Gender Research as Knowledge Resource in Technology and Engineering

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Introduction – Science Creating Realities

Aspirations in gender research within technology and engineering have developed into a research-transforming activity focusing on societal relevance and engineering faculties. The conditions that are needed and created require epistemological pluralism. The gender research referred to here is also called feminist technoscience.

When discussing gender in sectors like technology and engineering, we often tend to count heads, i.e. how many women are present in which functions. By contrast, gender issues are much less seen as generating knowledge and technology in themselves. This chapter will illustrate what kind of added value certain academic activities starting in gender-related issues can have. Epistemological comments on feminist technoscience are presented as fostering and attempting to advance our understanding of knowledge production in technology and engineering.

In the last three decades the research-political debate on gender research in Sweden has moved back and forth. Major voices in the dominant academic discourse have rarely stressed the knowledge contribution made by gender research across all disciplines. Despite this circumstance, increasing numbers of scholars within gender research are finding their way and place at Sweden's universities.[1]

1 | See www.genus.se/meromgenus/forskningsmilj%C3%B6er/ (accessed 1 June 2012).

When it comes to gender research within the faculties of technology and engineering, relevant contributions from this research cause specific challenges, which have to be acknowledged. Why is that? One challenge is to have an understanding of gender research as actual research, in a situation where the obvious gender (non)equality issue is in the forefront, that is in a situation of imbalance in terms of the number of active researchers. Women are few and especially so among the professorial staff. The issue moves away from research to quantitative gender equality, which makes little sense when it comes to knowledge production within technology and engineering. The second and core challenge for academia is that gender research within technology and engineering does NOT primarily focus on gender – women and men. It focuses on technology. This means that gender researchers within technology and engineering quickly find themselves working with epistemological issues as the starting point for producing the technical knowledge, systems, artifacts etc. that are of relevance in the actual contexts of application and implication. The framework of theories and methodologies for this work is gathered from feminist research, nationally and internationally, as well as research fostering fundamental research transformations identified in society. This is what prompts me to use the concept of feminist technoscience instead of gender research within technology and engineering.[2] The concept of feminist research connotes change and transformation in a more explicit way than gender research, which is regarded as less provocative and not touching the raw nerves of academia.

Not only Donna Haraway but also scholars like Sheila Jasanoff, Sharon Traweek, and Elisabeth Gulbrandsen offer convincing arguments about research as reality-producing / world-making activities. Jasanoff (2003) emphasizes technologies of humility instead of technologies of hubris. I am particular inspired by Traweek's argumentation concerning detector building in particle physics laboratories and the reality-producing dimensions of the specific constructions of these detectors (Traweek, 1992a). Gulbrandsen was one of the first scholars to introduce Donna Haraway in the Nordic countries and her use of the reality-producing / world-making concept. Science is (co-)creating society and is thus political. That is why I also encourage researchers to concern themselves with the political aspects of their research. As a scientist I have to see myself as a producer of realities for myself and for all others in society.

2 | This is a concept inspired in particular by scholars like Donna Haraway, see e.g. Haraway 1991, 1997.

Anyone who finds this statement too abstract should just think of research in medicine or ICT. Particularly mode 1 researchers (Gibbons et al., 1994) feel provoked by this approach that rejects the dominant epistemology of neutrality and objectivity as well as discarding the God trick[3] (Haraway, 1991: 189).

In order to dissolve the rather categorical statement of feminist technoscience above, I will in this chapter give an example of a research project starting out with quite traditional gender equality issues which was found to bring fundamental reality-producing results in society. There are no cut-in-stone processes within feminist technoscience but a call for openness for what makes research relevant in society, robust and leading to more livable worlds not just for a few.

The aim of this chapter is to contribute to the recognition of feminist technoscience and its knowledge-producing values. Discussions of key understandings of feminist technoscience are illustrated by two cases and summed up by some closing remarks.

The Position of Feminist Technoscience – My Approach

As indicated above, I use the concept of feminist research synonymously with gender research and I use the concept of feminist technoscience almost synonymously with feminist research within technology and engineering. In my academic context I still have to explain why I am defining myself as a feminist researcher. When I started in the 1980s I thought it would be possible to "cleanse" the concept of feminist researcher from all strange associations people used to make (Wahl, 1996). This concept is still provocative (in Sweden) because it is a call for political and transforming actions regarding an academic discourse unwilling to transform. I should interpret this situation positively as it signals transformation of a second order (Ahrenfelt, 2001), which is what I am striving for. A second-order transformation refers to a more deep-going change in contrast to shallow activities of change which will keep the status quo intact.

Within international feminist research with strong links to the dominant technical fields of our age – information and communication technology (ICT), biotechnology, and material technology – there is a widespread under-

3 | "God-trick of seeing everything from nowhere."

standing of the production of knowledge and technology as processes taking place in distributed systems. In other words, knowledge is co-generated in the overlapping borderland of universities, companies, and other regional, national, and international actors. These processes are also apparent in my own region Blekinge and affect the way in which my university, the Blekinge Institute of Technology (BTH), is carrying out research and development, the R&D work. The term technoscience connotes this understanding of the production of knowledge and technology. The way in which technoscience is defined by scholars like Donna Haraway raises important questions about boundaries and transgressions between implosion of science, technology, politics and society, humans and non-humans etc. as well as implosion phenomena within the same spheres (Haraway, 1992).

One characteristic of technoscience is, as Gulbrandsen (2006) emphasizes, its reverse logic: knowledge has to be used in order to be tested. A classic example is reproduction technologies,[4] for instance where the practice of test tube babies has to be used in women's bodies in order to test this technique. This issue has therefore an important research-political dimension. In feminist technoscience, the research-political discussion is vital for the relation between research and politics, i.e. the reality-producing aspect of science and research.

Seeing ICT as a reality-producing technology rests on the idea that all of us, researchers in the field included, are enmeshed in development processes where no innocent positions exist (Flax, 1992; Haraway, 1997). ICT intervenes in and creates people's everyday lives. On the other hand, ICT is something developed and interpreted by people. The work of my colleagues and myself is inspired by this feminist technoscientific approach and aims to create both a theoretical basis and practices for development processes in ICT-related disciplines, as well as in the context of innovation systems. This is particularly relevant for our PhD students and colleagues coming from East Africa and Bolivia.

My concern is to open up for and foster epistemological pluralism[5] at faculties of technology and engineering in order to encounter complex realities in our research, encounter young people and their preferences in learning pro-

4 | From in-vitro fertilization to cloning see e.g. www.finrrage.org (accessed 17 February 2013).

5 | In contrast to one dominant, singular epistemology e.g. the dominant western positivistic related epistemology.

cesses of higher ICT-related education as well as our cooperation partners in society both in the private and public sectors. We, who are working at faculties of technology and engineering, have to transform in more advanced ways than expected. One fundamental condition for the necessary transformation is to open up for and foster epistemological pluralism. With regard to this challenge Ina Wagner has contributed some essential understandings. She argues (Wagner, 1994) that the central idea of combining established forms of scientific inquiry with the social pragmatics of developing goals, methods, theories, and products can be realized by epistemological pluralism and partial translations between situated knowledges of different communities.

Fostering epistemological pluralism is a challenge at faculties of technology and engineering, whether young or long-established. When we have learned to spell the word epistemology, when we have acknowledged that we do research and teach by walking on a certain epistemological infrastructure, then it is high time to pose ourselves the question whether this infrastructure is relevant enough, whether it is appropriate for our identified needs.

Situated at a technical university with an explicit profile of applied ICT in close cooperation with university, industry, and government, epistemological openness is a huge challenge. The present knowledge and technology production occurs in situations that are far removed from what is identified as a traditional mode 1 university[6] (Gibbons et al., 1994) – the linear model university. These knowledge processes are my daily experiences at one of the campuses of BTH, more precisely at campus Karlshamn, which is integrated in an innovation node called NetPort.Karlshamn.[7] A too restricted and unreflected epistemological basis constitutes an impediment in our daily work.

What resources does an ICT researcher and member of the academic teaching staff have at her disposal in order to remain confident, future-oriented, and innovative? In the course of our now twelve years of development experience with so far good results in student recruitment, research, and campus building, the resources for the necessary epistemological infrastructures were found within feminist research developed within a faculty of technology – i.e. within feminist technoscience. It might sound strange that we have found relevance

6 | Some characteristics are disciplinarity, internally-driven taxonomy of disciplines, neutrality / objectivity / scientific discovery, hegemony of theoretical or experimental science, autonomy of scientists and their host institutions / the universities, sharp divide of basic and applied research.

7 | See www.netport.se (accessed 17 February 2013).

within feminist technoscience for the benefit of building a much needed epistemological pluralism. This chapter will provide arguments for the why and how.

FROM COUNTING HEADS TO RESEARCH TRANSFORMATION

As mentioned in the introduction, the history of feminist technoscience situated at faculties of technology and engineering has proceeded from the practice of counting heads (how many women) to fostering and advancing understandings and practices of knowledge production. This is not a linear process but more of a process in parallel. The gender equality work continues and is still far from reaching its goal in sustainable 40/60% representation of men and women at all levels. The academic story in Sweden within a time frame of more than 3 decades shows that we have moved from the gender equality question, to the woman question[8] to the science question. This refers to the Harding turn (Harding, 1991) moving from the question of what science can do for women to what feminists can do for science. There are no simple or self-acting links between these general phases.

During the last decades we have emphatically argued for the importance of perspectives from *within* (Trojer, 2002). This is a central condition for feminist technoscience to be relevant and useful at faculties of technology and engineering. Karen Barad has fostered this argument. She writes that "on an agential realist account of technoscientific practices, the 'knower' does not stand in a relation of absolute externality to the natural world being investigated – there is no such exterior observational point" (Barad, 2003: 828). It is not enough to do gender research of technology from the outside. It is equally important to be deeply involved in "the belly of the beast", a belly you are passionately interested in (Haraway, 1991: 189).

For the introduction of feminist epistemology into technoscience in practice at BTH, one statement of Donna Haraway has been especially important: "Technology is not neutral. We're inside what we make, and it's inside us. We're living in a world of connections – and it matters which ones get made and unmade." (Haraway cited in Kunzru, 1997) This quote was put up on the wall in the lunchroom at a research laboratory focusing on water jet tech-

8 | For instance developing cars or speech synthesizers suitable for women's bodies.

nologies close to BTH. Together with a colleague we were hired to integrate some kind of gender research perspective in a EU project at the laboratory mentioned. The Haraway quote was almost impossible to comprehend for the water jet researchers in our introductory discussions. But some of them took the initiative to copy it and put it on the wall for further internal debates. Almost a year after this event, we came back for continued collaboration and found the involved researchers appreciating the quote and all the discussions it had nurtured.

Co-evolving Processes

It is not by accident that feminist technoscience easily links up to and contributes to fostering co-evolving research processes within technology and engineering. As will be exemplified below, co-evolving processes are important where relevance and contexts of application and implication constitute the essential elements. The frame of understanding co-evolution includes the triple helix concept (Etzkowitz and Leydesdorff, 1997), which gives us some comprehension of the structure of the actors involved. The main actors are universities (knowledge institutions), industry (private sector), and government (on any level). But the triple helix concept does not contribute with the core answer to how the co-evolving / triple helix process is carried out. One answer to the 'how' question can be found in the research processes termed mode 2[9] (Gibbons et al., 1994).

The Swedish Council for Planning and Co-ordination of Research (FRN) initiated and financed a study that resulted in the publication *The new production of knowledge* (Gibbons et al., 1994), where the research process mode 2 was thoroughly described. Characteristics of mode 2 include for instance context of application, trans-disciplinarity, much greater diversity of sites of knowledge production, accountability / context of implication, novel forms of quality control, socially robust knowledge. The strong and hostile reactions from the dominant university (mode 1) representatives showed the mode 2 understandings were and are really touching the raw nerves of the existing academic discourse. These mode 1 representatives are protecting disciplinar-

9 | Some characteristics are context of application, trans-disciplinarity, great diversity of sites of knowledge production / research, highly reflexive / accountability, novel forms of quality control, socially robust knowledge, context of implication.

ity, internally driven taxonomy of disciplines, neutrality, objectivity, context of discovery, hegemony of theoretical or experimental science, a sharp divide of basic and applied research. But as Gibbons explained,[10] mode 2 knowledge productions have always existed and mode 1 is a very efficient specialization of knowledge production. This specialization finds its roots in the scientific revolution in the 1600s (Merchant, 1980).

The debates around the mode1 / mode 2 understandings concerns the twin notions of 'science speaking to society' and 'society speaking back to science'. In other words, 'society' is required to take part not only in the input phase but in the whole process (which more likely is non-linear) up to the output and outcomes of results.

We have experienced on a municipal level how society, represented by the local government, explicitly manifested the need in being involved in the whole input-operation-output process. The need for this involvement comes from the budgetary process in local government to have local tax resources approved for the input of research funds and infrastructure requests of universities. What the mayor and local government directors need are good arguments for the relevance of this 'investment' in order to convince the local parliament to vote in favor of it. For this argumentation to be successful, the mayor of Karlshamn clearly announced that "input is not enough".

THE CASE OF SWEDEN: NETPORT

The following case serves to illustrate co-evolution and research transformation processes in particular.

As mentioned above, the research division where I am academically situated has a specific history and obligation integrated in an innovation node called NetPort.Karlshamn,[11] hereafter referred to as NetPort. NetPort is co-owned by the university (BTH), the local government, and the industry in identified sectors (new media and ITS[12]). This relation of ownership constitutes a strong signal for putting triple helix processes in a real-life context. NetPort is not only a loose network of triple helix actors, but organized and jointly owned in a challenging and inspiring way.

10 | Interview at the HSS03 conference Ronneby, Sweden, 2003.

11 | See www.netport.se (accessed 17 February 2013).

12 | Intelligent transport systems.

The start of NetPort coincided with the start of a new university campus of BTH in Karlshamn. Developing a new campus at a technical university in a triple helix context needs at least 4 starting conditions:

1. Undergraduate students
2. Graduate students
3. Epistemological acknowledgement of mode 2
4. Tolerance towards resistance that is always appearing in development processes, especially internally at the university.

In the year 2000 the Vice Chancellor of BTH gave his approval for the department that includes the division of ICT and Gender Research at BTH to take the main responsibility of starting to develop the new campus. This task was supported by BTH with a centrally appointed project coordinator. The division had the authority and competence to initiate bachelor programs in media technology and was already running a PhD program with a number of doctoral students. The division staff was strongly motivated to embrace a triple helix collaboration practice i.e. to work in close collaboration between the university, local government, and industry.

For his approval the VC had become convinced of above condition Nos. 1 and 2. Condition No. 3 characterized the practice of the VC and seemed to be self-evident for him. The ambitions of the division to fulfill condition No. 3 were probably implicitly recognized by the VC, as explicit interest was demonstrated in cooperating with stakeholders outside the university, of which the local government of the campus city was the main partner.

Regarding condition No. 4 the experience of Bo Ahrenfelt (2001) proved to be of great help to the division in understanding different manifestations of resistance. Peter Ekdahl (2005) stresses that resistance in development and transformation processes is important and creates energy, even though resistance is momentarily experienced as destructive and energy consuming. A lack of resistance obstructs the possibilities for giving focus to the direction of one's development effort. In addition, resistance helps to clarify what kind of development and transformation conditions you need besides promoting dialogue.

Both BTH campus Karlshamn and NetPort started in the year 2000. NetPort Science Park was established in 2009. The status in 2012 for BTH campus Karlshamn included over 300 students in the bachelor programs Digital Visual Production, Digital Audio Production, Digital Game, Web Development plus an Introductory Year. The PhD program as well as the present research division is called Technoscience Studies and includes 4 profile areas namely

ICT4D, Design for Digital Media, Feminist Technoscience, Innovation system and Development.[13]

The research division is hosting an organization unit focusing on the development of clusters and innovation systems in collaboration with developing countries. This platform is called SICD (Scandinavian Institute for Competitiveness and Development).[14] The team working at SICD has long-term experiences with Sida (Swedish International Development Cooperation Agency), VINNOVA (the Swedish Governmental Agency for Innovation Systems), and BTH (Feminist Technoscience). The R&D projects in ITS are mostly conducted in NetPort projects with researchers from BTH.

The local government's involvement stems from the mutual 'project' NetPort of fostering sustainable development of (local) society. The prerequisite for this 'project' is a triple helix-like process, which in our case is nurtured by a constant, almost daily, dialogue. In this dialogue, which is a kind of agora, mutual understandings are supposed to find their expression in very concrete ways resulting in co-evolution processes. For us, who have been involved, we talk about an

> "establishment of the institution of a 'kitchen cabinet'. A generous, open, inviting, allowing arena had to be created for the construction of new questions and dreams …. We need a lot of 'kitchen cabinets' on campus to cater for the polycentric, interactive and multipartite processes of knowledge-making we may dream of. A vision that entails transformative processes, changing research cultures and 'teaching smart people how to learn'" (Gulbrandsen, 2004: 120; see also Argyris, 1991).

During the pioneer phase, the dialogue within NetPort was intense and relatively easy to keep going. There were always various kinds of challenges but they remained manageable, as the core group (kitchen cabinet) had an ideal number of members and it was possible to share the mode 2 experiences. As new colleagues and partners joined and the upscaling of NetPort activities continued, the kitchen cabinet became increasingly challenging to maintain. It is easier to prioritize time for the increasingly advanced development within each partner's areas of responsibility than to set aside sufficient time for the triple helix co-evolving process. The aspect of the co-evolving processes thus

13 | For more information see www.bth.se/tks/teknovet.nsf (accessed 17 February 2013).

14 | For more information see http://sicd.se/ (accessed 17 February 2013).

changes over time but the standpoint of keeping the main actors together is an absolute prerequesite for sustainability.

With this short summary of the case NetPort I hope to have illustrated how some fundamental concepts of feminist technoscience such as situated knowledges, transdisciplinarity, and co-evolution have been filled with substance for us active in the same professional environment.

The Case of Uganda: ICT Centre Arua

A radical change of context provides an opportunity to understand meanings of situated knowledges, epistemological pluralism, co-evolution processes, and the relevance of mode 2. The following case illustrates this.

Secondary schools in Uganda, except for some very few in the capital Kampala and its vicinity, have to cope with extremely scarce resources, like very few qualified teachers, no books, no laboratories, and poor electricity and Internet infrastructure.

A researcher at the Faculty of Technology, Makerere University (MAK) started a research project in 2004 investigating the reasons why there were so few female students at the Faculty of Technology at his university, why there were so few students at MAK coming from secondary schools in rural areas and how to change this situation (Lating, 2009). At that time, over 90% of the few female engineering students came from the 'elite' and advantaged urban schools located in Kampala and its surrounding districts of Mukono and Wakiso. The study's research questions were linked with the explicit dimension of gender issues, clearly in the more quantitative notion of gender equality but implicitly also in a qualitative sense, especially with regard to knowledge production at a technical faculty.

The study was conducted in Arua, which is a remote, poor, and unstable rural district of Uganda, 500 kilometers from Kampala in the north east of the country close to the borders of Democratic Republic of Congo and Sudan. Since the focus was on female students, two girls' secondary schools were chosen in the periphery of Arua town. The project was designed in such a way that boys and pupils in other schools would also benefit at a later stage in the research.

Hybrid e-learning tools were developed and implemented. Hybrid e-learning in the context of the project signifies a form of e-learning, where the main course delivery platform consists of interactive multimedia CD-ROM and is combined with traditional face-to-face classroom teaching. The development

part and the implementation of the project took place in a kind of parallel process that involved setting up an ICT Centre in the middle of Arua town. The main reason for establishing an ICT Centre (later on to become the ICT/GIS Research Centre) in the project was the financial situation in both secondary schools. Resources for the operational costs of sustaining Internet connectivity were not available. A decision was made to deliver content in CD-ROM format to the schools, but also to set up an ICT Centre with satellite Internet connectivity, VSAT, within the vicinity of the two schools for training and further digital resources.

In order to anchor the whole project in its starting phase, the researcher approached the local and district government of Arua and presented the project including the interest of the Faculty of Technology to develop an ICT Centre in Arua with the facilities of Internet connectivity. The response from the Arua government was very positive. They understood the potentials for the town and district and acted accordingly. They provided premises for the Centre in an old court house building, which they quickly repaired and upgraded with regard to security facilities. The Faculty of Technology, with financial support from Sida/SAREC (the research unit of Swedish International Development Cooperation Agency), equipped the Centre. Furthermore, the researcher approached the business community in Arua which agreed to use the services at the Centre to make it sustainable. A triple helix process was thus practised in the specific context of a rural district in Uganda with the main actors Makerere University, Arua local and district government, and the local business sector.

The girl students participating were enthusiastic, but a number of notable and sometimes critical situations occurred with the students and their teachers during the project.[15] As a very concrete result, the analysis of the research study showed that, for girls born and living in Arua, 41% of the final year (A-level) students passed[16] and were eligible for university admission compared to almost 0% before the introduction of e-learning tools. This was the result after only six months of girl students and their teachers using these tools.

The decision to establish an ICT Centre had a huge impact not only for the town and its surrounding district but also for municipalities on the other side of the nearby border with the Democratic Republic of Congo and Sudan.

15 | For more details see Lating, 2011.

16 | The school system in Uganda uses a national curriculum with nationally coordinated examination tests. The latter was used as indicators in this research study.

What started as an e-learning project in order to increase the number of female students at the Faculty of Technology, Makerere University, ended up as an ICT/GIS Research Centre in Arua facilitating 10 schools, district and local businesses and organizations, district and local governmental authorities, 2 hospitals, local authorities across the borders of Sudan and Congo.[17]

In 2010, the government of Uganda decided to establish a new university – Muni University – with the ICT/GIS Research Centre in Arua as its initial nucleus and including a Faculty of Technoscience.

The number of stakeholders is impressive and quite unique compared to a Swedish regional context. This is a strong signal from the stakeholders for the

17 | *District and local government officials:* Regional District Police Commander's Office; District Police Commander's Office; Chief Administrative Officer's Office; District Medical Officer's Office; District Forestry Office; Resident District State Attorney's Office; District Information Office; and District Engineer's Office.

Schools: Muni Girls Secondary School; Ediofe Girls Secondary School; Mvara Secondary School; Arua Public Secondary School; Arua Public Primary School; Uganda Christian University; Arua Campus; Arua Vocational Training School; Arua Core Primary Teacher's College; St. Joseph's College Ombachi; and Anyafio Role Model Secondary School.

Hospitals: Arua Hospital and Maracha Hospital.

Other governmental institutions: National Social Security Fund and Northern Uganda Social Action Fund.

Business sector: The District Chamber of Commerce; West Nile Rural Electrification Company; Uganda Breweries; Private Sector Initiative; Sumandura Construction Works; Boniface Television Networks; Nile Fm / radio station; Arua One FM radio station; Copcoot Uganda; Westnile Distilleries; Heritage Gardens – hotels business; Multitech Uganda – ICT training business; Kuluva Hospital and Marie Stopes Uganda –Reproductive health provider.

Non-governmental organizations and community-based organizations: Netherlands Development Organisation (SNV) Uganda; United Nations High Commission for Refugees; Cream Uganda (Community Based Organization); PAD (Community Based Organization); PRAFOD (Community Based Organization); CAFECC (A Sudanese Community Based Organization); World Vision Uganda; WENDWOA (A women's organization helping widows and disadvantaged children); NSEA / Needs Service Education Agency.

Others: travel agents; students from schools outside Arua District mostly during school vacations; community workers and the indigenous people mostly using the Internet for communication with their relatives and friends in and outside Uganda.

acknowledged relevance of the e-learning project, the triple helix collaboration, and its impact in a place like Arua District (Trojer and Lating, 2011). The researcher responsible for the project was collaborating with us at the Division of Technoscience Studies, BTH campus Karlshamn. Mutual learning and practice of its epistemological pluralism took place while the project was in progress. It is impossible to know at the beginning of such a project what will happen and how it will unfold. What is essential is to learn from one another, find situated solutions, and remain open for diverse understandings of knowledge.

CONCLUDING REMARKS

The Unknown, Unspecified, Uncontrollable

The case of Uganda presented above elucidates how boundaries between society and research are not straightforward and clear. That holds true for all our civilizations increasingly depending on research and knowledge. Helga Nowotny claimes that research and society are co-produced or co-evolve (Nowotny et al., 2001), which is a long way from the simple, linear understanding of this relationship that has for a long time dominated research in our traditional universities as well as in research policy. Gulbrandsen (2004) states that it is in the field of technoscience (such as information and communication technology, bio/gene-technology, and material technology) that scientists are most clearly pushing the boundaries between science and society, research and politics, and thereby underscoring the obsolescence of a linear understanding of knowledge production processes.

The increasingly acknowledged non-linear knowledge production processes stress the importance for us to assess the unknown, unspecified, uncontrollable, irregular in both research and political spheres. What follows for all actors is to admit there are limits to knowledge in research. Sheila Jasanoff emphasizes the practice of "technologies of humility" in favor of "technologies of hubris" in the dialogue between science and society. Jasanoff (2003: 225) addresses the driving force for society to speak back in stating that uncertainties and risks are "part of the modern human condition, woven into the very fabric of progress. The problem we urgently face is how to live democratically and at peace with the knowledge that our societies are inevitably 'at risk'." Appreciating technologies of humility brings me back to the typical characteristic of technoscience in the reverse logic. This means, as mentioned

above, that knowledge must be applied in order for it to be tested. The reverse logic as the 'collective experiment' has been explicitly discussed by Bruno Latour, where he states, that

> "all of us have become members of collective experiments on global warming, the influence of genetic engineering, conservation of species, demography, pollution, etc. Thus we have to practice something that, until recently, was the calling of very few specialists, namely science policy. Now everyone is led to practice science policy over a vast range of scientific and technical controversies. This has entirely modified the relations of the public with the producers of science and technology" (Latour, 1998: 7).

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 researchers' relations with society "… after all the serious epistemological action is over" (Haraway, 1997: 68). Neither sustainability nor other values that we would like to realize can be secured retrospectively. Our technoscientific research is positioning its projects and work to promote more complex and integrated understandings of the relationship between research and society in this grey area that Nowotny et al. (2001) interpret as a dedifferentiation of the social spheres of modernity.

Resources for What?

Trying out practices of feminist technoscience at a Swedish technical university as exemplified above has enabled us to formulate what kind of resources feminist technoscience can offer. Feminist technoscience represents resources to:

- expand the knowledge frames and practices for technology development in increasingly complex realities;
- open up preferential rights of interpretation in selections of procedures and standards, which are always reality producing activities;
- develop epistemological infrastructures relevant to a society heavily dependent on research and technology;
- establish new arenas for developing understandings of relations between research, the political sector, and industry;
- develop driving forces for inter- and transdisciplinary constellations.

Innovation Revisited

Situated knowledges is a cornerstone concept in feminist technoscience (Haraway, 1988, 1997) that also fosters our understanding of innovation processes. The term 'situated knowledges' was coined by Donna Haraway as part of her epistemological work to provide alternatives to "… developing at home that voice of entitlement, the voice of control, that accompanies the conquest of empires far from home" (Traweek, 1992b: 461). For Haraway, all knowledge is local. It is historically and culturally situated. It is problematic to argue for a watertight bulkhead between the researcher as a subject and the research object, between observing and changing, and between research and politics. The researcher is regarded as an active participant in the research process. She/he generates and organizes knowledge in an ongoing interaction with the reality she/he is researching. This notion of situated knowledges constitutes a vital part of the epistemological base for the case in Uganda as well as in Sweden as presented above.

The feminist technoscience I represent is deeply involved in innovation processes leaning on triple helix experiences and I wish to argue that feminist technoscience strengthens these processes by:

- process-oriented development through a broader understanding of transformation practices;
- enforcement and integration of situated knowledges and technology development;
- emphasizing the importance of power relations and their impacts, including complex understanding of gender structures (which is not explicitly discussed in this chapter but can be found elsewhere[18]).

For me, the innovation processes circle around the practices of situated knowledges, co-evolution, socially robust technology and knowledge, and technologies of humility. Nowotny has given an inspiring approach by stating that "innovation is the collective bet on a common fragile future and no side, neither science nor society, knows the secret of how to cope with its inherent uncer-

18 | For instance Birgitta Rydhagen's research project *Innovative clusters closing the gap between University and Society in East Africa. A living proof of Mode 2 excellence?* See http://www.bth.se/tks/teknovet.nsf/sidor/researchandprojects (accessed 31 January 2013).

tainties. It has to be done in some sort of alliance and a sense of direction which is shared" (Nowotny, 2005: 10).

The dominant discourse of innovation and innovation systems is focusing on the development of the market economy. In this context it is non-controversial to talk about sustainable economic development. But what I would like feminist technoscience to argue and try transformations for is innovation, in all its complexity, that creates sustainable conditions for a liveable world and life not only for me and other privileged people.

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