway 1997) of these rather basic concepts. While producing input for policy-making at the turn of the century, building on an established knowledge base produced by Nordic gender research, we felt condemned to always running late while pointing to flaws, biases, barriers as well as bad baseline statistics. These are necessary dimensions of a knowledge base for working equality. But we started to suspect that they function best as background for appealing to the state to devise and implement affirmative actions (measures to compensate for flaws and overcome barriers). We concluded that the knowledge base needed to be supplemented, when developing policies at the level of mainstreaming aiming at structural and cultural transformations of our research and innovation systems.

To illustrate this further, we referred to the so-called ETAN-report; *Promoting excellence through mainstreaming gender equality* from the Commission (2000), and its listing of principles of mainstreaming. Principle number five, visioning, is explained as gendering apparent gender neutral procedures and practices: “It

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[10] For an inspiring effort to bring together policy studies and science and technology studies in an exploration of different modes of governance of relevance to societally robust innovation, see Voß, J.-P., Bauknecht, D., and Kemp, R. (eds.) (2006)

[11] Technoscience designates number of fields where it no longer makes sense to try to distinguish between pure and applied science or between science and technology.

[12] Our most important policy engagements are documented in *Gender & Research*, EC (2002) as well as reports from the Swedish Committee for Co-operation of eight Research Councils (*Samverkansgruppen*) (2000)

involves recognizing the ways in which our current systems and structures, policies and programmes, in effect, discriminate" (page 67). Our trying transformations in Nordic policy contexts suggested that we needed to extend this principle to include visioning future solutions not only patterns of past and present gender segregation and discrimination. We began to question whether the scientific commitment to systematic, causal descriptions of gender differences and inequalities, served our transformative ambitions and struggles as well as we wished to believe.[13]

When working to mainstream gender, we ought to be able to discuss and suggest in fairly great detail, what kind of innovation system we want to be equal to. In order to mobilize for, develop and evaluate strategies at the level of mainstreaming, we need to focus more strongly on where we are heading. We ought to be up front facilitating and fostering alternatives, new figures, stories and meanings as well as developing strategies for struggling towards them. It was not enough to point to what we want freedom *from*.

When questioning what we want to be equal to, we are also invited to consider many other broad questions, besides horizontal and vertical gender segregation, confronting and troubling our innovation systems at present. What will it mean to work in a mainstreamed innovation system? In her book *Mainstreaming Equality in the European Union* (1998), Teresa Rees points out how we are still stuck with mostly negative definitions of mainstreaming. To paraphrase Donna Haraway; we need to develop performative images of mainstreaming that can be inhabited (Haraway, 1997).

A central tool of mainstreaming – and its demands

Building ownership is a central tool for mainstreaming, and the knowledge base for mainstreaming gender must be supported by skills and competencies for opening up, in order to let new voices and alternatives flourish. Ready-made solutions need to be replaced by processes co-visioning future solutions by dominant and marginalized voices together. This may be difficult, if the problems (and most of the power to deal with them) are represented as being localized "out

[13] See Rosanne Stone's *The War of Desire and Technology at the Close of the Mechanical Age*, page 173. Reference also to Genevieve Lloyd's *The Man of Reason* as well as an emerging tradition in organizational theory exemplified by the practice and texts of Gro Johnsrud Langslet

there" belonging to the structures or to the GOBSAT[14]. To be better equipped to deal with co-visioning solutions, we, who are involved in innovation, must strive to develop a readiness to think and feel ourselves as part of the problems, and learn how to use our sense of implications as resources for our transformative projects. We have to experiment with forms and organizations, meeting places or arenas allowing us to learn from our failures as well as from our successes. In the 1970s, the slogan was "you're either part of the solution or the problem". In order to become part of the solutions for the future, we have to reinvent ourselves as part of the problems.[15] As the strength of Donna Haraway's figurations rests on this move from either/or to both-and, we continue to refer to her work. Also, as demonstrated in Carol Bacchi's *Women, Policy and Politics; The Construction of Policy Problems* from 1999, a constructivist approach to research and policy-making is also worth consulting when negotiating to make an impact. In a discussion on the role of gender expertise in equality work, Liisa Husu includes as the third and last point "… the ability to translate this theoretical understanding into organizational policy and practice." (Husu, 2001, p 182). A constructivist approach invites a much more intense and reciprocal dialogue between researchers and policy-makers right from the start, which we find is indispensable when co-visioning is on the agenda.

If we are to win change, it is not enough, as e.g Hilary Rose claims, to focus on improving the statistical data and on improving explanations (Rose 1999). By our continued invitations to gender researchers and policy-makers to a new arena for co-visioning, we unwittingly came to question a fairly established, but silent, contract between them. According to contract it is expected that researchers work up the knowledge for delivery to policy-makers, who then, in turn, work out the policies. In return, the researchers expect "policy for science". We have suggested that we name this kind of contract "state-feminism" (Gulbrandsen 1998) designating a fairly widespread way to think about the relationship and the division of labor between research and policy/politics – not just pertaining to gender research. In fact, it is so common that it has been called "the Nordic way of governance" (Eide 1996). We like to underline that this is not a bad contract. It has been highly effective when affirmative action is on the agenda, but it is not sufficient for mainstreaming.

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[14] Reading; Good Old Boys Sitting At the Table

[15] As developed in Trojer and Gulbrandsen (1996)

New contracts, skills and directions

As technoscientists we cannot fulfill the contract of "statefeminsm". We have no recluse to an innocent position, that allow us to produce new maps while "reading" nature and/or society. We are "writing" nature as well. This becomes very evident in fields like nanotechnology and synthetic biology. Technoscientists cannot claim that they are "speaking truth to power" from a neutral, objective position. As the weft of technoscience increases in everything that surrounds us, what becomes more important is developing the capacity and skills needed for relating to the invasive effects of our research, which cannot be contained within any kind of knowledge reservoir.[16] This emerging contract of co-production[17] of "science and society" not only disturbs professional identities,[18] it also entails questioning the traditional dichotomy between "theory" and "practice" as witnessed by the proliferation of reference to action learning and even action research in the literature.[19]

Being involved in more horizontal partnerships for learning, development and innovation still seems quite challenging for expert systems in general, and perhaps especially so for academia, which have to shed its cloak of assumed neutrality and objectivity and create for itself a role as a societal actor. This challenge is partly a consequence of research's growing impact and "success". Research is increasingly involved in every aspect of life, *including* what is represented as grand and global challenges these days. There can be no doubt that research plays a crucial role in the development of innovation, industry and commerce, it affects our decision-making processes, it colors our culture and the development of society. However, research and technology not only have an integrating effect on the development of society, society also influences the processes of developing research and technology. Focusing on "society in science" will thus be at least as important as "science in society".[20]

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16 Reference to Sheila Jasanoff and Sang-Huyn Kim's article "Containing the Atom" (2009) and Allenby and Sarewitz' "We've made a world we cannot control" *New Scientist* (2011) as well as the often cited and report from Vannevar Bush; Science the Endless Frontier (1945)

17 Many scholars have proposed figures of science-society interactions that direct our attention to the many processes involved in the co-production of scientific knowledge and the political order. See Gibbons et al (1994) and Nowotny et al (2001) for an introduction to these discussions. It has been suggested that 'contract' is not an apt way of figuring this move from separation to integration, see e.g David Guston's discussions.in "Boundary Organizations in Environmental Policy and Science, *Science, Technology & Human Values* 26(4)

18 A described e.g in Rune Nydal Ph D thesis (2005) concerning the initiation of the large-scale biotechnology programme FUGE in The Research Council of Norway.

19 This is a central discussion theme in Nordic feminist research as well, e.g Ewa Gunnarsson's "Other Sides of the Coin" International Journal of Action research (2007)

20 "Science in society" has been a catch word for science-society activities of EC during FP7. Lately we have seen how the focus is broadening to include struggles coming to grips also with "society in science" e.g the expert-reports by Felt (2007) and Markus (2009).

As technoscientists we are intimately implicated in the grand and global challenges. The societal challenges can therefore be addressed as not only residing "out there", but "in here" as well; as if research and innovation was in crises itself. As there are glimpses of this understanding in the mentioned OECD-strategy and in the recent communications from the Commission[21], we are encouraged to keep on struggling with this shift and the required re-learning. From time to time we find great comfort in re-reading Jane Flax' inspiring feminist text "The End of Innocence"(1992) concerning the anxieties involved in such trying transformations without closure in sight. And we are inspireded by the exploration of new roles for scientists as e.g figured by the concept of 'citizen scientist".

citizen scientists

Helga Nowotny, a central figure in European research policy and the former head of the European Research Advisory Board (EURAB), has for some time been calling for a renewal of the contract between science and society, promoting a greater degree of reciprocity in the relationship. She is arguing that a renewed partnership presupposes more transparency concerning the processes involved in research and technology. Nowotny contends that the research system needs to be opened up, and she believes it is particularly important to be able to communicate "uncertainties, contradictions and contingencies" – everything that cannot be assured as "scientifically" proven and which therefore turns the spotlight on the idea of science and technology as based on neutral and to a certain extent "objective" knowledge processes. "A new kind of more mature partnership" needs to be developed, Nowotny claims, and this can only be achieved if the processes whereby research and technology are developed, are opened up:

> "Science can no longer expect unconditional support on the part of society for whatever it wants to do, nor unconditional acceptance of its authority. Society will have to become more involved in understanding better *how research actually functions* and why it is important". (Nowotny, 2005)

The same tendency is also evident in the United Kingdom, one of the leading countries in Europe in terms of development of the dialogue and new contract between research and society. Here, focus is increasingly on the actual process of developing research and technology. This shift is described as "upstream", and

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21 See the strong statements in the "science and society" stream of expert group reports from the Commission 1995-2009.

Wilsdon et al (2005) positions the challenges thus in *The Public Value of Science* (2005):

> "Those who see upstream engagement as a means of providing earlier and better predictions of risks and impacts are missing the point. It is not a matter of asking people, with whatever limited information they have at their disposal, to say what they think the effects of ill-defined innovations might be. Rather, it is about moving away from models of prediction and control, which are in any case likely to be flummoxed by the unpredictability of innovation, towards a richer public discussion about the visions, ends and purposes of science. The aim is to *broaden* the kinds of social influence that shape science and technology, and hold them to account". (p 34)

"Upstream engagement" refers primarily to the reflexivity of research and technology systems, according to Brian Wynne. The requirements that knowledge must be reflexive and societally robust will only continue to grow in the years to come.[22] The conditions necessary to create a constructive dialogue with society seem to be rooted in the increased ability of the research system to open up and admit the limits of its knowledge. This is necessary in order for research to be able to invite collaboration with other social institutions. The same demand to be able to open up and acknowledge one's limits also applies to interdisciplinary work. One of the main challenges facing efforts to nurture interaction between research and society relates to inviting other parties to participate in dialogue in ways that make it possible and interesting for them to be involved and engaged. This requires what a recent report from the EC (Markus, 2009) calls the development of "further skills" by researchers, as they must be able to explicate their premises, conditions of validity, uncertainties, areas of ignorance, values and conditions of applicability to certain contexts. Because "Involving publics …, can be more productive if not only the knowledge at the object level is presented and discussed, but also the related meta knowledge."(p 14-15) Developing the dialogue with society thus requires major changes in expert systems in general and the research system in particular. One of the challenges lies in "bringing out the citizen in the researcher". Wynne (in the preface to Weldon, 2004) points out that this kind of understanding is just hatching:

> "The only recently recognised challenges of two-way understanding between science and its publics, replacing one way understanding of science, are in their very earliest days. This is emphatically a long haul, of nurturing not merely policy shifts, but *profound cultural change* in such science fields, their policy and technological uses, and the assumption underpinning them….The bottom line issue in the new climate of "public engagement" is not just seeking earnestly for 'public inputs' – preferences, values or knowledge. It is being encouraged, by

22 There is increasing pressure (as articulated by OECD, EC as well as the president of US) on science and technology to address the grand and sometimes global challenges of our times – the 2009 Lund Declaration is just one example.

> public dialogues and questions among other things, to question the validity of our own scientific-institutional taken-for-granted assumptions and routines". (p. I)

If research has an impact on society and interacts with other stakeholders in ways that are not linear, it becomes necessary to address the legitimacy and responsibilities of research on a broader basis than merely through reference to the fact that public research grants are used and distributed by institutions and allocation mechanisms that follow strict internal quality requirements and professional norms. Helga Nowotny et al (2001) stress that the dialogue with society must necessarily be an ongoing process:

> "That the authority of science in the future will have to be established in an ongoing process that needs to be worked out again and again in each concrete situation is the meaning of the somewhat aphoristic title of this final chapter of the book, that re-thinking science is not science re-thought". (p. 249)

societally robust innovations

As we have indicated, the realization that complexity and dynamics characterizes innovation systems, is fairly widespread in policy these days perhaps even more so than in the research community. Such systems demand new approaches to governance in order to ensure a societally robust impact (Arne Eriksson, 2005 Nowotny et al, 2001). Climate, energy, poverty and food security are examples of challenges that are of a "systemic" kind; they extend across established sectors, institutions, professions, expertise and disciplines. They are also full of so-called wicked problems; problems that are difficult or impossible to solve because of incomplete, contradictory, and changing requirements often difficult to recognize. Moreover, because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems. These grand challenges themselves as well as adequate solutions must therefore be identified in distributed processes and dialogues in-between different actors. Catch words like networking logic and – organization, partnership development, learning, and open innovation points to new understandings of governance issues. The exploration of more experimental approaches in research like post normal science, strategic research, triple helix, mode 2 and agora, can be seen as a parallel based on acknowledging how important it is to get a grip on how research processes can be developed as productive interactions in-between 'science and society'.

In contexts of scares resources the quality issues in Science, Technology and Innovation (STI) get explicit and easy to understand in e.g. research linked income generating activities and solutions encountering fundamental needs for people and society like energy, food, water and communication possibilities. The robustness can be recognized on the ground by the stakeholders and people

involved. Knowledge in this context corresponds to concrete relevance, results and sustainability. While knowledge in a Nordic, academic context corresponds more likely to peer reviewed publications and later e.g. proofs of concept to be piloted[23].

In a recent paper exploring new ways of linking science and innovation to development for a more sustainable, equitable and resilient future, Melissa Leach and Linda Waldman, discuss the assumptions that underpin the establishment of knowledge institutions like centres of excellence within Africa (Leach & Waldman, 2009). They suggest that an alternative image to that of centers is networks; networks that connect people and groups, often across diverse places and around issues of concern. Networks emerge as central ways in which otherwise marginalized people mobilize around the politics of knowledge, in arenas from agricultural biotechnology to global health, seeking to solve local problems in alliance with scientists: "In such networked movements, scientists and citizens, official and local experts, and producers and users of technologies often interact in sometimes unexpected, yet often highly productive, ways. Might 'learning networks' or 'learning alliances' offer valuable alternatives or complements to a knowledge production via 'centres of excellence model' ", Leach and Waldman ask.

Their discussions correspond well with what we are learning at Blekinge Institute of Technology being involved in cooperation concerning development of innovation systems and clusters in East Africa since 2004. In Zanzibar, the tourist paradise in the Indian Ocean just outside the mainland of Tanzania, researchers at the Institute of Marine Science[24] collaborate with other inhabitants, mostly women, in villages along the coast line of the island. They join in evolving the production of seaweed, in innovative development of seaweed species, production technologies, environment considerations, different seaweed products etcetera. Linked to these activities is a complex work of building conditions like attaching the local and regional government as active stakeholders, fund raising, building infrastructure (like connecting electricity), quality control of products, training, transports, marketing, management as well as care of different kind for the families concerned like conditions for education and health, day care for the youngest children. The processes involved refer to triple helix processes (Etzkowitz & Leydesdorff, 1997), which are situated in the program frame called Innovation Systems and Clusters Program – East Africa[25]. The triple helix stakeholder of University in this seaweed cluster holds the role of cluster mobilizing actor, facilitator, knowledge and innovation co-producer, technology co-developer as well as legitimate negotiator for funding. The role of Government is to involve Ministries of Agriculture, Fisheries, Trade, Women in leadership

23 For an elaborated discussion see "Normative machineries at work" in chapter IV (Ulrike Felt, 2009).

24 IMS belongs to University of Dar es Salaam, Tanzania. Dr Flower E. Msuya is the over all facilitator.

25 ISCP-EA, see //si4cd.wordpress.com/background/

groups and task forces, helping cluster groups financially and participating in village leadership of cluster activities. The Business sector includes farmers (core), buyers (participating in cluster activities, teaching how to make value-added products, purchasing seaweed) and middlemen (sales). The learning processes at all levels are substantial and involves today thousands of persons. The exact figure is hard to give as the network of people involved is steadily growing[26]. The challenges in this kind of co-evolution activities are numerous but can be summarized in the understanding and practice of collaboration and competition.

We like to leave a note here concerning the prominent place that the challenges of *implementation* of policies take in policy literature in Europe and the U.S. This focus seems irrelevant in contexts where the different actors/stakeholders are involved in modulating ongoing processes like the ones described here.[27]

Another indication that co-evolutionary and networking models are gaining ground out of Africa can be found in the changes now pertaining to so-called ELSI-research (Ethical, Legal, Societal Implications of new and emerging technologies). In the second phase of ELSI-research - now being developed in US, UK, Canada, the Netherlands and Norway[28] – ELSI is challenged to integrate its activities into technoscience, not to function as a way of outsourcing such concerns from the technological development processes ”proper”. Experimentation and the challenge for research processes to take on the shape of learning processes seems to be the order of the day as developed e.g. in Erik Fisher et al's ”Midstream Modulation” (2006), NWO's programme Responsible Innovation (2008). In parallel to this, the Netherlands, UK as well as the Nordic countries, have put much effort into inviting 'society' to speak back to 'science', of experimenting with different types of stakeholder involvement in order to establish the much sought for two-way dialogues and the productive interactions between science and society. The re-thinking of stakeholder involvement that we have referred in EC and UK, point out how the infamous 'deficit model' is simultaneously laid to rest and resurrected in these experiment. And they point towards a lesson; there seems to be a continuing failure of scientific and policy institutions to place their own science-policy institutional culture into the frame of dialogue, as a possible contributory element that hinders a genuine two-way dialogue. As Brian Wynne puts it; we are 'hitting the notes, but missing the music' failing to acknowledge the deeper challenges of opening up our

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[26] In 2010 more than six villages were active in the seaweed production and that is only at the producer level.

[27] Reference also to Arie Rip's discussion of the difference between "governance of" and "governance in" innovation systems (2006)

[28] Link to the Research Council of Norway's ELSA Work programme: www.rcn.no/ELSA

institutions and assumptions to critical debate. The reflexive capacity to acknowledge that one's framing of a problem is positioned and partial, and thus open to challenge from other perspectives, needs to be enhanced as well as assessed as a vital marker of scientific excellence.

co-evolutionary approaches

The weft of science increases in everything that surrounds us and it is at the same time possible to ask: What is progress these days? And how to measure it?[29] Increasingly open systems for knowledge production require a focus on the direct reality-producing effects of research – its "context of implication" (Nowotny et al, 2001). According to Donna Haraway there is neither time nor space to develop research's relations with society "… after all the serious epistemological action is over" (1997, p 68). Neither sustainability nor other values that we would like to live by, can be secured retrospectively. It is these features of the development that made Ulrich Beck query whether representative democracy is collapsing through the emergence of the modern research complex: "Politics breaks out in a new and different way, beyond the reach of formal responsibilities and hierarchies. So we are looking for politics in the wrong place, with the wrong concepts, on the wrong floors, on the wrong pages of the daily newspapers" (Beck, 1996, p. 24). We want to position our ambitions to promote more complex and integrated understandings of the relationship between research, technology and society, in this grey area that Nowotny et al (2001) ascribe to a dedifferentiation of the societal spheres of modernity.

The boundaries between politics and research are not straightforward and clear in a society that increasingly depends on research and knowledge. As we have already indicated, it is even claimed that research and society are co-produced or co-evolve[30], which is a long way from the simple, linear understanding of this relationship that has dominated research policy hitherto. We can no longer take the reservoir-model[31] for given, trusting that somebody else takes care of the societal implications while tapping out research results we as researchers have already supplied.[32] Research is no longer merely a means to realise goals in other policy sectors; research is becoming a policy sector in its own right. And as we have stressed repeatedly throughout this paper: It is in the fields of technoscience (information and communication technology, bio- and gene technology, material

29 Reference to e.g. OECD's Global Project on Measuring the Progress of Societies.

30 Reference back to footnote 17

31 Reference back to footnote 10

32 In January 2010 the Norwegian Minister for Research and Higher Education, Tora Aasland, while addressing the Norwegian Parliament, pointed out that the reservoir model is not the only relevant model .

technology and now neurotechnology) that scientists are most clearly pushing the boundaries – as well as the division of labour - between science and society, research and politics, thereby illuminating the obsolescence of linear figurations of this relationship (Gulbrandsen, 2004).

'Innovation system' was one of the first concepts put forward as an interactive alternative to the linear model in policy making contexts. Strategic research, post-normal science, triple helix, mode 2 and agora are other examples. The term innovation system is in widespread use in the Nordic countries. Finland is usually held up as the paradigmatic case for the concept 'national innovation system' (NIS). Reijo Miettinen's analysis of how the NIS developed in Finland can also be called paradigmatic because of his focus on the role of the NIS as a mobilising metaphor (Miettinen, 2002). Miettinen talks about a double development in that NIS has become both a scientific term and a political term. He introduces and develops: "…an epistemology of transdiscursive terms that are simultaneously and interactively used both by scientific communities and in policymaking" (p 17). We believe that this is a perspective that can provide our transformatory efforts with better tools to process changes in the relationship between research and society or science and politics, as well as help produce more substantial, complex and integrated understandings and images of this relationship. By exploring other figurations like mode 2, the agora, post-normal science and technoscience as transdiscursive terms, we might be able to improve our understanding of the convergence between research questions and policy questions.

Miettinen discusses the extent to which Nordic social democracy and its political culture predestines political decision-makers and researchers alike to apply technocratic and pseudoscientific interpretations of the concept of NIS. However, it does not have to be so. Miettinen argues for a more modest way of relating by emphasising reflexivity, learning processes and contextual knowledge production. This is an echo of Haraway's situated knowledges (1997) and Jasanoff's technologies of humility (2003); rather than seeking mastery and control, we should focus on collaboration with ambitions of developing modulations in the diminishing gap between variation and selection or between promotion and control/regulation (Rip, 2002a). This corresponds well with recent discussions in policy studies concerning how a "governance by design" mode of working needs to be supplemented by a "governance through dynamics" approach[33].

33 For an introduction to such discussions see Voß, J.-P. (2007): Designs on governance. Development of policy instruments and dynamics in governance.

reinventing innovation[34]

Even if the call for co-evolutionary approaches to STI is often heard, it seems hard to realise in practice and as culture. How to walk the talk? The so-called "regime of collective experimentation" suggested in an EC-report from an expert group on science and governance [35] is a recent articulation of this challenge. How to identify potentials for, how to design instruments for, how to promote, manage and evaluate productive interactions between "science and society" or between science, technology and the market? The report collects examples featuring the recent shift from the idea of centralized organization of innovation to explicit recognition of the importance of distributed and more diverse innovation. Referring to John Dewey's conception of policy as collective experimentation, the authors contend that: "… the experimentation is now at the technological level as well"(p 26). This move is inspired by experiments with "open innovation" in the business sector, and connects to the range of suggestive figures from the history of science policy already mentioned such as mandated science, strategic science, triple helix, mode 2, post-normal science, agora. Still, it seems hard for science as well as for policy organisations to see themselves as involved in governance through dynamics, to figure themselves as societal actors in more horizontal partnerships, as key players amongst other key players. How come?

We find encouragement to keep on posing this question in recent literature underlining that the challenges to research and to policy may be quite parallel – e.g. the way Marie Celine Loibl puts it in her contribution to *Reflexive Governance for Sustainable Development* (Voß et al, 2006): "… there (are) striking similarities between steering problems in society and steering problems in complex research settings" (p. 298). And hearing e.g. nanoscientists discussing their knowledge processes today, we are struck by the similarity to discussions raised in *Reflexive Governance* following the acknowledgment of "unintended consequences"; stressing complexity, dynamics, unpredictability, context dependency and so on. Loibl also draws attention to the importance of transforming the actors' tacit knowledge and hidden "driving" forces to what she calls "manifest contributions to the joint … process". Or as professor in the History of Consciousness at University of California, Santa Cruz, Donna Haraway puts it; how to become responsible for what we learn how to see?[36]

Figurations associating co-production of science and society indicate that such intimate interaction between science and society can further more societally robust science and technology. We must strive to open up a "reflective

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[34] For an excellent introduction to the theme of reinventing innovation, see Rip, Callon, Joly (2010)

[35] Felt (2007).

[36] We read this as a core theme in Haraway's "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century" reprinted in Simians, Cyborgs, and Women: The Reinvention of Nature (1991).

conversation with the situation" as Donald Schön phrased it in his influential work *The Reflective Practicioner: How Professionals Think in Action* (1983). This argument may still be felt to be provocating in some corners of research. How far into research will the arena for co-production extend? And what will the interaction be concerned with? Quality, relevance or both? To develop a role as co-player seems to be dependent on a mode of humility and acknowledgement of limits in singular positionalities, that can be hard to find. (Jasanoff, 2003, Felt, 2007) It might even be felt to be "contraintuitive" for researchers to move away from a "mastery and control" mode in order to ask for help and to open up for input from and collaboration with others.

challenging research quality and innovation

Interactive policy models entail changes in the concept of quality. Contributing to productive collaboration and co-production between science and society, becomes an important mark of quality:

> "Recent discussions of Mode-2 science (Gibbons et al. 1994; Nowotny et al. 2001) has pointed out that ways of producing technoscientific knowledge already extend well beyond the classical 'independent' mode of basic science. Stronger roles of applications contexts and imaginations in the very production of knowledge, transdisciplinarity, and socially as well as epistemically extended peer-review are but a few elements which indicate much broader social involvement in how knowledge is produced and validated. This co-production of science and society changes the very meaning of notions like objectivity and rationality". (Felt, 2007, p. 77)

It no longer suffices only to identify thematic priorities or societal challenges "upfront". We must also explore how research processes can be developed as productive interactions between different actors for relevant innovations; how to develop and how to evaluate them as societally robust processes. (Voß et al, 2006) A more complex, dynamic and open understanding of the relations between science and society, asks for the development of new competencies and skills in the research system. The challenges are of an institutional as well as of an individual kind, and they seem to touch especially raw nerves, maybe because assessing the quality of research relates to heavy investments (institutionally as well as individually) in specific forms of rationality. Indicating that we may have some triple loop learning[37] to do, can be provocative regarding our professional identities. At the same time, if we are *not* able to discuss and explore alternative

[37] Triple loop learning entails inquiring how we know that we are doing the right things, while single loop learning entail$_S$ asking ourselves whether we are doing "things right" (first order learning) and double loop (or second order learning) concerns whether we are doing "the right things".

figurations of quality[38], the recourse to traditional academic standards will be imminent.

One of the more promising attempts to meet these challenges is situated in the Netherlands, still being developed by a network involving several policy organisations.[39] Their approach is called Evaluating Research in Context (ERiC). The comprehensive method that they propose takes into account the fact that much current research is produced in a complex socio-economic context in which demands are made by a variety of social actors. Moreover, research that addresses complex questions (for example aids, global warming, migration, renewable energy) is often multi-, inter- and/or transdisciplinary and is conducted in a context in which experts with different backgrounds, knowledge and expertise operate and different demands and interests have to be negotiated. This complexity requires a different approach to evaluation than traditional peer review that mainly emphasizes scientific excellence and relies on publications in high impact journals for its primary indicators. Since quality in the ERIC-approach is defined as a multidimensional concept which includes the expertise of stakeholders in different social domains, they elaborate on the concept of quality by looking at these different dimensions, distinguishing in each the modes of production and interaction of researchers and a variety of stakeholders. This is the how they present their approach to evaluation (Spaapen et al, 2007):

> "Evaluation is not the same as accounting and control; that is, the evaluation of output in terms of certain benchmarks and indicators. The method we propose aims to include a form of second order learning that also put the meaning of benchmarks and indicators that are used into question. It therefore stimulates not only first order but also second order learning processes by way of reflection, debate and ongoing iteration between goals and methods". (p. 29)

It is a major challenge – in changing times – that the models deeply inscribed in the statistical practices underpinning our monitoring and governance activities, are so hard make explicit and to put into play. The ERIC-network underlines the importance of paying attention not only to the input in research (people, money apparatus), and its output (publication and other products), but also to the 'throughput'. By this they mean the processes to mediate with the environment, for example co-operation and strategic alliances. This implies discussions about

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[38] Developing practices of figuration is still challenge for feminist research. The one outstanding exemption being Donna Haraway.

[39] The network emerged out of a project from the Consultative Committee of Sector Councils for Research and Development (COS) concerning how to measure the social impact of research. Later The Royal Netherlands Academy of Arts and Sciences (KNAW), Netherlands Organisation for Scientific Research (NWO), Netherlands Association of Universities of Applied Sciences (HBO-Raad), and Quality Assurance Netherlands Universities (QANU) have participated in the project, and Hogeschool Utrecht, the Ministry of Education, Culture and Science (OCW) and Rathenau Institute have been involved as observers.

the strategic positioning of a research program, thus giving deliberation about goals and public methods weight.

Taken together, these principles form a program that combines some of the lessons of classical pragmatism (notably the anti-dualism) and new governance policy-techniques; especially the mechanism for co-ordination and co-operation, that share a focus on 'learning processes'.(Spaapen et al, 2007, p. 29) We include a "conclusion" that they arrive at 28 pages later:

> "The above lead us to the conclusion that we are not looking for an instrument to evaluate a specific research group or a program, but a process of interaction. And we are not so much looking for indicators that can tell us how good or bad the 'quality' of the research is, but we are looking for indicators that can tell us whether the group succeeds in fulfilling its mission in a relevant context". (p. 57)

As hinted at earlier, the emerging acknowledgement of "unintended consequences" is stressed as motivating transformatory action and experimentation in STI. Another way of approaching this may be through the discussion initiated by Sandra Harding in her introductory chapter to *The "Racial" Economy of Science: Toward a Democratic Future* (1993). Here Harding re-invents 'scientific illiteracy" as pertaining not to "humanists or … the working classes", but to "many scientists, policymakers, and other highly educated citizens". She contends that: "… most scientist are not in a position to evaluate in a maximally objective way important parts of the evidence that they use in arriving at their results of research, nor is the educated public provided with the information and skills it needs to detect such a problem". This happens because " …elite science educations rarely expose students to systematic analyses of the social origins, traditions, meanings, practices, institutions, technologies, uses, and consequences of the natural sciences that ensure the fully historical character of the results of scientific research" (p. 1). In her *Reflections on Gender and Science* book from 1985 Evelyn Fox Keller comes close to a similar description of the challenges: "Yet, while our sensitivity to the influences of social and political forces certainly has grown, our understanding of their actual impact on the production of scientific theory has not" (p. 5). It was Keller, who some years later, contended that researchers had to supplement the assessment that "it works" with questioning what it works at as well as how it could have worked differently (Keller, 1992, pp. 74). Sandra Harding's diagnosis relates to natural science, but is echoed by Brian Wynne's concerning the social sciences in the "Afterword" to *Governing at the Nanoscale* from 2006:

> "The mode of social science presented here involves more than intellectual dimensions alone. It also involves learning new relationships and responsibilities, with 'the public', with the natural sciences and with policy. And it involves social sciences becoming actors in those worlds as well as commentators.

> However, this leaves a continuing issue unresolved. If we are to engage in these more politically immersed relationships, and leave behind our well-bounded peer cultures, how are we to ensure that the knowledge we generate can claim validity?" (p. 77)

If we want to move from "speaking truth to power to making sense together" as Robert Hoppe (1999) has suggested, it also entails exploring how we can evaluate research and technology on the move – between the no longer and the not yet.

In "The Agora and the Role of Research Evaluation" (Frederiksen et al, 2003) the three authors from Copenhagen Business School, note that the evaluation of research is undergoing change and that they want to "… investigate how recent societal developments – epitomized by the concept of the agora – influence research evaluations". The 'agora' here denotes co-evolutionary figuring of the relation between science and society. In summing up they contend that:

> "The trust in science has traditionally been and to a large degree continues to be based on institutions that are attached to the idea of an autonomous and disinterested science (universities and the peer review system). In this article we have tried to demonstrate that the rise of a whole new field of technical research evaluation systems should be understood as part of the modernization process taking place in all western societies where the close links between social trust, visibility and accountability in any part of society have also reached science. If science is to engage in the developing and changing relationships with society and face the financial interests and power games and at the same time retain the public's trust, demands for a radical change of perspective and implementation of new methods or procedures in relation to the evaluation of scientific knowledge are unavoidable" (p. 166-167).

The issue of stimulating and developing conflicting and contested perspectives, is also part of what Arie Rip (2003) find is important in realising societally robust science and technology through 4th generation research evaluation. It also figures quite prominently in the section "Knowledge production and assessment" in the before mentioned *Reflexive Governance for Sustainable Development* (Voß et al, 2006), especially in the contributions by Katy Whitelegg and Marie Celine Loibl. They are more focused on the processes of knowledge production than on the assessment of it, but it can be argued on the basis of their texts, that production processes and assessment or evaluation, should be closely interlinked, reference also to the ERiC approach as well as to the weight placed on reflexivity or triple loop learning in the discussions we have referred to in this article. This is also a point brought forward by Arie Rip in a report to EC, June 2002; "Challenges for Technology Foresight/Assessment and Governance":

> "The key point, however, is to move away from a focus on our limited knowledge of the nature and extent of impacts (which will remain full of uncertainties) to the process by which they come about, starting with the here and now. The question of technological innovation and its impacts is a complex and real-time challenge for the actors. Prospective technology analysis must therefore also be "real time", and formative (a term from evaluation studies, where real-

time evaluation informs, and thus helps to form, subsequent reflection and action). Anticipating outcomes (including impacts of the technology on society) must be an ongoing concern, rather than ad hoc efforts to persuade a sponsor or regulator that the innovation journey can continue" (Rip, 2002b, p. 52).

government and science as key players amongst other key players

Co-evolution in a non European context e.g. in an East African context make sense in a very explicit way where the mission of the national universities existing and the Governments coincide in the main objective of poverty reduction. When faculties of technology and engineering position themselves as relatively equal partners with entrepreneurs in society for development in sectors like seaweed production in Tanzania (see above), ICT in Uganda[40], beef production in Mozambique[41] we see examples of how the Governments, no matter if local, regional or national, see the relevance and join in co-evolution processes.

In the example of our East African collaborations, the R&D&I directions to be considered by Government and research institutions seem simpler in the context of poverty reduction but more complicated in the context of fragile institutions in the country as well as its weak position in the global economy. The energy production sector is a hot issue in the context of avoiding a new colonialism situation (nuclear power material, ethanol production, solar energy etc.). Initiatives for ethanol production in the south of Tanzania and north of Mozambique out of raw material not competing with domestic food production and with foreign business interests involved encounter a number of challenges. One of them is weak negotiation power in the land use because the rights to land are not regulated in a manner in favour for the country and its inhabitants concerned. The Government in Tanzania has used the University (UDSM) to assess the conditions for ethanol production addressing this complex web of implications and interests. A biofuel cluster initiative in Dar es Salaam and Morogoro, Tanzania[42], is showing how a micro-political articulation can create a diverse and hopefully sustainable environment, where stakeholders like governmental and knowledge institutions can cooperate and deliver concrete results including a number of innovative solutions very much needed.

40 For a short comment see //allafrica.com/stories/200808220147.

41 //si4cd.files.wordpress.com/2009/01/cluster-initiatives-in-east-africa1.pdf

42 Progress Report August 2008 within the Sida supported program ISCP-EA.

co-inventing innovation

Addressing gender mainstreaming as well as grand challenges through innovation bring us inevitably to questioning our academic practices. We have tried to bring out, through a number of discussion threads, how the claim for excellence out of the already existing normative machineries at work in the academic world emerge as empty in complex and dynamic situations and thus problematic as bases for societally robust and relevant innovations. The question is what kind of quality in innovative knowledge production that is relevant in what context and for what purpose. Both researchers and policy makers have to create and enter a joint learning space with a learning mindset in order to be able to tackle this never ending question. If we have learned anything from our experiences in cooperation with colleagues in developing countries, it is that research and politics are deeply intertwined and constitute conditions for innovative processes. One excellent skill needed concerns how to navigate in a more or less totalitarian political system AND at the same time keep the university as autonomous as possible through learning alliances in-between scientists and citizens, official and local experts.

We have been discussing transformation processes, that we realize and try to take part in, as figured by mode 2-research. Ulrike Felt and her colleagues are exploring the changing academic research environments in a European context and how researchers encounter, transform and oppose these changes. Felt is emphasizing the issue of creating and inhabiting what she calls epistemic living spaces (Felt, 2009). We recognize these discussions as an important prerequisite for ourselves and other inhabitants in the academic world in order to feel "intellectually and socially 'at home' " (Felt, 2009, p. 231) and for "becoming answerable for what we learn how to see" (Haraway, 1991).

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