

CONTENT

| | |
|--|-----|
| INTRODUCTION TO THEME | 3 |
| ORGANISERS | 4 |
| PROGRAMME COMMITTEE | 4 |
| INFORMATION ABOUT INSTITUTE FOR INNOVATION AND GOVERNANCE STUDIES (IGS) | 5 |
| INFORMATION ABOUT EU-SPRI | 6 |
| INFORMATION ABOUT UNIVERSITY OF TWENTE | 7 |
| PROGRAMME | 8 |
| EXTENDED ABSTRACTS PAPERS & POSTERS | 11 |
| INDEX AUTHORS PAPERS AND POSTERS | 118 |

INTRODUCTION TO THEME

For emerging science and technology (EST) governance becomes tentative when it is designed as a *dynamic* process to manage interdependencies and contingencies. Tentative governance aims at creating spaces of openness, probing and learning instead of trying to limit options for actors, institutions and processes. It answers political and organizational complexities with explorative strategies, instead of relying only on orthodox or preservative means.

Tentative governance is a particularly pertinent issue for EST such as nanotechnology, life sciences, genomics and other emerging fields of innovations with the potential to radically transform domains and sectors,. These fields are subject to a broad array of inherent uncertainties related to technological shape, configurations and applications and the resulting societal benefits and risks. At the same time, actor constellations and practices related to knowledge production, innovation and societal appropriation are in the process of emerging and largely differ from established technologies. This poses specific challenges to the governance of these fields, which has to address ill-defined and sometimes 'moving targets'. Simultaneously, promises and expectations abound. Many actors from government, academia, industry, and civil society expect that EST will constitute "key technologies of the future" and that some may even lead to a "next industrial revolution". Thus, developing appropriate governance modes seems all the more important. However, modes of governance are usually attuned to established technologies. Innovative modes of governance under headings such as 'reflexive governance', 'transition management', 'Constructive Technology Assessment', 'Ethical, Legal and Societal Issues (ELSI) Studies', or 'Real-Time Technology Assessment' are only now emerging. What we are seeing, in other words, is a co-evolutionary growth of innovative modes of governance and constellations, practices and technologies in EST. Hence, it can be argued that governance modes, be they regulatory approaches, institutional arrangements or modes of coordination among various actor constellations turn out – and probably even need – to be tentative in order to respond to the uncertainties and to be prepared for further dynamics. We assume that tentative governance is neither a particularly desirable or worrisome approach, but rather an empirical phenomenon.

The aim of the conference is to identify and elaborate the specific governance challenges of EST and to discuss ways of responding to them. Papers may address these issues conceptually or empirically for EST in general or for a specific innovation. We invite interdisciplinary contributions from policy and regulatory governance studies, legal studies, higher education studies, science and technology studies, technology assessment and innovation studies.

ORGANISERS

The conference is organized by the **Institute of Innovation and Governance Studies (IGS)**. Internationally, the conference will be run as a key event of the European Forum for 'Studies into Policies for Research and Innovation' (Eu-SPRI Forum; succeeding the PRIME Network of Excellence).

The **Conference Organization Board** includes:

Prof. Stefan Kuhlmann

Dr. Kornelia Konrad

Dr. Roel Nahuis

Dr. Peter Stegmaier

Dr. Paul Benneworth

Dr. Bärbel Dorbeck-Jung

Sjoerd van Tongeren

Conference Secretariat:

Marcia Clifford (IGS)

Address:

University of Twente

P.O. Box 217

7500 AE Enschede

The Netherlands

Phone: +31 53 489 3423

Email: info@igs.utwente.nl



PROGRAMME COMMITTEE

Prof. Andrea Bonaccorsi (Pisa University)

Prof. Susana Borrás (Copenhagen Business School)

Prof. Susan Cozzens (Georgia Institute of Technology)

Dr. Bärbel R. Dorbeck-Jung

Prof. Charles Edquist (Lund University)

Prof. Jürgen Enders

Prof.dr. Stefan Kuhlmann

Prof. Philippe Larédo (ENPC Paris, Manchester University)

Prof.dr. Arie Rip

INFORMATION INSTITUTE FOR INNOVATION AND GOVERNANCE STUDIES (IGS)

The Institute for Innovation and Governance Studies (IGS) conducts research relating to the *governance and management of technological and social innovation*. IGS research addresses issues of co-ordination, steering and the operation of (networks of) actors and institutions in both public and private sectors with an emphasis upon a multi-level, multi-actor systems perspective. IGS strives to combine scientific excellence with relevance for public and private stakeholders.

IGS research is grounded in the social sciences, and specifically in:

- business administration (including innovation and entrepreneurship studies),
- public administration (including political science, policy studies, legal studies, economics, and sociology),
- science, technology, innovation and safety studies.

IGS research is characterized by its interdisciplinary approach, combining ideas and insights drawn from a range of scientific disciplines. Common to its participating researchers is an appreciation of the need to take a multi-level view of societal dynamics.

IGS research covers public governance, entrepreneurial and business development processes in services, manufacturing and construction industries, health systems, knowledge production (science and higher education), and sustainability (energy and climate, environmental quality, and water). These fields cut across a range of technologies, including information and communication technologies, energy and water, smart systems, biomedical technology, nanotechnology, and new materials.

IGS also helps to place the University of Twente's technological research into a wider societal context. There is clear added value derived from understanding the close relation between technology and her application, acceptance, risks and many more social science related subjects to research on both the technological and social sciences domains of the university. The relevance and quality of IGS research is highlighted by the high level of external research funding acquired (around two-thirds of the total budget).

Strategic Research Orientations of the IGS

Research in the IGS is organized in four large research programs, named *strategic research orientations* (SROs). Each SRO brings together researchers from different academic departments to work jointly towards realising common research agendas. Fourteen of the University of Twente's academic departments participate in the IGS, involving almost 300 researchers. The four SROs are:

Governance of Innovation, Technology, Higher Education and Research (GITHER) focuses on university-industry knowledge interactions in emerging science and technology, the governance of universities and public research, and evolving research 'regimes' of universities, business and government.

Management of Innovation and Entrepreneurship studies the fundamental understanding of innovation and entrepreneurship/ business development, primarily in technological contexts. These empirical domains are explored through perspectives derived from operations management, organization theory, organizational behaviour, business ethics, human resource management, strategy, marketing, international management and entrepreneurship.

Innovation of Governance focuses on changes in the relationships between citizens and their government at various levels in terms of legitimacy and effectiveness, focusing on contemporary shifts from 'government in hierarchies' to 'governance in networks'. This IGS research program focuses on public sector developments, rooted in theories and insights from the fields of public administration, political science, sociology, law and public sector economics.

Sustainable water, energy and spatial governance studies management and governance of the environment and natural resources for sustainable development. The SRO addresses a range of questions around the theme of water, energy and spatial governance. How do societies interfere in natural processes? How do changes in natural systems in turn influence human development? How do societies respond and adapt to new problems and risks? What is, or could be, the role of multi-level and multi-actor governance in relation to behavioural and engineering solutions? Strong research lines also exist on policy instruments, implementation networks, and information systems.

INFORMATION EUROPEAN FORUM FOR STUDIES OF POLICIES FOR RESEARCH AND INNOVATION (Eu-SPRI FORUM)



The “European Forum for Studies of Policies for Research and Innovation” (Eu-SPRI Forum) aims to strengthen the **vibrant but dispersed interdisciplinary community** of researchers focussing on interdisciplinary dimensions related to policy and governance in the field of knowledge creation and innovation.

Typical questions of the Eu-SPRI Forum are: How can research and innovation policies cope with ‘grand social challenges’ in the areas of health, energy, security or the environment? Which public policies help to pro-actively shape responsible technological innovation? How to make public sector research more creative and effective? How to achieve a more intelligent interaction between investments in research and higher education policies for universities? Are there better ways to link governments’ research policies to other public policies? How to balance forces of globalization and localisation?

Policies for research and innovation are a centrepiece of the current global ‘knowledge and innovation society’. However, the design and implementation of such policies is not a simple and straightforward business. During the past few decades, policies for research and innovation have no longer become the exclusive remit of national governments. Other public authorities at the local, regional, European and international levels intervene actively in policy design and in policy implementation. Likewise, the creation of highly specialized and professionalised agencies at each of those levels has added to this rapid decentralizing trend. Furthermore, the number and type of stakeholders in research and innovation policy is growing rapidly. NGOs, charities and other public-private actors have become very active stakeholders shaping new policy directions.

The Eu-SPRI Forum has three key missions:

Mission 1: Next generation – The Eu-SPRI Forum supports the intellectual and career development of early career SPRI researchers (doctoral candidates; PostDocs), most notably through doctoral programs, conferences, summer schools and mobility between the partner groups.

Mission 2: Exploratory initiatives – The Eu-SPRI Forum aspires to anticipate new SPRI themes, concepts and methods. The exploration of new interdisciplinary analytical horizons will be facilitated through co-funding of working groups producing position papers within up to 18 months (competition-based selection).

Mission 3: Structuring the field – The Eu-SPRI Forum will hold a bi-annual European Conference on Policies for Research and Innovation, featuring both presently relevant and incoming new themes. The Conferences will act as an informal space for exchange for the European and international SPRI community as well as for innovative stakeholders and policy-makers in the field. In the mid-term the Eu-SPRI Forum will extend existing strong links and exchanges with **non-European research communities** and their organisations aiming at setting up a “Global SPRI Forum”.

On June 8, 2010, in Paris 12 leading institutes in the field of studies of policies for research and innovation have established the “European Forum for Studies of Policies for Research and Innovation” (Eu-SPRI Forum). Members are:

- University of Twente, Institute of Innovation and Governance Studies (IGS);
 - Université Paris-Est, Institut Francilien Recherche Innovation Société (IFRIS);
 - Copenhagen Business School (CBS);
 - Consejo Superior de Investigaciones Científicas (CSIC), Spain;
 - Universidad Autonoma de Madrid (UAM-Accenture Chair on Economics and Management of Innovation);
 - Consiglio Nazionale delle Ricerche (CNR), CERIS Institute for Research on Firm and Growth, Rome;
 - Politecnico di Milano;
 - Consorzio Universitario in Ingegneria per la Qualità e l’Innovazione, QUINN, Pisa;
 - AIT Austrian Institute of Technology;
 - University of Lund, Sweden;
 - University of Manchester, Institute of Innovation Research
 - Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.
- Prof. Stefan Kuhlmann (IGS, U Twente) is the President of the Eu-SPRI Forum for 2010-12; other members of the Executive Committee of the Eu-SPRI Forum are Dr. Emanuela Reale, CNR CERIS, Rome (Vice President); Prof. Susana Borrás, CBS; Prof. Jakob Edler, University of Manchester; Prof. Philippe Larédo (IFRIS); Prof. Jordi Molas Gallart, CSIC, Polytechnic University of Valencia.

Contact: <http://www.euspri-forum.eu/>

Secretariat: Marjatta Kemppainen, University of Twente, Institute of Innovation and Governance Studies (IGS), P.O. Box 217, 7500 AE Enschede, The Netherlands, u.m.kemppainen(at)utwente.nl

INFORMATION UNIVERSITY OF TWENTE (UT)

The **University of Twente** is the only full campus university in the Netherlands and has 3,300 faculty and staff and about 9,000 students. Its mission is to integrate social and engineering sciences. The University is committed to bringing about socially relevant innovation and providing inspiring teaching for students. The campus is home to around 100 businesses, including student-run businesses. The University has also generated more than 700 successful spin-off companies.

There are six Faculties: Management and Governance, Behavioral Sciences, Electrical Engineering, Mathematics and Computer Science, Engineering Technology, Science and Technology, and International Institute for Geo-Information Science and Earth Observation. Research activities are organized under several research institutes including the Institute for Innovation and Governance Studies (IGS), Centre for Telematics and Information Technology (CTIT), Institute for Social Sciences and Technology (IBR), Institute for Energy and Resources (IMPACT), Institute for Nanotechnology (MESA+) and Institute for Biomedical Technology and Technical Medicine (MIRA).

The **School of Management and Governance**, with about 350 staff and 2,200 students, strives to hold a leading position in the field of business and social sciences. It focuses on management, governance, innovation, technology and entrepreneurship. In all these fields, the School provides Bachelor, Master and professional development programs. In addition, scientific and applied research is carried out in various settings, such as, manufacturing, financial, health care, tertiary education and service industries. Research activities of the School are taking place within the university-wide research institutes: the Institute for Innovation and Governance Studies (IGS) and the Centre for Telematics and Information Technology (CTIT).

Thursday, 28 October 2010

| | |
|-------|--|
| 08:30 | Registration Ravelijn Entrance Hall |
| 09:30 | Opening Speeches WA2 Ed Brinksma (Rector Magnificus University of Twente) Kees Aarts (Scientific Director IGS) Dave Blank (Scientific Director MESA+) |
| 09:50 | Stefan Kuhlmann (on behalf of the organizers) Tentative Governance in Emerging Science and Technology |
| 10:10 | Opening Plenary Lecture WA2 Andrea Bonaccorsi The Governance of Science and Technology in Fast Moving Fields: Issues from Going Beyond the Human Scale Chair: Stefan Kuhlmann |
| 10:45 | Short Break |
| 11:00 | Parallel Sessions I |
| | Mediation in Innovation Systems <i>Chair: Roel Nahuis RA1501</i> - <i>Van Lente, Boon & Klerkx</i> : Tentative positions: the positioning of intermediary organisations in the context of emerging technologies - <i>Dalohoun, Van Mele, Bengaly, Dugue, Huat & Senou</i> : Multi-stakeholder platforms to stimulate innovation system learning: experiences of sustainable and integrated exploitation of inland valleys in Benin and Mali - <i>Klerkx & Leeuwis</i> : Establishment and embedding of innovation brokers at different innovation system levels |
| | Has Governance Become More Tentative? <i>Chair: Paul Benneworth RA2501</i> - <i>Benninghoff, Braun, Gorga & Ramuz</i> : The Swiss public research system: between conservatism and innovation - <i>Hedmo & Engwall</i> : Changing governance and authority relations in the Swedish public research system - <i>Laudel & Enders</i> : "Steering from a distance" or "too close for comfort"? How Dutch university governance reforms influence career systems and individual research lines - <i>Gläser, Lettkemann & Schimank</i> : Tentative governance in Germany: too little, too late? |
| | Limits and Implementation of (Regulatory) Governance <i>Chair: Bärbel Dorbeck-Jung RA2502</i> - <i>Lyall</i> : The limits to governance - <i>Murdock, Stemerding & Van der Meulen</i> : Biosecurity regimes and the rise of synthetic biology - <i>Vikolainen, Bressers & Lulofs</i> : Integrated nature design: lessons from the Veluwe border lakes in The Netherlands |
| | Reflection on Concepts: Governance & Innovation <i>Chair: Rob Hoppe RA2504</i> - <i>Stegmaier</i> : Governance in action-continual permutations of practices and structures. The example of society and genomics intermediaries - <i>Borrás</i> : Types of policy learning in innovation policy: addressing systemic problems - <i>Eidler</i> : Towards understanding the emerging governance marble cake in multi-level European R&D funding |
| | Long-term Perspective and International Comparison <i>Chair: Fokko Jan Dijksterhuis RA2503</i> - <i>Cozzens, Soumonni & Woodson</i> : Building equity and equality into emerging technologies: Preliminary Observations on Nanotechnologies in the Global Economy - <i>Scordato, Klitkou & Pedersen</i> : The emergence of a "global challenge" policy priority: an analysis of Scandinavian countries' S&T policy responses to climate change - <i>Heimeriks</i> : Governing search regimes. Towards a co-evolutionary model of research, science, and society |
| 12:30 | Ravelijn Entrance Hall Lunch and Poster Session |
| 13:30 | Parallel Sessions II |
| | Emerging Patterns in Biotechnology Innovation <i>Chair: Dirk Stemerding RA1501</i> - <i>Nahuis & Stemerding</i> : Emerging stabilisation in genomics. Governance and practices of valorisation - <i>Marris</i> : Synthetic biology in the UK: tentative governance or speculative ethics? - <i>Hopkins, Crane, Nightingale & Fuller</i> : The right prescription for therapeutic innovation? Exploring modes and impacts of the tentative governance regime on new UK therapeutic firms |
| | New Pathways and Channels for Emerging Science Governance <i>Chair: Philippe Larédo RA2501</i> - <i>Benneworth & Vossensteyn</i> : University cooperation models as an rescaling of tentative governance spaces - <i>Reale</i> : Governance as a policy instrument for shaping the higher education systems balancing between autonomy, accountability and academic freedom - <i>Peters</i> : Public communication of research as informal science governance |
| | New Regulatory Governance Methods <i>Chair: Luisa Marin RA2502</i> - <i>Moors, Boon & Meijer</i> : New modes of governing pharmacovigilance: a contribution to responsible innovation? - <i>Below & Steffensen</i> : Representation of Consumer attitudes and behaviour as a means for better regulation - <i>Dendler</i> : The role of product labelling schemes in shaping more sustainable production and consumption systems |
| | (Changing) Modes of Governing Promises & Risks <i>Chair: Harro van van Lente RA2504</i> - <i>Konrad</i> : Governance of and by expectations - <i>Blümel</i> : Receptive governance: legitimization strategies and field formation in synthetic biology - <i>Schaper-Rinkel</i> : Weak signals in the governance of emerging technologies: the case of nanotechnology - <i>Hausser, Gazsó & Kaiser</i> : Governing by dialogue: Pre-emptive politics in the field of nanotechnology |
| | Modes of Governance in Long-term Perspective <i>Chair: Nil Disco RA2503</i> - <i>Dijksterhuis & de la Bruheze</i> : Technical norms as emerging governance structures - <i>Weyer</i> : New modes of governance of complex systems in the era of autonomous technology - <i>Seibt</i> : Automation of transport, an emerging technology still in the making - <i>Pádua</i> : Are there rules in "games against nature"? Lessons learnt from the development of an HIV vaccine |
| 15:00 | Break |

| | | |
|-------|--|--|
| 15:30 | Parallel Sessions III | |
| | Distance and Proximity in Knowledge Production <i>Chair: Wouter Boon RA1501</i> - Frenken, Boschma, Hardeman & Ter Wal: Proximity and collaborative mode 2 knowledge production: the case of non-pharmaceutical Type 2 Diabetes Mellitus research in Europe - Hasse & Passarge: Swiss biotechnology as an alternative mode for radical innovations- contingencies, institutional practices and theoretisation - Holl & Rama: The technology sourcing of Spanish biotechnology firms - Klerkx & Aarts: The interaction of multiple champions in innovation networks: conflicts and complementarities | |
| | Creating Transnational Strategic Science Spaces <i>Chair: Liudvika Leioste RA2501</i> - Barker & Cox: The Europeanisation of metrology research-how national research managers have built a European programme and what it means for research governance - Larédo: The rationales and processes of the European Research Council - Van der Meulen & Hoedemaekers: International research programs: research dynamics and governance | |
| | Challenges of Intellectual Property Protection <i>Chair: Nico Groenendijk RA2502</i> - Böschchen, Brandl, Gill & Spranger: Cultures of knowledge, cultures of autorisation and the governance of intellectual property - Adams: Patent protection, governance, and economic growth in developing countries - Kica, Rodrigues & Groenendijk: High-quality patents for emerging science and technology through external actors: Community scientific experts and knowledge societies | |
| | Creating Spaces for Exploring Promises and Risks as a Tool for Governing EST <i>Chair: Will McDowell RA2504</i> - Van Lente, Rip & Stegmaier: Assessing nanotechnologies: the future of reflexive co-evolution - Bitsch: Tentative governance in the innovation journey of genomics and healthcare - Stermerding & Walhout: Governance challenges in the field of synthetic biology | |
| | Methodological Perspectives <i>Chair: Nelly Oudshoorn RA2503</i> - Leydesdorff & Rafols: How emerging technologies conquer the world: diffusion, differentiation, and transformation into research technologies - Van Rijswoud: Comparing settled and emerging governance arrangements from a biographical-narrative perspective: the cases of hydraulic engineering and virology - Flipse & Osseweijer: Laboratory engagement in for-profit context | |
| 17:00 | Break | |
| 17:15 | Evening Lecture WA2 | Arie Rip A Tentative Scenario for the Future of our Science Institutions (Chair: Peter Stegmaier) |
| 18:00 | WA2 | Launch of the new Eu-SPRI Forum The European Forum for Studies of Policies for Research and Innovation |
| 20:00 | Parklocatie de Jaargetijden, Enschede, Volkspark Conference Dinner & Jury Prize for Best Poster in Conference | |

| Friday, 29 October 2010 | | |
|--------------------------------|---|--|
| 09:00 | Parallel Sessions IV | |
| | Governance of and by ICT <i>Chair: Nelly Oudshoorn RA1501</i> - Kurt: Interaction, networking, integration: a challenging route for the Turkish ICT sector in Europe? - João Simões & Santos: Building governance in Portugal: some reflections upon the Digital Cities and Regions Program - Robinson et al.: The Emerging Governance of Virtual Research Communities | |
| | Strategic HEI Research Governance Regimes for Emerging Life-science Fields <i>Chair: Ben Jongbloed RA2501</i> - Leisyté: The strategic responses of university researchers to the challenges of the higher education and research reforms in England and the Netherlands - Stermerding & Nahuis: Genomics as a new innovation regime: implications for governance | |
| | Regulation by Standardisation I <i>Chair: Ron Holzhaecker RA2502</i> - Aanestad & Hanseth: Governance of bottom-up standardisation processes - Daemrich: Co-innovation of materials, standards, and markets: BASF's development of Ecoflex - Jakobs: Governing ICT standardisation | |
| | Governance of Promises & Risks-Between Opening up and Closing down <i>Chair: Kornelia Konrad RA2504</i> - Warnke: Foresight as tentative governance instrument-evidence from Germany - McDowell: Roadmaps, transition management and the governance of hydrogen energy - Parandian, Rip & te Kulve: Dual dynamics of technological promises and waiting games around nanotechnology | |
| 10:30 | Break | |

| | | | |
|-------|---|--|---|
| 10:45 | Parallel Sessions V | | |
| | Organizing Collaboration - <i>Korbee</i> : Different governance settings in the adoption of eco-dynamic designing - <i>Vasileiadou</i> : Research teams as complex systems and implications for research governance - <i>Kloet & de Cock Buning</i> : How to read the fine print of science's social contract and deal with the knowledge paradox? | | Chair: Roel Nahuís RA1501 |
| | Strategic Governance of Science in Emerging Marketplaces - <i>Beerkens & Jongbloed</i> : University-industry partnerships: between mission and market - <i>Sanchez & Elena</i> : Changing patterns of governance and management in European universities: emerging paradoxes in Spanish universities - <i>Van der Most</i> : Gearing research councils towards funding of emerging science and technology | | Chair: Dirk Stemerding RA2501 |
| | Regulation by Standardisation II - <i>Delemarle & Throne-Holst</i> : The role of standardisation in the shaping of a vision for nanotechnologies - <i>Forsberg</i> : The role of ISO in the governance of nanotechnologies - <i>Dorbeck-Jung</i> : How can standardisation and other forms of 'soft' regulation enhance responsible nanotechnological development? | | Chair: Ramses Wessel RA2502 |
| | Assessing Discourses of Promises & Risks I - <i>Wullweber</i> : The strategic governance of nanotechnology: social struggles for public acceptance - <i>Oudshoorn</i> : Assessing expectations. Promises and silences in discourses of websites of producers of telecare technologies - <i>Van Oost</i> : Mapping the ELSA-discourse on humanisation trends in social robotics | | Chair: Philine Warnke RA2504 |
| | Methods of Assessment - <i>Roelofs, Broerse & Bunders</i> : Constructive Technology Assessment on ecological genomics: challenges and strategies for reflexive learning - <i>Rask, Jacobi & Damianova</i> : Citizens, visions and research agendas – balancing between analysis and deliberation | | Chair: Ruud Smits RA2503 |
| 12:15 | Lunch | | |
| 13:00 | Parallel Lunchtime Lectures | Roger Brownsword Rights, Regulation, and the Technological Revolution Chair: Bärbel Dorbeck-Jung RA1501 | Richard Whitley Changing Governance and Authority Relations in the Public Sciences Chair: Jürgen Enders RA2501 |
| 13:45 | Parallel Sessions VI | | |
| | Governance of Laboratory Work - <i>Ravesloot, Bimmel & Borm</i> : Organizing collaboration in innovative design and collective intellectual property - <i>Ulinicane-Ozolima & Kuhlmann</i> : International collaboration in nano S&T as a change mechanism in research institutes - <i>Rafols, O'Hare, Perianes, Hopkins & Nightingale</i> : Collaborative practices and technological trajectories in large pharmaceutical firms | | Chair: Philippe Larédo RA1501 |
| | Innovation Policies - <i>Fallon</i> : Struggling with emerging instruments in Belgium: how do institutions adapt to contingency of tentative governance - <i>Laranja</i> : Networked governance of innovation policies: the "Technological Plan" in Portugal - <i>Flanagan, Uyarra & Laranja</i> : Complexity and co-ordination: reconsidering the 'policy mix' for innovation | | Chair: Ruud Smits RA2501 |
| | Regulating Technologies: Asian Perspectives - <i>Rajan</i> : Scientific uncertainty. Risk and democracy-the case of India - <i>Barpujari</i> : Informational regulation of emerging technologies in India: a comparative study of nanotechnology and agricultural biotechnology | | Chair: Víctor Rodríguez RA2502 |
| | Assessing Discourses of Promises & Risks II - <i>Coenen</i> : Tentative governance of synthetic biology: a comparative perspective - <i>Kanerva</i> : Nano S&T in the global south: assessing risk discourses - <i>Orwat & Büscher</i> : New perspectives for technology assessment | | Chair: Ellen van Oost RA2504 |
| | New Fields of Governance Research - <i>Karo & Kattel</i> : Governance of STI Policies: re-thinking the coordination challenge - <i>Mölders</i> : Open spaces and the Single European Sky | | Chair: Gonzalo Ordóñez RA2503 |
| 15:15 | Break | | |
| 15:30 | Closing Roundtable Discussion RA1501 | Tentative Governance of EST: a Useful New Research Perspective? S. Borrás, R. Brownsword, S. Cozzens, P. Larédo, A. Rip, R. Whitley Moderated by S. Kuhlmann | |
| 16:15 | RA1501 | Book Presentation & Drinks "The Theory and Practice of Innovation Policy-An International Research Handbook" (Edward Elgar) | |
| 17:00 | End of Conference | | |

EXTENDED ABSTRACTS PAPERS & POSTERS

Da Vinci Surgery? “It’s a No-brainer”

Robot-assisted Prostate Surgery in the Mirror of Statutory Health Insurance

Payam Abrishami, MD, MA, Pabrishami@cvz.nl
Dutch Health Care Insurance Board (CVZ)

Context

After the introduction of the Health Care Insurance Act in the Netherlands, stakeholders in the context of care delivery were granted a large degree of freedom of choice to finance, provide and request many new forms of curative care (i.e., the non-urgent B-segment of care). At the same time, the nature of the statutory health care benefits package was ‘open’, thereby permitting the automatic reimbursement of the majority of innovative therapies and a reimbursement assessment for only a few.

Once freedom of provision is granted within an open system of managing the benefits package, the dynamics of the need to implement/use a new form of care is a subsequent crucial issue that a benefits package manager should explore. At the heart of this issue lies the ‘perceived benefits’ of the new therapy, or simply, the reasons why someone demands the new therapy.

To examine this issue, one of the latest surgical treatments for prostate cancer, robot-assisted laparoscopic prostatectomy (RARP), was chosen as a prototype (case study) of high-tech health care innovations. The core element of this surgical treatment is the da Vinci robotic device; a state-of-the-art technology that allows surgeons to perform operations remotely. It is a promising innovation that has been received with profound enthusiasm, most notably by urologists for the surgical removal of cancerous prostate. This therapy is, however, expensive and its superiority is still unproven with the available clinical and economic evidence. For these reasons, there must be convincing arguments and rationales about the benefits of this treatment that drive stakeholders to demand it. The main research question is therefore: ‘How is the demand (sense of need) to purchase, implement and request the da Vinci robot for prostate surgery constructed within the context of care delivery in the Netherlands?’

Method

This is an empirical qualitative study inspired by an ethnographic approach under the domain of Health Services Research (HSR). In addition to consulting many relevant internet sources, a sample of 28 respondents from geographically diverse locations in the Netherlands were comprehensively interviewed. These included urologists, hospital managers, advisors of private health insurance companies, patients, a board-member of the prostate cancer patients’ organisation, an operating theatre nurse, an epidemiologist, an organiser of international medical congresses, health care journalists and advisors of health care regulatory organisations.

Results

- The perceived benefits of the da Vinci operation are examined in the following processes:
- The premise of progress, technological precision and fascination,
- A new-is-better mindset together with a taken-for-granted assumption that high-tech care is high quality care,
- The ‘symbiotic’ enthusiasm of stakeholders for incremental development of the technology and its applications, sometimes supported by government innovation funds,
- The ‘compatibility’ of the da Vinci device with the field of urology, in particular for prostate surgery and the opportunity it provides to move towards minimally invasive surgery,
- Considerable scientific (research) career opportunities for medical professionals to contribute to the clinical/technical science surrounding the da Vinci robot,
- Perceived improved ergonomics of operating with the da Vinci system,
- Perceived improved competitive position that allows competing care-providers as well as private insurers to gain prestige and perhaps profit by attracting more clients,
- Patients’ perceived superiority of RARP based upon the information they receive via various communication channels or via the patient-urologist relationship (driven by the urologist’s interest and his/her professional authority),
- The intriguing nomenclature of the device, framed with the words ‘robot’ and ‘da Vinci’,
- Manufacturer’s publicity and promotional activities, targeting both medical professionals and the public, and
- The mass media’s mainstream image-building of the da Vinci system as a seductive state-of-the-art technology.

These benefits are subject to constant negotiation as demonstrated in the interactions between the stakeholders involved, namely, the manufacturer, providers (including scientific communities), receivers (patients), and insurers. The characteristics construct and disseminate a sense of need among stakeholders and enhance the demand for RARP. While adopting RARP apparently involves a choice, the enthusiasm of stakeholders brings about a sense of

inevitability in demanding RARP. The mindset that using the da Vinci device is 'the way to go' or a 'no-brainer' is reproduced within the context of care delivery and leaves little room for further hesitation by potential adopters and patients. After purchasing and during the course of implementation, another pressure (marked sense of an inevitable need) comes to be perceived. The need to purchase is now replaced by a subsequent imperative for ever-expanding use of the robot to enhance surgical skills, produce more scientific evidence, and more notably, to meet the break-even point for costs. In fact, the da Vinci system offers users the capacity to increase not only therapeutic productivity (state of the art surgery) but also scientific (clinical research), technical (device development) and economic (profit/status) productivity. Accordingly, over-treatment ('doing more') can be an expected direction of care delivery.

Conclusion

In the current Dutch health care system, the demand constructed around state-of-the-art health care innovations leans financially, in part, on the social health insurance fund. Besides driving up health care costs, the fulfilment of such demands may impede optimal utilisation of the collective insurance fund through service overuse and/or supply-induced demand. This re-emphasises the regulatory capacity of financing arrangements such as reimbursement policy (for collective health insurance). Regulating demand by means of reimbursement policy does not aim at hindering innovations but at ensuring meeting a realistic demand whilst optimising the health gains for the Euros spent by the social health insurance system.

Part of the regulatory capacity of reimbursement policy may come into effect by communicating with the stakeholders regarding the concerns/risks at a collective/national level, hence, influencing them to be more critical in weighing up health care innovations. The potential to channel the incentives of stakeholders in demanding and delivering socially-robust innovations indicates the strategic position of reimbursement policy in the governance of health care innovations on a collective or national level.

Patent Protection, Governance, and Economic Growth in Developing Countries

Samuel Adams, Ghana Institute of Management and Public Administration, sadamss2000@yahoo.com

A key feature of the knowledge economy is the increased importance of tools (patents, copyrights, trademarks, and licenses) to protect intellectual property. Chief among the formal means of such protection is the patent, which is defined as the legal right of an inventor to exclude others from making or using a particular invention (Hall, 2007). This right is sometimes termed an intellectual property right (IPR) and is viewed as incentive for innovation. Over the past decade, the development and use of products embodying intellectual property rights have increased considerably. Indeed, one of the most dramatic changes with respect to the global economy is the development of international economic law (Yueh, 2007).

The need to promote strengthen IPR has gained prominence in development literature because it motivates technological change, which plays an important role in promoting economic growth (Chu & Peng's, 2009). The creation of an effective IPR regime has an effect not only on the incentive for new knowledge creation and its dissemination, but even more important, the market structure, prices and distributional equity. Chen and Puttitanum (2005) argue that even if the developing do not benefit directly from strong IPR protection in their trade with the developed countries, they may still benefit in terms of domestic innovative activities. It is not surprising therefore to note that the protection of IPR has moved from an arcane area of legal analysis to the forefront of global economic policymaking (Maskus, 2000). To sum it all, the Deputy Director of the World Intellectual Property organization, Rita Hayes in 2003 claimed that intellectual property rights protection will provide a powerful engine for economic development of nations in the 21st century.

Many other experts, however, question the positive effect of IPR on economic performance in the context of developing countries with low innovative capabilities (Leger, 2005; Maskus, 2000). Leger (2006) observed that the very low innovative capabilities of the less developed countries limit the potential of IPRs to support local innovation. Others also indicate that strengthening IPRs may result in job losses; drive up prices due to monopoly and reduce access to technology needed for development (Hillery, 2006; Kumar, 2002).

The ambiguity in the theoretical assertions have led to many empirical studies on the IPR, economic growth and income inequality, however, the results of these studies are also not conclusive. The generalizability of such studies, however, is limited as the developing and developed countries differ in their political, sociocultural, and scientific and technical capacities (CIPR, 2002). For instance, Schneider (2005) found distinct effects of IPRs on the developed and developing country groupings and suggested that pooling together developed and developing countries might lead to misleading conclusions and hence inadequate policy recommendations. To reduce the bias in the regression estimates, this study examines the impact of IPRs on economic growth in the context of developing countries between 1970 and 2005, based on a panel data set consisting of five separate 5-year periods, using OLS, OLS, seemingly unrelated regressions (SUR), LSD, fixed and random effects estimation techniques

Initial results indicate that the effect of IPR on economic growth based on 1985-2003 data is negative and significant. This finding supports Park and Ginarte (1997) claim that countries not conducting innovative research would enjoy few, if any, of the benefits of IPR protection. Park and Ginarte (1997, p.51) described the effect of strong IPRs in developing with an analogy, which goes as follows:

[C]onsider a town with few, if any vehicles. If the town passes a law against lead emissions, the law is likely to have no effect on lowering pollution.

However, when we tested for differential effects of IPRs on economic growth before and after the passage of TRIPS agreement, the results show a significant positive effect of the TRIPS*IPR interaction variable. This demonstrates that the effect of IPR on economic growth after 1995 (when TRIPS took effect) is far and above the pre - 1995 period. This positive effect, however, could be related to many other factors associated with overall economy, as most of the countries in the developing countries also implemented other social, economic and institutional reforms to promote economic growth.

Because of the possibility of regional effects of the relationship between IPRs and economic growth, we did a further examination of the relationship between IPR and economic growth in the context of SSA countries over the period 1970-2008. The regression results show that IPR is positive and significantly correlated with economic growth, a result that is consistent with Chu & Peng's (2009) finding that increase in patent protection in either the north or south leads to an increase in welfare. A similar argument was made by Lai and Qiu (2003) and Grossman & Lai (2004) that global welfare is always higher under an enhanced IPR protection. Thompson & Rushing (1999), however, showed that strengthening patent protection has a positive effect only in countries that have a GDP per capita above \$4000.00 meaning that strengthening patent protection should benefit only developed countries. The supposed negative effect is based on the fact that the enforcement of IPRs shifts financial benefits to those who have knowledge and inventive power, and to decrease the costs of access to those without (which indeed is the situation for most SSA countries).

On the other hand, it is possible that the use of more recent data may account for the differences in results. Further, a negative relationship does not necessarily mean that IPRs are not good for the region, but that it needs a more effective governance or institutional environment to operate efficiently. As noted by Braga & Fink (2000), developing countries could achieve substantial gains from IPR reforms by establishing an effective governance infrastructure for knowledge acquisition and development of innovative capabilities in the new global economy. The literature reviewed and the findings of this study suggest that one size fit all strategy for promoting IPR protection might be optimal. The way forward might for more country specific studies.

The Brokers:

The Case of Jatropa Network in Indonesia

Yuti Ariani Fatimah, Jon C. Lovett

CSTM - Twente Centre for Studies of Technology and Sustainable Development
University of Twente, y.arianifatimah@utwente.nl

Introduction

This research elaborates the concept of intermediary agency in facilitating transitions from one socio-technical system to another. Traditionally the intermediary operates in a static state. In science and technology studies (STS), the concept of an intermediary refers to agencies connecting two or more different patrons (Braun, 1993; Rip, 1994). Later, van Lente et al. (2003) defined intermediary agencies based on their functions to 'connect, translate and facilitate flows of knowledge' (p. 2). This concept was built on the transition to sustainable development, which functions at a system or network level and operates in the long-term with complex changes.

In actor-network theory (ANT), an intermediary is defined as something that passes anything between actors without transformation (Bijker and Law, 1992). Absence of transformation distinguishes intermediaries from actors defined as 'entities that do things' (Latour, 1992:241). However, by using the ANT basic assumption that force, knowledge or power may be seen as an effect of a heterogeneous network (Law, 1992), then the distinction between intermediaries and actors becomes more a labelling issue than a theoretical one. In this research, both of the terms are used in order to contrast the changing roles of actors in a transition from one socio-technical system to another.

Combining the concepts from STS and ANT creates a working definition as follows: (i) intermediary agencies play a role in connecting different socio-technical systems; and (ii) the dichotomy between intermediary and actor is used to analyse the degree of entanglement of the new socio-technical system emerge. Here we use the term 'broker' for the role of intermediary in the case of Jatropa development in Indonesia in order to test the definition derived from the combined concepts.

Jatropa Development in Indonesia

Jatropa development in Indonesia was built on both the energy crisis and poverty discourses which require at least transitions in the energy system, agricultural system and socio-economic system. To elucidate the dynamic of the

jatropha initiative in Indonesia, this research follows jatropha's actors at both the national level affecting the national policy and at the village level.

The Jatropha discourse at national level can be traced back to the mid 2000s when the Indonesian government conducted a study on biofuel development in India. A year later, Indonesia's President, Susilo Bambang Yudhoyono held an internal meeting with his Ministers and relevant stakeholders in Losari, Central Java to support jatropha development. The meeting was followed by number of regulations on biofuel development.

Coming from Indonesia's top leader, the national call to develop biofuel was followed by a range of activities. However, not all of the activities ended as expected. There were cases where the farmers withdraw their involvement for cultivating jatropha due to the low price of the crop in the existing market. To understand why one area succeeds in maintaining the jatropha development while the others failed, two villages with contrasting results were chosen: Mandalasari village in West Java and Labuhan Alas village in West Nusa Tenggara.

In Mandalasari, jatropha cultivation was pioneered by a member of a local farmer group named Pager Warna in December 2005 after receiving information from an ITB's (Institute of Technology Bandung) scientist about jatropha potential for fossil fuel substitution (Amir et al., 2008). As a member of Pager Warna, the farmer extended his network by involving other members, and later to other groups. The buyer was DPKLTS, an environment organization formed by Sundanese elites to aid local farmers (Amir et al., 2008). However, as the amount of jatropha production increased, DPKLTS could not absorb it. As result, the farmers withdraw their involvement in jatropha development.

In the second case, in Labuhan Alas, the cultivation was pioneered by a jatropha broker who was placed at the intersection of two different systems: the agricultural system in Labuhan Alas, West Nusa Tenggara and the academic system in Bandung, West Java. In 2003, he supplied jatropha from his homeland in Labuhan Alas to the scientists in Bandung where he got his bachelor degree. In 2009, he started to expand his role by establishing a bio-diesel plant with support from ITB, a Japanese company and a telecommunication company.

Table 1 Comparison between Mandalasari and Labuhan Alas

| | Mandalasari, West Java | Labuhan Alas, West Nusa Tenggara |
|------------------------|--|--|
| Initial Phase | | |
| Brokers | Pager Warna; DPKLTS | Jatropha supplier |
| Roles | Connecting jatropha seed with the farmers; connecting the farmers with the aid | Connecting jatropha farmers in Labuhan Alas with scientists in ITB, Bandung |
| Secondary Phase | | |
| Brokers transition | None | Bio-diesel producer |
| Result | The initiatives failed to create a new integrated socio-technical system; the transition maintain the actor's function, but failed to shift it into the jatropha-network | The initiatives succeed in creating a new integrated socio-technical system covering transition in the agricultural system, academic system, and energy system; the transition maintained the actors' network by changing their function |
| Approach | Function oriented | Actor oriented |

Conclusion

Contrasting the two villages, the existence of the brokers can be found in the initial conception phase when the initiator attempted to predict actors' possible reactions and create a working plan based on the prediction. In the existing literature, the brokers are defined as a connector among different system e.g: knowledge system and market system. However, if the broker(s) succeed in connecting the different systems then their existence in the system is indicated by a specific role.

In Labuhan Alas for example, at the initial phase, there were two systems namely an agricultural system in West Nusa Tenggara and academic system in West Java. Through the existence of the broker, both of the systems integrated into a new 'bio-fuel system' where each of the actors involved hold a unique role. Therefore, in a stable state, distinction between intermediary (or broker) and actor becomes meaningless. On the contrary, in explaining transition, the dichotomy between the concept of intermediary and actor can be used to resolve the degree of entanglement. The more that an intermediary can be replaced by an actor, the more difficult it is for the existing systems to transform into an integrated one (unstable condition).

Acknowledgements

Yuti Ariani thanks to Indonesian Ministry of Education for the scholarship granted

References:

- Amir, Sulfikar, Ida Nurlaila, and Sonny Yuliar (2008), "Cultivating Energy, Reducing Poverty: Biofuel Development in an Indonesian Village", *Perspectives on Global Development and Technology* 7 (2008) 113-132.
- Braun, Dietmar. 1993. Who governs intermediary organizations? Principal-agent relations in research policy-making. *Journal of Public Policy* 13 (2): 135-62.
- Bijker, Wiebe; Law, John (eds.) (1992). *Shaping Technology / Building Society Studies in Sociotechnological Change*. Cambridge, MA: MIT Press.
- Dillon, Harbrinberjit Singh, Tara Laan and Harya Setyaka Dillon (2008). Biofuels at what cost? Government support for biodiesel and ethanol in Indonesia. Report for Global Subsidies Initiative of the International Institute for Sustainable Development.
http://www.iisd.org/pdf/2008/indonesia_biofuels.pdf. Accessed on 2nd February 2010.
- Latour, Bruno (1992a). The Sociology of a Few Mundane Artifacts. In Bijker, Wiebe; Law, John (eds.) *Shaping Technology / Building Society Studies in Sociotechnological Change*. Cambridge, MA: MIT Press.
- Rip, Arie. 1994. The republic of science in the 1990s. *Higher Education* 28:3-23.
- Van Lente, Harro, Marko Hekkert, Ruud Smits and Bas van Waveren (2003). 'Roles of Systemic Intermediaries in Transition Processes', *International Journal of Innovation Management* Vol. 7, No. 3 (September 2003) pp. 1–33.

The Emerging Governance of Virtual Research Communities

Franz Barjak,^{*} Kathryn Eccles,⁺ Eric T. Meyer,⁺ Simon Robinson,[#] and Ralph Schroeder⁺

^{*} School of Business, University of Applied Sciences Northwestern Switzerland

⁺ Oxford Internet Institute, University of Oxford

[#] empirica Gesellschaft für Kommunikations- und Technologieforschung mbH

Corresponding author: franz.barjak@fhnw.ch

Acknowledgements

The paper mainly draws on data collected within the eResearch 2020 study (<http://www.eresearch2020.eu/>) funded by the European Commission, DG Information Society & Media. Part of the work (at the Oxford Internet Institute) was also supported by ESRC grant RES-149-25-1022 for the Oxford e-Social Science (OeSS) project: Ethical, Legal and Institutional Dynamics of Grid-enabled e-Sciences.

Introduction

E-infrastructure – or cyberinfrastructure in the US – is a new type of infrastructure for research that has obtained significant funding at national and international levels over the past 10 years. The common characteristic of these efforts is that they draw on geographically distributed digital resources, such as data, computing power, visualization technology, and storage, to provide services enabling the resource sharing and collaborative work essential to collaborative research. Many funded ventures fitting this definition of distributed ICT-based support systems are currently attempting the transition from local provision in a project setting to larger-scale, production-quality provision and sustainable financing of an e-Infrastructure. This transition requires very significant changes in several aspects (Jackson, Edwards, Bowker, & Knobel, 2007; Star and Ruhleder, 1996), including the governance of the various infrastructure activities, following Stoker's (1998, p. 17) rather broad understanding of governance as "ultimately concerned with creating the conditions for ordered rule and collective action. The outputs of governance are not therefore different from those of government. It is rather a matter of a difference in processes."

There are many practical demands, such as achieving the best mix of centralised and decentralised decision-making and safeguarding inter-operability in decentralised institutions (= effective coordination), generating transparency and accountability of resource provision and involvement of users, or at last finding sustainable funding models. In addition to these practical demands, we find that there is little social science analysis of the governance of emerging e-infrastructures.

In our exploration of emerging patterns of governance of e-Infrastructures we generate more systematic information at the level of individual e-Infrastructures. We ask how the transition from a project to more permanent governance of e-Infrastructure proceeds, whether there are different trajectories of e-Infrastructure governance transition and what different governance structures are emerging under what circumstances.

Theory

Given that the purpose of e-infrastructure provision is to support scientists in their work, the governance of e-infrastructure for scientific activity cannot be seen independently of the context of the governance of scientific activity as a whole. Science itself is not autonomous of outside governance structures, and it appears that the governance transition processes we are studying are strongly related to the intersection of endogenous (by scientists) and exogenous governance (by funders and other stakeholders) of scientific activity, i.e. related to where "governance in science" meets "governance of science".

The increase in availability and power of services based on modern information and communication technology (ICT), not least the Internet, had an impact on the governance in and of science (in addition to other recent processes). It weakened traditional gatekeeping rights by providing new routes for the exchange of the results of scientific activity ("open access"). Some new facilities and services such as the pooling of distributed computing power, the sharing of primary data, remote access to research equipment or the activation of external resources for scientific work, have the potential to change the process of knowledge production itself and to extent already have done so. These new support systems and applications did not appear out of nowhere. They typically originate from within scientific communities, adopting important elements and input from existing services (computing centres, instruments, data archives, etc.), and utilising existing contacts to funding and other stakeholders.

In terms of governance this transition and emergence of an infrastructure is in our view best described by the following five variables.

- Size and scope,
- Embeddedness in a community,
- Elementary mechanisms of coordination,
- Formality of governance,
- Time horizon

Sample

This paper is based on case studies for 16 e-infrastructures/projects which were assembled during the eResearch2020 study for the European Commission, DG Information Society & Media (see Table 2). The cases cover different types of service: services based on Grid computing (OSG, EGEE), supercomputing services (TeraGrid, DEISA2), providers focussed on raw connectivity (GEANT), and providers of access to specialist data (Swedish National Data Service, C3-Grid, Clarin). The study included systems specialised for their field of science, including the life sciences (MediGrid, Swiss BioGrid), the physical sciences (US-NVO), social sciences and humanities (Clarin), as well as services for communities outside traditional academic disciplines (Driver for libraries or CineGrid for cinematic production). The cases were sampled to cover the discipline categories of the ESFRI roadmap (ESFRI, 2008). Corresponding to today's e-Infrastructure landscape, there is also considerable variation in the geographical range of the cases, some span multiple continents; some cater to regional populations of scientists; while others concentrate their activities on a specific country. The cases also differ in regard to their "maturity" reflecting the current dynamic state of development. Some cases have already developed most of their services and have likely reached their peak (OGF), other projects have offered tools and engaged users, but expect to considerably expand their service repertoire and extend their user community (US-NVO, DEISA2, OSG, TeraGrid), while others are at a much more formative stage (CLARIN).

Results and conclusion

We have found considerable variety in governance arrangements of the studied cases. Looking at size and scope only, we see that only few cases would clearly result either as e-infrastructures (CineGrid, EGEE, Géant, OGF) or local support systems (MediGrid, US-NVO, Swiss BioGrid), whereas the majority lies in between. This can be seen to arise both from their different governance requirements, relating to the specific services, the targeted user groups and the geographic spread of provision, and in particular to the varying progress the cases in our sample have made towards a large-scale and production-quality e-Infrastructure.

Distinguishing the cases along all five variables we find that some of them have reached this level consistently or are very close to reaching it (CineGrid, EGEE/EGI, Géant, OGF, OSG, TeraGrid). On the opposite side there are few ventures which still remain in the project stadium (MediGrid, Swiss BioGrid) which probably is not sustainable in the long range – both cases have in the meantime terminated their activities. In between are many cases with varying levels of development and forms of governance.

Among those cases which meet the characteristics of an infrastructure in regard to governance we can broadly distinguish two types: The first and predominant type are large-scale e-infrastructures providing connectivity or distributed computing services (EGEE/EGI, Géant, OSG, TeraGrid) at different geographic levels and to many disciplinary communities. They tend to be in the format of meta-organizations with organizational members and formal governance resting on material incentives, vertical relationships (between the coordinator and the distributed members) and contracts or binding agreements. The second and less frequent type are e-infrastructures which are strongly anchored in a few communities, notably in scientific communities as well as communities of practice (CineGrid and OGF). These are coordinated by trust and reciprocal action securing their existence by small-scale funding through membership fees and dedicated contributions.

We do not identify a clear third alternative to the described two types and it seems that the other cases (C3-Grid, CLARIN, D4Science, DEISA, DRIVER, EELA-2, ETSF, US-NVO) would need to choose one road to avoid the destiny of becoming stalled and most clearly failed initiatives like MediGrid and Swiss Biogrid.

References

- Jackson, S. J., Edwards, P. N., Bowker, G. C., & Knobel, C. P. (2007). Understanding infrastructure: History, heuristics and cyberinfrastructure policy [Electronic Version]. *First Monday*, 12. Retrieved 03.09.2010 from <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1904/1786>.
- Star, S. L., & Ruhleder, K. (1996). Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces. *Information Systems Research*, 7(1), 111-134.
- Stoker, G. (1998). Governance as theory: five propositions. *International Social Science Journal*, 50(155), 17-28.

The Europeanisation of Metrology Research – how national research managers have built a European programme and what it means for research governance

Katharine Barker¹, kate.barker@mbs.ac.uk, and Deborah Cox (MIOIR, Manchester Business School)

This paper will report on work² undertaken in the context of understanding more about the roles of non-university public research institutes in the European Union context. We have undertaken a historical review, mapping and characterisation of metrology research institutes, including interviews with senior managers to understand the evolution and recent changes in the institutes. We then undertook a foresight exercise, again with the managers and related experts, to gain an understanding of drivers for change and future scenarios.

This sector is extremely interesting as it shows how managers have formulated and orchestrated a new funding model, namely a European programme of metrology research, which is now implemented as an Article 169 action. Highly diverse organisations (in terms of size, funding and research capacity, as well as in national context) now coordinate and share a common R&D programme, mainly as a response to static or dwindling budgets for research and also anticipating competitive threats from outside Europe. This case demonstrates how highly nationally-focussed institutions have acted pro-actively and strategically well beyond their institutional boundaries and entered into national research policy and European decision-making processes.

Public research institutes in other fields identify the need for more European cooperation, with diverse drivers for this. The paper reflects upon the lessons for governance which the metrology case offers for other domains, and argues that this model is not necessarily likely to emerge elsewhere.

University-industry partnerships: between mission and market

Maarja Beerkens and Ben Jongbloed, University of Twente
m.beerkens@utwente.nl, b.w.a.jongbloed@utwente.nl

Universities' cooperation with the business sector is nowadays a rule rather than an exception. Existing research shows that universities engage in such partnerships for a variety of reasons: additional financial support; broadening the experience of students and staff; identifying interesting and relevant problems; enhancing regional development, and increasing employment opportunities for students (Prigge 2005). This paper explores whether the rationale for developing university-industry partnerships (UIP) has an effect on internal university policies and on the university's research performance. We use two case studies as an example of different approaches to UIPs: Maastricht University and Twente University. We analyse the cases in the framework of the university production function.

According to a standard economic production function for non-profit entities, universities try to maximize their mission related objectives while being constrained by financial resources as determined by the market (Massy 2009). Cooperation with industry can enter the equation on either side – as an objective function or as a constraint. It is an objective if UIPs are seen as a part of the core mission, and it is a constraint if UIPs are a way to gain additional resources that could be reinvested into core activities. We argue that the two universities follow a different logic. In Twente, known as an entrepreneurial university, UIPs are a part of the core mission and a performance goal in itself. Maastricht University attempts to profile itself more as a research excellent university and uses UIPs strategically for advancing research capacity and generating additional funds. Otherwise the two universities face quite similar external constraints and opportunities, as determined by national policies, regional incentives and their history.

The two case studies are based on a series of interviews with university representatives and the analysis of university documents and performance data. The paper draws from a project "Good University-Enterprise Partnerships – Good UEP", funded by the European Commission, that examines the effective governance of university-enterprise partnerships in 6 countries and 18 universities.

¹ Corresponding author: Katharine Barker, Manchester Institute of Innovation Research, Manchester Business School, kate.barker@mbs.ac.uk

² Project funded by DG Research of the European Union "Analysis of Public Research Institutes in Europe in Selected S&T fields: historical evolution and future scenarios"

The analysis is currently still in progress. The preliminary results seem to suggest that some difference in the trajectory of how the two universities are developing can be noticed. However, the differences are quite small, probably because of the overpowering dependence on the financial constraint. Lastly, UIPs can develop successfully regardless of whether they are seen as a core mission or as a resource generating activity.

Massy, W.F. (2009) Academic values in the marketplace. *Higher Education Management and Policy* 21(3): 51-66.
Prigge, G.W. (2005) University-industry partnerships: what do they mean to universities? *Industry & Higher Education*, 19 (3): 221-229.

Adaptation to Climate-Change Induced Flooding in Dutch Municipalities¹

Maya van den Berg, *CSTM-Twente Centre for Studies in Technology and Sustainable Development*
University of Twente, m.m.vandenberg@utwente.nl

1. Introduction

Climate change is real. Rising sea level, increasing average temperatures and more severe weather events are already occurring, and, moreover, North-western Europe is experiencing rising temperatures that exceed the predictions of some climate change scenarios. Even if we were to cut our emissions of greenhouse gases today, climate change would continue due to the accumulation of gases emitted in the past. Because of this, the need to take adaptation measures is urgent (IPCC 2007).

Although national governments are now taking a lead on the issue of climate change adaptation, the European Commission has emphasized the crucial role of local authorities (COM 2009). The Dutch National Adaptation Strategy, too, has referred to the importance of local level government (Ministry of VROM 2007). The local level is considered to be essential since it is where the most comprehensive information on local characteristics is available, where civil awareness can be most effectively raised and where impacts are most felt. As Næss et al (2005) argue: while a country can, as a whole, often be considered resilient, its local communities can nevertheless be at risk due to local economic conditions, geography and the state of infrastructure.

Local adaptation to climate change has recently drawn considerable research attention (e.g., Adger & Vincent 2005; Adger, Arnell, & Tompkins 2005; Wall & Marzall 2006; Wilson 2006; Smit & Wandel 2006; Amundsen, Berglund, & Westskog 2010). Yet very few studies address how local institutional capacity affects levels of preparedness. Therefore, this study focuses on local adaptation strategies by exploring the effect of institutional capacity on local initiatives in the Netherlands. We aim to offer an enhanced knowledge base for scientists and politicians occupied with the development of local adaptation strategies.

2. Research Design

We selected cases based on three variables in order to determine the extent to which they drive adaptation efforts. First, the *history of exposure* dimension was operationalised in relation to the 1953 North Sea Flood and the 1993/1995 high waters –events that could be assumed as ‘settled’ in the institutional memory of the relevant cases.² The impacts of flooding events resulted in the definition of two potential research areas. Second, we differentiated the dimension of *increased risk*. This was operationalised by studying the ‘Risk Map’ that shows flood-prone areas – among many other types of risk³. Third, the dimension of *size* was operationalised according to the size of the local population. This resulted in a group of urban and a group of rural cases. The combinations of these three dimensions lead to a preliminary scoping of relevant municipalities, resulting in the selection of nine municipalities that would form our cases for the study.

3. Key Findings

By selecting cases on the dimension of *increased risk*, we aimed to determine the effect of increased risk on the level of adaptation action. However, when comparing high-risk cases to low-risk cases, no clear distinctions can be observed. Compared to the low-risk cases, the five high-risk cases show a larger general awareness of the increased risk. However, climate change induced risks are still not perceived as major threats – though protection is expected from the national government. The two high-risk urban cases distinguish a broad range of climate change effects that

¹ An extended version of this paper is published as Van den Berg, M. M., Lafferty, W. M. & Coenen, F. J. H. M. (2010). Adaptation to climate change induced flooding in Dutch municipalities. In P. Martens and C. Chang (Eds.), *The Social and Behavioural Aspects of Climate Change: Linking Vulnerability, Adaptation and Mitigation*. Greenleaf Publishing: Sheffield UK.

² In 1953, parts of southwestern Netherlands flooded resulting in 1,800 casualties. In 1993 and 1995, the high waters threatened the river dykes in the middle of the country. During the 1995 ‘near-flooding’ event, the largest postwar evacuation in the country took place: 250,000 people (and a million livestock) were forced to move.

³ These regional risk maps are available at <http://www.risicokaart.nl> (in Dutch only).

will affect their area, yet they show differences in the sense of urgency. This difference can be explained from experience (and the lessons learned from that): the 'careless' case fully counts on national protection, whereas the other case—which has experienced flooding in the past—feels a need to act autonomously. Increased risk, as such, did not appear to make a large difference in this.

Another key concept we studied for each case was *institutional capacity*. In our study, we have considered this concept quite broadly: it refers to the governing systems, the resources and manpower of a municipality, and the quality of knowledge present. We found a major division between the rural and urban cases. Compared to their urban counterparts, the rural communities clearly have less manpower and limited means to implement their tasks. It is quite standard here, for instance, that one civil servant may be fully responsible for climate change adaptation. This obviously limits the capacity to maintain a relevant network and improve the necessary knowledge skills. This explains the low levels of concern over climate change in the rural cases, and the correspondingly low sense of urgency for adaptation strategies.

In addition to risk awareness and institutional capacity, the cases show that we must add *sense of urgency*. We connected this condition to a certain feeling of responsibility, which can lead to action. In each case, a certain awareness of increasing climate change risks was present – and all interviewees showed clear awareness of the importance of climate change impacts – but only for some was a lack of adaptive means considered to be a major barrier. In fact, only when the local administrators considered climate adaptation to be their own responsibility was adaptation placed on the political agenda. Only under this condition did a sense of urgency arise over a lack of resources. For instance, the two urban cases that experienced flooding in the past express a clear sense of urgency and state that a lack of resources is the major obstacle for action.

Furthermore, the presence of a Green Party administrator responsible for environmental issues –and a more favourable political environment in general– proved to be the most decisive condition in explaining the different levels of action within the urban cases. Cities are more likely to have a 'green-minded' administrator since the green party receives more votes in cities than in rural areas. One out of the four urban cases we studied did not have a green party administrator –here we observed that the level of action was not as high as in the other urban cases.

References

- Adger, W.N., & Vincent, K. (2005). Uncertainty in adaptive capacity. *Comptes Rendus Geosciences* 337(4), 399-410.
- Adger, W.N., Arnell, N.W., & Tompkins, E.L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change Part A*, 15(2), 77-86.
- Amundsen, H., Berglund, F. & Westskog, H. (2010). Overcoming barriers to climate adaptation—a question of multilevel governance? *Environment and Planning C: Government and Policy* 28(2), 276-289.
- COM (2009). *White paper - adapting to climate change: towards a European framework for action* {sec(2009) 386}{sec(2009) 387}{sec(2009) 388}(Brussels: Commission of the European Communities). Retrieved from http://ec.europa.eu/environment/climat/adaptation/index_en.htm.
- IPCC (2007). Assessing key vulnerabilities and the risk from climate change. Climate change 2007: Impacts, adaptation and vulnerability. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P. J. Van der Linden & C.E. Hanson (Eds.), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge UK: Cambridge University Press.
- Ministry of VROM (2007). *Maak Ruimte voor Klimaat: Nationale Adaptatiestrategie, De Interbestuurlijke Notitie*. Den Haag: Ministerie van VROM. [Ministry of Housing, Spatial Planning and the Environment on National Program on Climate Adaptation and Spatial Planning – in Dutch]
- Næss, L.O., Bang, G., Eriksen, S., & Vevatne, J. (2005). Institutional adaptation to climate change: Flood responses at the municipal level in Norway. *Global Environmental Change Part A*, 15(2), 125-138.
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16, 282–292.
- Wall, E. & Marzall, K. (2006). Adaptive capacity for climate change in Canadian rural communities. *Local Environment*, 11(4), 373-397.
- Wilson, E. (2006). Adapting to climate change at the local level: the spatial planning response. *Local Environment*, 11(6), 609-625.

Representation of Consumer Attitudes and Behaviour as a Means for Better Regulation

Nicola Below (Society for Institutional Analysis (sofia)) and Prof. Dr. Bernd Steffensen (University of Applied Science Darmstadt, below@sofia-darmstadt.de)

Previous experiences show that regulation often

- entails high costs for one of the actors addressed;
- establishes complex administrative requirements,
- mainly generates bandwagon effects or
- does not meet the set targets.

Therefore, initiatives for Better Regulation often centre on economic aspects. In recent years Better Regulation was merely related to simplification processes like the reduction of administrative burdens: these are mostly “information obligations”. But Better Regulation also encompasses the need to take into account economic, social and environmental aspects when considering how to improve or set up regulations that meet the present political targets. Regulation is non-trivial in all cases which aim for a change in behavioural patterns of those actors which are obliged to fulfil specific tasks as a means of meeting the regulatory targets. These problems intensify when regulatory attempts purpose behavioural shifts that are difficult to supervise or control: e.g. consumer behaviour. This for instance holds true when regulatory targets focus on health and environmental impacts of products containing nanomaterials. Information on such products will have to reach consumers so that the latter have the opportunity to evaluate potential risks and deduce modes of proper product handling.

The project “SEBEROC – Simulation and Evaluation of Better Regulation of Converging Technologies” deals with regulative attempts in the field of consumer products containing nanomaterials or genetically modified organisms (GMOs). Due to the diffusion of everyday products with nanomaterials or GMOs in the Member States, consumers and their application and disposal of products become crucial for the avoidance or realisation of possible environmental or health impacts. In Europe regulation must consider in general that:

- National situations regarding consumer knowledge might differ. Consumers in one Member State might be more aware of environmental or health risks relating to certain products than in others.
- Consumers can choose to use products in different ways. Research findings have recurrently shown that consumers apply, for instance, detergents in their own way, which does not necessarily conform with the instructions of use. Other examples are health effects relating to pickling agents which closely depend on the usage conditions: indoor, outdoor, open window, use of fan, breaks and so on.

Therefore, it is crucial that consumers have sufficient information at their disposal about the effects of chemical substances in everyday products in order to enable high safety standards and reduce negative environmental effects.

Knowledge about information strategies and risk evaluations of consumers in the field of chemicals and nanomaterials in everyday products is required for the development of regulations aiming at building an appropriate general information base on new technologies for consumers. So when providing information it must especially be taken into consideration that European consumers living in different informational and regulatory settings might have different strategies and routines for staying informed. They might also have different levels of risk awareness.

European regulation in the field of consumer protection presumes a well-informed and interested consumer who is rationally balancing product information so as to make the best choice. Yet the reality looks somewhat different. Neither at the point of sale nor at the point of use does the average consumer intensely seek for information about necessary safety requirements when he or she uses paints, for example, or other do-it-yourself-products:

- Many consumers are not aware of the risks of environmental or health impacts.

Additionally, their previous experience with product information is often based on dissatisfaction and frustration because:

- helpful information is difficult to acquire;
- safety instructions are hard to understand, they do not seem to be written for ordinary consumer; and
- it is difficult to comply with safety instructions.

Consumer information on the risks of everyday products is taken as an example to test a novel approach of participation in the process of political decision-making. The key question is how knowledge about consumer behaviour can be transferred to the political process. As set out by the European Better Regulation Initiative, the interests of the civil society organised in Civil Society Organisations (e.g. Non-governmental Organisations [NGOs]) will have to be taken into account by the legislator to ensure good quality consultation in the impact assessment process and achieve the objectives - in other words, to promote the effectiveness of regulations.

On the one hand, there are well-established, but rather selective European consultation processes which enable the interested stakeholders to be somehow considered in the decision making process. On the other hand, there are substantial knowledge gaps concerning the risks of nanotechnology. Every decision taken now might be amended in the future due to new information arising in the course of the experience gained with the use of nanomaterials in products.

The aim is to evaluate the legal or regulatory situation in the fields of GM soybeans and nano-silver. While the regulatory situation is quite different for these, both applications of the technologies have an impact on consumers through everyday products on the European market. Politics has been dealing with GMOs for years. In contrast, the issue of nano-silver or nanomaterials is in its political infancy and has only been addressed by a few regulations to date.

The first step is to carry out a prospective (nano) as well as a retrospective (GMO) regulatory impact assessment with a particular focus on information flows. Then, consultations and interviews are carried out with representatives of national and European NGOs. These talks will centre on the question:

“What is it important to know about consumer behaviour in order to satisfy the ideal of better regulation?”

The information on crucial NGO-topics will influence about 30 focus group discussions in the five participating countries (Austria, Finland, Germany, the Netherlands, and the United Kingdom). The cross evaluation of national results will reveal joint aspects of information strategies and risk evaluations as well as substantial differences.

In a second step the results will be used as feedback for the NGOs. Via workshop discussions on the results of the focus group discussions will be evaluated. This will enable these results to be used in future political discussions about GMOs, nano-silver or products deriving from new technologies.

University cooperation models as an rescaling of tentative governance spaces

P. Benneworth¹ & J.J. Vossensteyn, Center for Higher Education Policy Studies (CHEPS), University of Twente, 7500 AE Enschede, the Netherlands, p.benneworth@utwente.nl

There is a huge amount of contemporary interest in higher education in models for higher education collaboration (DfES 2003; COU, 2004). This co-operation can have a range of purposes, whether to improve efficiency within particular HEIs, or for particular universities to compete more effectively within their target markets (HEFCE, 2004; Marshall, 2008). But efficiency within markets presumes the functioning of a competitive mechanism, raising a paradox of how can co-operation between institutions contribute to efficient market outcomes in higher education. Added to this is the issues that universities are traditional autonomous institutions, and fiercely proud of that autonomy. Where do the limits lie to the value of co-operation, how does co-operation create spaces for mixing needs for tentative and preservative governance, and what implications does this have for our evolving contemporary ‘idea of a university’.

The habitual answer to this seeming paradox is that there is a trade-off, with universities prepared to concede individual autonomy to better secure their position within higher education systems. This can be conceptualised as an rescaling of the institutional space necessary to allow universities the autonomy necessary to behave creatively and uncertainly, whilst also allowing them to operate effectively in preservative governance networks of national science systems characterised by top-down control. From this conceptual starting point, the paper asks the question of what are the conditions under which universities collaborate, and whether that collaboration allows them to achieve tentative behaviours otherwise unattainable within preservative national science systems. In other words, this paper asks the question of whether university collaboration represent a new form of tentative governance (or a tentative ‘fix’) within science systems?

To address this question, we highlight two main approaches to understanding university collaborative activities. The first, theoretically driven, is in terms of the closeness of the interaction between participating institutions, from full merger to one-off collaborative projects (*cf.* Goedegebuure, 2002). Secondly, empirically driven, collaborations can be classified in terms of the institutional scope of their ‘collective body’, ranging from a project bureau to a fully merged new institution. However, we argue that these approaches fall short by focusing primarily on internal organisational issues rather than considering this wider question of how collaborations create new form of governance space within wider science systems that allow the enactment of tentative behaviours in the pursuit of emerging science and technologies.

The paper draws on a series of seven case studies of university collaborative models (Karlsruhe, Oresund, Helsinki, Denmark, North East of England, Lyon and the Swiss ETH) in to explicitly explore whether these university collaborations represent tentative governance. The paper hints that in some cases it is merely that these collaborations reflect something new that makes them attractive to external stakeholders, and allows university partnerships the time and space to experiment in shaping emerging domains, rather than the specific content of collaborations. The paper then reflects upon the consequences of this for our understandings of tentative governance of EST more generally, in particular in terms of the roles of government funders in attempting to manage this wider emergence process.

The Swiss public research system: between conservatism and innovation

Martin Benninghoff, Dietmar Braun, Adriana Gorga and Raphael Ramuz (University of Lausanne)
martin.benninghoff@unil.ch

The Swiss public research system is characterized by a strong internationalization of its academic market as well as a good position in terms of academic reputation. This position is matched by close connections to the private economy in research-intensive sectors, where multinational companies occupy a strong position also in basic research, for example in informatics (IBM research centres) and pharmaceutical products (Novartis). At the same time, the Swiss research system is heavily rooted in national and regional specificities. Thus, the higher education system is decentralised, with weak central governance and a strong role of the cantons. This adds an interesting aspect to the comparison because of expected differences with governance in unitary states.

Switzerland can be considered as a “late-comer” in higher education reforms: the introduction of new university laws based on new public management ideas has evolved slowly and with strong differences between universities. Financing patterns have not radically changed and the use of new governance mechanisms has been handled with prudence, maintaining sufficient buffering for scientists. Pressures to acquire external funding resources have increased but are probably lower than in the other countries and, despite some organizational reforms, the link between teaching and research remains strong. In this sense, Switzerland is pursuing an incremental path of reform. In addition, the Swiss system is characterised by its small size with probable effects on the social relationships (social capital, proximity, intimacy, close-knit networks etc.) and thus a delicate balance between competition and cooperation, both at the institutional and disciplinary level.

In which way the Swiss public research characteristics and its governance can conduct to “creating (new) spaces of openness”? We can hypothesise that today scientists, in Switzerland, have lost some discretion in defining own research topics compared to the past: they are more constrained by judgments from peers in the Swiss national science foundation, by intra-organisational discussions with the academic managers, and by application for projects in oriented research. Scientists must accept more competition and risk of failure when applying for funds and are constrained to take up the latest developments in research in order to raise their chances of getting non-institutional support. The search for networks (in European and national programs) and other partners in research has become an important element for doing research. European funding has helped to find other sources for launching ideas and above all to build up international cooperation. Then, it seems that in Switzerland, though conservative tendencies remain in the development of new research ideas and diffusion of new research results, the increasing competition and the growing role of the European level has helped to diversify the scientific community and has created spaces of openness.

Tentative governance in the innovation journey of genomics and healthcare

Lise Bitsch, MSc., University of Twente, l.bitsch@utwente.nl

Introduction

The combination of medical genomics and healthcare is a highly dynamic innovation process. On the one hand, medical genomics promises a future of personalized medicine, with new data being produced at an impressive speed every day. On the other hand, the reality of these promises, and the implications of such changes for society, in terms of organization of healthcare and the experience of the individual, is highly contested territory. As with other emerging technological developments there is a high degree of uncertainty about future developments. At the same time there is a recognized need for opportunity to anticipate and predict such developments.

To engage with this process we need to understand the way in which genomics and healthcare interacts, and the possibilities for future development emerging as a result. In other words: How are genomics and healthcare interacting? What are the implications for future healthcare of such interactions? In this presentation I present a case study of genomics and asthma research, and work-in-progress on a conceptual framework on how to think of such interactions.

Genomics and asthma research

In order to investigate the interaction of genomics and asthma research an analysis of review papers was performed. These review papers were identified through a keyword search in the ISI Web of Knowledge. Journal accounts are highly accessible areas of science. Review papers belong to a particular group of academic papers, since they represent an interpretive effort of the author(s) to create order and overview of the past, present and future of a scientific field (Myers 1990, 1991). The set was restricted to 13 review papers between 1999, when the first reviews appear, and 2008. In analyzing the reviews, attention was especially paid to future expectations and visions of asthma research, how asthma was defined, which aetiological models were proposed and what methods were used to investigate asthma.

Initially a link between asthma research and genomics was made based on expectations that genes for asthma could be found. The unravelling of a genetic component to asthma becomes the premise on which future innovations can be realized. Specifically they would contribute to improved understanding, diagnosis, treatment and prevention of asthma. As genes for asthma are found, the promises of future opportunities for innovation are reinforced. Genomic methods applied in large international collaborative settings become the standard approach. Simultaneously the definition and the aetiological model of asthma are sought in exceedingly complex non-linear models of gene-gene and gene-environment interactions.

The interaction between genomics and asthma research as an unfolding 'innovation journey'

It is clear from the case of genomics and asthma research that genomics has become part of asthma research. Less clear, is the way in which this interaction will unfold in the future, and what possible implications this might have for asthma research and practice in particular, and more generally for healthcare practices directed towards common disease.

In my case study I approach the question through a fine-grained analysis of a part of asthma research. Conceptually I refer to the concept of 'innovation journey'. The term was coined by Van de Ven et al. (1989/1999), to denote the unpredictable nature of innovation within firms. It was further developed by Rip and Schot (2002) to refer to 'the underlying phenomena of emerging path-dependencies' (Rip and Schot 2002: 157). Basically interacting actors are responsible for de- and realignment processes through which structure is both produced and taken apart. Linkage creation is the central activity in building structure. (Rip and Schot, 2002) The phenomenon of linkage creation is conceptualized as 'emerging irreversibilities' (Van Merkerk and Van Lente 2005), defined as configurations that 'make it more difficult (or less easy) for actors to do something else or easier to do something' (Van Merkerk and Van Lente 2005: 1096). Specifically emerging irreversibilities can be identified by following the dynamics of expectations, agendas and actors.

Casting the case study in these concepts the interaction between genomics and asthma research becomes an unfolding innovation journey. Within this journey actors are structuring an emerging irreversibility on genomic investigations of asthma. The question is what the possible future directions and implications of this journey are.

Future perspectives

- Smith, Voß and Schot (2010), discuss the Multi-level perspective (MLP) as an attractive model to guide efforts of 'tentative governance' of sociotechnical systems towards sustainable outcomes. Might sustainable be cast in terms of social and ethical implications of the innovation journey of genomics and healthcare within a regime?
- To anticipate on actors response to 'tentative governance' efforts, knowledge of 'actors own perspectives' are needed. Could discourse analysis be a tool to access such perspectives?

Garud, R., & Ahlstrom, D. (1997) Technology assessment: a socio-cognitive perspective. *Journal of Engineering and Technology Management*, 14(1), 25-48.

Myers, G. (1990) *Writing Biology: Texts in the Social Construction of Scientific Knowledge*, Madison, Wisconsin, The University of Wisconsin Press.

Myers, G. (1991) Stories and styles in two molecular biology review articles. In Bazerman, C. and Paradis, J. (ed) *Textual Dynamics of the Professions*. Madison and London: University of Wisconsin Press.

Rip, A., Schot, J. W. (2002) Identifying Loci for Influencing the Dynamics of Technological Development. In R. Williams, Soerensen K. (Ed.), *Shaping Technology. Guiding Policy; concepts Spaces and Tools*. Cheltenham: Edward Elgar.

Smith, A., Voß, J. P., Grin, J. (2010) Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, 39, 435-448.

Van de Ven, A., Angle, H., and Poole, M. S. (eds.) (1989) *Research on the Management of Innovation: The Minnesota Studies*. New York: Ballinger Publishing/Harper and Row.

Van de Ven, A., Douglas, A. H., Polley, E., Garud, R., Venkataraman, S. (1999) *The Innovation journey*. New York, Oxford: Oxford University Press.

Receptive governance: legitimization strategies and field formation in synthetic biology

Clemens Blümel, Humboldt University Berlin, Germany, Clemens.Bluemel@hu-berlin.de

New and emerging scientific fields more and more raise the awareness of scientists and policy makers. Along with growing importance, expectations of a wide range of actors and actor groups structure the governance of emerging technologies be it either civil society or industry (Borup et al. 2006). Scientific actors and science organizations especially in emerging technology fields respond to these dynamics carefully. New modes of tentative governance have been established through which claims are transformed into reflexive concepts of governing science.

In this paper it will be demonstrated in which ways new governance modes in a specific science field have been established in order to take up emerging expectations and claims but also to mediate conflicts between actors in

established and new science fields. By analysing the interactions and relationships between science organizations, research councils and companies, it can be shown that emerging science fields are receptive to claims, building new science – society interfaces. The paper focuses on the case of synthetic biology. Synthetic biology is a new science field aiming at the intentional design of artificial biological systems that do not exist as such in nature. In recent analyses of science studies scholars, synthetic biology has been classified as a field where science and technology already converge (Schmidt et al. 2009). Knowledge production in Synthetic Biology takes the form of being “engineered” towards future application contexts already in early phases, thus altering existing modes of research organization and standardisation in related research fields. In the process of field formation, conflicts between established disciplines and the new field emerge that are mediated by new claims of utility and societal orientation of funding organizations and policy actors. Emerging “tentative” governance mechanisms like steering groups are being developed, leading to new actor constellations in the field. Possible consequences for funding instruments in this emerging field of research will be addressed. The paper draws on documentary analysis and interviews of researchers, experts in research funding organizations and policy makers.

References:

- Borup, M.; Brown, N.; Konrad, K.; Van Lente, H. (2006): The Sociology of Expectations in Science and Technology. *Technology Analysis & Strategic Management*, Volume 18, Issue 3 & 4, 285 – 298.
- Schmidt, M.; Kelle, A.; Ganguli-Mitra, A.; Vriend, H. (eds): Synthetic Biology. The Technoscience and its societal consequences. (Dordrecht: Springer Netherlands).

Types of Policy Learning in Innovation Policy: Addressing Systemic Problems

Susana Borrás, CBS Sb.cbpp@cbs.dk

Bengt-Åke Lundvall's work on learning processes has not only focused on the learning economy and learning institutions, it has also focused on the importance of policy learning as an adaptive process. This paper brings Lundvall's innovation systems' view on policy learning closer to the rich literature of policy analysis and change. This paper sets to identify a series of conditions that define levels and types of learning in the particular context of innovation policy. These are in turn linked to a series of normative premises from innovation system studies on systemic policy-making. The resulting framework is used empirically in three case studies explaining cross-national variation in STI policy learning, and their effects on the respective innovation systems.

Cultures of knowledge, Cultures of Authorisation and the Governance of Intellectual Property

Stefan Bösch, Barbara Brandl, Bernhard Gill, Philipp Spranger, stefan.boesch@phil.uni-augsburg.de

Innovation policies are contradictory. On the one hand, attempts of an increasing homogenisation of Intellectual Property Rights are observable with the aim of a global regime. On the other side, policies of innovation try to bring together different scientific disciplines as well as fundamental and applied research within a “mode 2” knowledge production. This constellation provokes new conflicts about the appropriation of innovative knowledge. The corresponding conflicts are mirrored in the open source movements, but also in an increasing debate over the scope and meaning of patents. For a long time, the institution of patents was uncomplicated as it was funded in well institutionalised distinctions. With the expansion of the use of patents not only in the realms of fundamental research (patenting of “research tools”, Eisenberg), but also in the realms of economic fields (so called “Brokkoli-Patent”) the institution of the patent changes its character. Expectations of generating unambiguity are running on and therefore new types of conflict of the appropriation of knowledge emerge. Its going hybrid. The topos hybridity highlights “zones of ambiguity” in which the scientific production of certainty and the economic allocation of property are getting into interactions full of conflict which are difficult to decipher.

Our thesis is that in present innovation systems diverse cultures of knowledge and their corresponding cultures of authorisation get into contrast with the system of appropriation. Different cultures of knowledge differ fundamentally with respect to their logics of authorisation of knowledge. Against a conventional “monetary incentives” perspective of the economists with its focus on appropriation, a sociological view focuses on authorisation of knowledge as a multifaceted process. The process of authorisation facilitates a symbolic interaction between scientist and knowledge-product which performs three functions: it should generate accountability with respect to validity and usefulness of the knowledge resp. knowledge-product, it should guarantee the addressability of risk hypotheses and it should facilitate the immaterial and financial reward of the author. Against this background, we argue that innovation policies which are exclusively focused on patents select (mostly implicit) options for innovative action because innovations based on a diverse and transdisciplinary setting of knowledge cultures are underestimated. Thus we try to describe the process of innovation and authorisation as entangled and heterogeneous.

Empirically, this perspective should be demonstrated on the example of the life science and of the machine tool industry. The field of life science is more influenced by patentable knowledge than the field of machine tool industry. For the latter, implicit and cumulative knowledge is more important than for the life science industry and patents may hinder innovations. Therefore, these different fields of innovation need a specific form of governance of Intellectual Property. Thus we try to describe the process of authorisation as entangled and heterogenous. We assume that a homogenised global patent regime cannot be responsive to these conditions.

Against this background, we will discuss a typology to describe different cultures of authorisation. If we distinguish between explicit versus implicit knowledge on the one hand, and decontextualising versus recontextualising applications on the other, then, by combination, four types of cultures of authorisation can be made out: (1) Cultures combining decontextualisation of application and explicit knowledge for the construction of knowledge goods are focuses on science based knowledge goods. They gain their results and technologies from well controlled experimental settings. The inherent innovation is mainly authorised by patents, which we would reconceptualise as tools of knowledge explication and the attribution of corporate and personal authorship. Biotechnology is an interesting hybrid case, since biological organisms can reproduce themselves, or let us say they operate their own fabrication. Hence the biotechnological innovation needs no complete scientific understanding - Karin Knorr-Cetina rightly speaks hereof as "Bastelwissenschaft". Yet, one may get repeatable products and nowadays even patents without the full explication of the underlying processes. (2) Decontextualising and more implicit cultures we see at work in the case of machine tool building. Excellence in machine tool building even after long waves of standardisation and automatisisation - which following Nonaka and Takeuchi may be described as knowledge explication - is still based on large amounts of handcraft expertise. The implicated knowledge is bound to the firm or to the industrial district and hence authorised by trade marks or protected origins. Patents are neither feasible nor necessary. (3) Recontextualising and more implicit knowledge cultures can be exemplified with the professional application and recombination of knowledge and knowledge products in the particular physical and sociotechnic environment, be it by a doctor proscribing a drug to an individual patient, or be it by a technician adapting a mass produced and hence standardised machine to the specific household conditions. The authorisation here is based on professional certificates, local embeddedness and social trust. Patents may be even strongly opposed in this case, because they shift profits upstream to the more decontextualised knowledge producers. (4) Finally, recontextualising and more explicit cultures of authorisation can be discovered in the case of scientific disciplines which are focusing on undesirable side effects of technologies (e.g. ecology, environmental medicine). At first sight, their results were often conceived as "negative innovations" since they touch on and de-trivialise the responsibility of the other knowledge producers. Yet in the long run, they strongly influence the authorisation regimes by enhanced and more systematically health and environmental standard setting.

With respect to these different cultures of authorisation, the argument is that an innovation process can be reconstructed as a multilayered process building up changeable constellations of such cultures of authorisation and their organisational and institutional settings.

Networks of expectations: a conceptual framework to analyse expectations and visions using the multi level perspective of transition theory

Björn Budde, Austrian Institute of Technology, Vienna, Austria, bjoern.budde@ait.ac.at
Kornelia Konrad, University of Twente, .k.e.konrad@utwente.nl

Future expectations are a powerful driver of innovation activities, and shared expectations and visions can contribute to the alignment of different actors. The impact of collective expectations on innovation processes has been shown by several studies related to the 'sociology of expectations' (Borup et al. 2006; Konrad 2006; van Lente and Rip 1998; van Lente 1993). Furthermore the role of expectations and visions has been recognised as being crucial in a range of research and policy approaches, in particular the transition management (TM) approach as well as the related approach of strategic niche management (SNM). Both assign a key role to visions and expectations for the governance of multi-level innovation and change processes (Geels et al. 2008; Sondejker et al. 2006). Furthermore the role of expectations and visions is at the heart of dedicated attempts to generate and use the role of expectations within a policy context, e.g. foresight, forecasting or technology assessment.

While transition management has emphasized the importance of a guiding vision for the governance of transitions, emerging technologies are often embedded in several different visions. It is of particular interest, that most technologies are part of several, often quite different, visions over time.

The poster presents a conceptual framework for the analysis of interrelated visions and expectations, or networks of expectations and applies the framework to analyse expectations around fuel cell technology in the policy discourse in Germany and at the European level.

Drawing on the multi-level concept of transition theory (Geels 2002), we assume that there are not only activities and actual developments at each of the three levels, but as well expectations and visions addressing future activities and developments at the landscape, regime and niche level (Truffer et al. 2008). As niche and regime, or regime and landscape developments can support and reinforce or contradict and weaken each other and ultimately exhibit complex dynamics, in principle the same holds for expectations and visions.

Expectations at the landscape level, for instance an expected shortage of fossil energy resources, may support expectations at the regime level, e.g. the vision of a transition towards an energy system based on renewable energies. Furthermore, expectations regarding landscape developments may support expectations on specific niche innovations, as will be seen in the following for the case of fuel cells and climate change. Expectations on niche innovations may relate to specific or even different visions at the regime level. These are either competing visions on potential transformations of a specific regime or visions regarding different regimes the innovation may link up with. The latter case corresponds to interactions and dynamics of multiple regimes (Konrad et al. 2008; Raven and Verbong 2007). Finally, expectations regarding different niche innovations may compete or support each other, comparable to the real-world multiple niche dynamics. The relations between niche, regime and landscape related expectation and visions we call “vertical linking”. The relations between different visions at the same level, for instance landscape level or expectations regarding competing or complementary niche innovations “horizontal linking”.

While we see similarities in the way how multi-level expectation networks interact and the way how real-world processes across these levels interact, it is important to take into account the differences between both. Certain ‘real-world’ states or processes constitute structural, constraining or enabling conditions for other ‘real-world’ processes, in particular at lower levels. Expectations, however, may rather be conceptualized as ‘prospective structures’ (van Lente & Rip 1998). That is, they may work as a kind of functional equivalents to structural constraints resulting potentially in self-fulfilling prophecies. For instance, expectations on potentially destabilizing landscape developments may destabilize a regime in a similar way as the real developments might do and expectations on future regime changes may create a protected space for niche processes and expectations similar to real changes. However, in general ‘prospective structures’ are more fragile and destabilize more easily. This can for instance be seen in the case of strong hype-disappointment cycles and the sometimes very sudden destabilizing of expectations at lower levels if expectations and visions at higher levels are shifting (Konrad 2006). Furthermore, the fact that there are competing ‘prospective structures’ at the same time has no simple equivalent at the real-world level. Thus, while we assume that the multi-level analogy is helpful for identifying dynamic processes within expectation networks and relating them to real-world processes, we would like to emphasize that it is merely an analogy.

In order to analyze expectations and visions related to a potential transition (or a technology, depending on the perspective and scope of analysis), we have to take into account the expectations about the landscape, regime and niche level and in particular how they are able to support or weaken each other. This conceptual framework can be applied in different ways. Firstly, in the next section we will use it for capturing the interrelations, interactions and ultimately dynamics within expectation networks. Secondly, we can analyze the effect of these expectation networks on innovation activities that are part of ongoing transition activities, e.g. niche experiments. Finally, it could be applied within foresight processes (see Truffer et al. 2008) or, in a similar way, for a critical analysis of expectation networks. For instance, expectation networks within societal discourses could be reconstructed and analyzed, in order to identify neglected or potential future relations and interactions, which may affect future discourses and ultimately transition dynamics.

The analysis has shown that niche activities are linked to several visions of potential transitions. From the perspective of niche activities it seems at least risky, to link these activities to a single guiding vision, which may be subject to quite unpredictable expectation dynamics (Konrad et al. in preparation; Ruef and Markard forthcoming; Schot and Geels 2008; Linden and Fenn 2003). For sustaining niche activities over longer periods of time – which are necessary for most transitions – niche expectations should be able to link to several visions for regime transitions. This linking to several visions can potentially contribute to make the niche expectations more “robust” with regard to hype-disappointment cycles.

Tentative Governance of Synthetic Biology: A Comparative Perspective

Christopher Coenen, KIT-ITAS (Karlsruhe), christopher.coenen@kit.edu

With regard to the spontaneous and organised interactions of innovation 'enactors' and 'selectors' and the governance of promises and risks, synthetic biology can be usefully compared with other technoscientific fields, such as nanotechnology, which emerged slightly earlier than synthetic biology. Such a comparison, which has recently been undertaken a couple of times from different perspectives (see, for example, Deplazes 2008; Tait 2009; Torgersen 2009), can serve several purposes. It can help to gain a clearer picture and better understanding of the governance of synthetic biology and of the hopes and fears associated with the field. Additionally, it can help to shed light on some of the more general developments which have been characterised as the 'tentative governance' of emerging science and technology in the call for papers.

In this paper, pertinent comparisons are summarised and discussed against the background of the more general knowledge available regarding the discourses in question and in view of the results of our own analyses of discourse on synthetic biology, nanotechnology and closely related fields. In summarising the comparisons, consideration is given to academic papers, mass media articles and various kinds of reports. This is supplemented by a more in-depth comparative analysis of the governance of promises and risks of SB and nanotechnology. The analysis is based on several 'vision assessments' which we have undertaken for the relevant discourses. The actor constellations in these discourses are systematically outlined and compared, including the institutional drivers and other groups of actors such as researchers working in the fields in question, those working on ethical, legal and societal aspects (ELSA), business consultants and civil society organisations. This will include a look at the visionary promoters of these fields, such as scientists and engineers who do not work in the field that they are promoting, scientists acting as a new brand of public intellectuals, techno-visionary activists and science journalists.

The paper demonstrates that the discourses in question share certain cultural and political particularities and that they involve similar constellations of actors. Against the background of these commonalities and similarities, a number of relevant specificities of the emerging governance of synthetic biology will become visible. This relates, amongst other things, to the question of who started and framed the discourse, to the impacts of earlier discourses on the governance of the field, and to the specific features of the label 'synthetic biology'.

Furthermore, the paper analyses – including but not restricted to the topic of 'hype' – the degree to which new modes of governance appropriately react to the challenges raised by the particularities of the fields in question, with a special focus on the discursive strategies and specific narratives of the various actors and their respective handling of uncertainty. Concentrating again on synthetic biology, and taking into account the emergence of a broader public discourse on the field, the actual and potential societal relevance of promises and fears are assessed. This includes analysing the cultural resources and political innovations that are already employed in the tentative governance of the field and discussing resources and innovations that could be used in the future.

Building Equity and Equality into Emerging Technologies:

Preliminary Observations on Nanotechnologies in the Global Economy

Susan E. Cozzens, Diran Soumonni, and Thomas Woodson

Technology Policy and Assessment Center, Georgia Institute of Technology, scozzens@gatech.edu

Emerging technologies – those that are new, science based, and of high potential impact (Cozzens et al. 2010) -- always carry the possibility to increase inequalities. Because the technologies are science based, they are likely to sell for higher prices and demand higher workforce skills than other technologies. But past studies of the distributional consequences of emerging technologies (see Cozzens 2009) have found that the effects of emerging technologies on inequality vary dramatically, depending on their conditions of commercialization, including the policy environment. Households and communities also vary in their abilities to absorb the new technologies, even when they are available and appropriately priced.

Past work in our group has established a framework for exploring the distributional consequences of emerging technologies (Cozzens 2009). We are considering both vertical and horizontal dimensions of inequality, that is, both the rich-poor differences and differences in culturally-defined categories such as gender, ethnicity, and ability status. The framework calls for exploring the effects of emerging technologies on the distribution of business opportunities and ownership; employment; benefits; and risks.

We are currently applying that framework to applications of nanotechnologies in the water and energy sectors. Comparing the influence of context in affluent and developing countries, we are gathering data on both the United States and South Africa, in an effort funded under the Center for Nanotechnology in Society at Arizona State University. We report in this paper on early observations from that work.

General Observations from the Earlier Studies

The earlier study examined the distributional consequences of five technologies in eight countries. The technologies were genetically-modified maize; mobile phones; open source software; plant tissue culture; and recombinant insulin. The countries included four in the global North and four in the global South. We found that the conditions of commercialization made a difference in how widely the technologies were available, either for consumer use or as the basis for new businesses. In many cases, large multinational corporations owned the relevant intellectual property and controlled the production processes of the products, funneling profits to the global North even when the products were available in the global South. In the open source cases, which included both software and plant tissue culture, a more diverse array of actors could use the technology, including in ways that benefitted poor households in the developing countries. One of the most commercial and private of the technologies, however, reached a very wide consumer base, namely, mobile phones.

The interplay between the development of technological capabilities and the regulatory pressure to open markets to competition resulted, in this case, in driving prices down and developing ways to reach low-income consumers, through pre-paid plans. The distributional boundary for the technologies was drawn not only by price, but also by infrastructural conditions (e.g., available electricity in rural communities) and educational and skill levels (e.g., insulin not being prescribed for those in urban slums because they could not maintain the necessary regimen).

Conditions for Nanotechnologies

Seen in the light of these lessons drawn from previous technologies, the circumstances surrounding nanotechnologies suggests that they will reinforce existing inequalities, unless policies and programs are specifically designed for a different outcome (see Cozzens 2010 for advice on doing so). A number of these circumstances are described by chapter writers in Cozzens and Wetmore 2010.

- Women are likely to be under-represented in the enterprise because of its associations with chemistry and physics. Women are already patenting at much lower rates than men in the field.
- Participatory processes are not in place that would incorporate the views of labor, the disabled, or other marginalized groups in decision-making around nanotechnologies.
- Large corporations in the global North are dominating the research and innovation front, and intellectual property is being grabbed very quickly by the main actors. There is very little attention to open source applications of nanotechnology knowledge.
- The research agendas for nanotechnology initiatives are heavily oriented towards commercialization and competitiveness, rather than towards using the technology to solve problems for poor households or communities. This is true even in most countries of the global South.

Our preliminary work has also shown that while there are very few programs oriented to solving such problems (South Africa is an exception), there are a number of products or projects that have this goal, including (on the last three in this list, see Meridian 2006):

- Work on nanostructured capsules for tuberculosis drugs (South Africa)
- Work on community-level water filtration systems at levels that poor communities can afford (South Africa)
- Tata Corporation (India) sells a nanofilter called the Tata Swach that uses silver nanoparticles in the paddy husk ash matrix. (www.tataswach.com)
- Eureka Forbes Company (India) sells low cost nanofilters designed for the rural poor in India. It filters out 3 common pesticides found in the drinking water in India (<http://www.eurekaforbes.com/default.aspx>)

Conclusion

In short, the efforts to make nanotechnologies work for marginalized groups, both vertical and horizontal, appear small at this time in comparison with the efforts to produce business profits and industrial advantage for the counties and companies that have the capacity to get into the nanotechnology game. These may eventually have trickle-down benefits, but the foreseeable consequences are more likely benefits for current elites. Strong efforts to change this direction of change are needed if nanotechnologies are to increase, rather than decrease, equality.

Acknowledgement

We gratefully acknowledge the support of NSF Grant 0726919, as well as current support from the Center for Nanotechnology in Society at Arizona State University (NSF Grant 0937591) and an NSF Doctoral Fellowship to Thomas S. Woodson. All opinions, findings, conclusions and recommendations are those of the authors and do not necessarily represent the views of the National Science Foundation.

References

Cozzens, Susan E. 2010. "Building Equity and Equality into Nanotechnologies." Chapter 26, pages 433-446, in Cozzens and Wetmore 2010.

Cozzens, Susan E. 2009. "Distributional Assessment of Emerging Technologies," presented at the Atlanta Conference on Science and Innovation Policy, October 2-3, 2009. Published with IEEExplore, Digital Object Identifier: [10.1109/ACSIP.2009.5367819](https://doi.org/10.1109/ACSIP.2009.5367819)

Cozzens, Susan E., and Jameson M. Wetmore. 2010 (forthcoming). *Yearbook of Nanotechnology in Society, Volume 2: Nanotechnology and the Challenges of Equity, Equality and Development*. Dordrecht, Netherlands, Springer.

Cozzens, Susan E., Sonia Gatchair, Hyuck Jai Lee, Jongseok Kang, Kyung-Sup Kim, Gonzalo Ordóñez, Alan Porter 2010. "Emerging Technologies: Quantitative Identification and Measurement," *Technology Analysis and Strategic Management* 22(3): 361-376.

Meridian Institute. 2006. *Workshop on Water, Nanotechnology, and Development*. Available at <http://www.merid.org/nano/waterworkshop/>.

Co-Innovation of Materials, Standards, and Markets: BASF's Development of Ecoflex

[†] Arthur Daemmrich, Assistant Professor, Harvard Business School, adaemmrich@hbs.edu

It is widely held that standardization at national and international levels provides economic benefits to producers and consumers alike by lowering transaction costs through uniform measurements, common definitions of product characteristics, and third-party validation of products. Standardization consequently acts as a method of technology governance, but with particular characteristics that differentiate it from other forms of regulating new products or services. Largely outsourced by governments to private organizations (often holding a national monopoly), the standardization of materials, production methods, and ultimate disposal of a product relies on coordination and compromise by manufacturers and communities of scientific and technical experts. Less well studied, however, is the fact that standardized systems also rely on behaviors of consumers and professionals who are not part of the network that develops a standard in the first place. This paper explores a dilemma that arises from standardization: in the absence of product standards customers have little basis to trust manufacturer's claims, whereas overly rigid standards undermine the variation in users and uses that are critical to market growth for novel technologies or products. To successfully introduce a new product, manufacturers therefore must balance technical definitions that provide competitive advantages against maintaining flexibility for diverse applications. This situation is especially important in emerging "green" markets, where trust levels are low and purchasers demand information on production methods, material composition, and disposal. A dilemma known to scholars in science and technology studies has ensued: standardized products require standardized users, but in green product markets, technology users resist following behaviors prescribed by firms. As a consequence, the gains to firms from standardization may be lost.

This research project – and my talk – advances draws on a case study of Ecoflex, a biodegradable plastic invented and manufactured by the German chemical firm BASF, to examine firm strategy related to standardization and to empirically study standards as a form of technology governance. The innovation sequence for the novel chemical Ecoflex included collaboration with academic scientists and direct involvement by BASF with a standard-setting process that defined composting based on breakdown components rather than molecular structure. Built on natural gas inputs rather than plant-based materials like its competitors, Ecoflex faced the risk of being dismissed as synthetic and therefore not a green chemical. BASF's involvement with the technical standard for composting helped resolve a conundrum the company faced regarding the boundary between natural and synthetic.

Standards for biodegradable plastics ultimately set a boundary separating different materials based not on their source (petrochemicals versus starch or other plant-based materials), but on their environmental fate. In turn, the formal technical standards for what counts as biodegradation was critical to the marketing of Ecoflex. As companies selling a variety of "green" or "natural" products have discovered, issues of product authenticity can become critical stumbling blocks in consumer purchasing decisions. For BASF, involvement with the technical standard setting process was an opportunity to add value to Ecoflex, both by giving it external verification as biodegradable and as a way to distinguish it from competing high-volume production plastics. Yet the anticipated primary market proved unruly and unwelcoming of plastic bags, even when made of biodegradable materials. Large-scale compost facilities removed all bags, including biodegradable ones, from waste streams. This resistance to BASF's product at the compost facility, a key node to the expected use and breakdown of the plastic bags, led the company to develop a set of secondary uses into more significant markets. Thus while a great deal of effort went into modeling uses for the product during its innovation, BASF's flexibility about alternative uses once it was on the market proved critical. Alternative uses for the Ecoflex plastic, including on farms, in various forms of food packaging, and in a new product blended with a starch-based plastic, nevertheless continued to rely on biodegradation standards as integral to the product identity.

The case study illustrates a proactive standardization process led by a major manufacturer, not in an effort to facilitate business with competing firms, but rather, an effort to gain public legitimacy for a new product as "green" and to link it with an emerging network of large-scale compost facilities. Developing standards for composting that were ideal for Ecoflex, however, did not guarantee a smooth chain of uses from consumers and compost facilities. Consumers increasingly can learn about the source, manufacturing chain, and ultimate fate of products and

packaging. The invisibility of the chemical industry to consumers in the past, which resulted from few products carrying brand names, has been superseded by traceable production chains and consumer interest in the environmental fate of products they purchase. By extension, the intentional erasure of negotiations among firms in processes of standardization that made them appear purely technical and objective also can come under greater scrutiny.

The product development pathway for Ecoflex does not fit neatly with longstanding models of a linear path from laboratory to market with regulators assessing the safety of the molecule at a critical point prior to sale. For the product Ecoflex, a co-innovation of the material, standards and certifications, and the market uses for biodegradable plastics as a category was critical. The failure of Ecoflex to align neatly with industrial-scale compost systems shows a lapse in the theory that product testing and standardization alone build markets. But flexibility at the firm with regards to uses and users helped avoid failure for the product; instead, BASF marketed Ecoflex and its successor, Ecovio for a more diverse range of applications based on additional market study. Standardization of biodegradation was nevertheless key to this development since the firm differentiated a product category from other kinds of synthetic plastics and could command a price premium to cover greater manufacturing costs and still enable multiple uses by consumers.

Multi-Stakeholder Platforms to Stimulate Innovation System Learning: Experiences of Sustainable and Integrated Exploitation of Inland Valleys in Benin and Mali

Daniel N. Dalohoun¹, M'Piè Bengaly², Paul Van Mele¹, Marie José Dugué³, Joël Huat¹⁴, Oumar Senou²
D.Dalohoun@cgiar.org

1 Researcher, Institut d'Economie Rurale (IER), Sikasso Mali

2 Researcher, Centre du riz pour l'Afrique (AfricaRice), 01 BP 2031 Cotonou, Bénin

3 Researcher ICRA, France

4 Researcher, CIRAD, UR 103, France

5 Consultants, Centre for Development Innovations, Wageningen, the Netherlands

Inland valleys have enormous potential for agriculture. Their exploitation creates important revenues for multiple economic agents. However, inland valleys provide diverse agricultural products, as well as environmental and cultural services making them complex to manage. Although this complexity provides a potential of wealth in West Africa, for decades approaches to intensify and diversify production in these inland valleys have not allowed the economic and development agents to converge their interests.

An approach for a sustainable and integrated use of these inland valleys implies that all activities involve both direct and indirect production of goods and services. It requires the introduction of technological, organizational and institutional innovations. In this regard, the multi-stakeholder platform (MSP) is initiated as a learning process of local agricultural innovation system.

The RAP project (Realizing Agricultural Potential of inland valleys in sub-Saharan Africa while maintaining their environmental services) experiments with MSP approaches in four inland valleys, of which two near Sikasso in Mali and two in the Mono-Couffo departments in Benin. The RAP project is funded by the European Union (2009-2010) and involves a consortium of organizations: AfricaRice, IITA, CIRAD, CDI, ICRA, and the IER in Mali, INRAB and the Faculty of Agricultural Sciences at Benin.

A multi-stakeholder platform (MSP) is an open and dynamic forum for discussions, research focus orientation and capacity building of actors to innovate. The MSP begins with a participatory analysis of strengths and weaknesses of past, current or future activities to enable actors to gain insights in the many factors contributing to success (technical, organizational and institutional) but also the interactions (links and partnerships) these successes require. Then, MSP members are motivated to implement individually or collectively their new skills of "economic, social or development entrepreneurship". These include setting the goals of individual or collective vision, assessing the needs, identifying the sources and pathways to mobilize resources, collecting and using the resources.

The dynamics displayed in MSP raises interests of private, governmental and non-governmental organizations that are excited to provide technical, financial and institutional support required for the actual exploitation of the inland valleys. However, for a sustainable impact the MSP approach needs to be strengthened through training and continuous information of its members. The continued involvement of local authorities in the dynamics of MSP in Benin and Mali should be encouraged.

The Role of Standardisation in the Shaping of a Vision for Nanotechnologies

Aurélié Delemarle, *Université Paris Est – LATTS -ESIEE Management, a.delemarle@esiee.fr*

Harald Throne-Holst, *National Institute for Consumer Research (SIFO),*

harald.throne-holst@sifo.no

We argue that standardisation plays a very important role in market shaping under situations of high uncertainty as exemplified in nanotechnologies. Its role is not limited to “its traditional role” i.e. to insure the safety of workers or consumers; to increase the inter-operability of products on the market. As already demonstrated, technical standards can also open markets (Garud, 2008). **We go a step further and argue that standards can contribute to shaping market institutions by supporting rules that will regulate the market and by creating a collective vision that will mobilise actors.** Even though some nanoproducts are already on the markets, we consider that markets for radical nanoproducts do not exist yet and that the work of ISO Technical Committee 229 “Nanotechnologies” is contributing to making them emerge.

In the paper, we first introduce the question of regulation in nanotechnologies, then describe the standardisation process and ISO more specifically. We point to the organisation and re-organisation of TC 229 that allows actors to build a collective representation of the evolving field and build legitimacy at the global level (Oliver and Montgomery, 2008). We argue that beyond the production of standards, this aspect is central in an emerging field that will impact regulators as they design new rules.

Field Configuring Event (FCE) theory helps us understand the mechanisms shaping the development of technologies, markets, or industries (Lampel and Meyer 2008). FCEs are defined as “settings in which people from diverse organizations and with diverse purposes assemble periodically, or on a one-time basis, to announce new products, develop industry standards, construct social networks, recognize accomplishments, share and interpret information, and transact business” (Lampel et al. 2006).

We base our case study on an in depth participation to the ISO TC 229 and to participations to national mirror committees in which the authors sit. ISO TC 229 meetings are considered as FCEs because national delegates meet on a biannual basis for five days and discuss work in progress. However, these events are not the place for technical work per se which happen mostly between meetings by emails and telephone conferences. Biannual meetings aim at strategic decisions and are the place for lobbying (Delemarle, 2009a)

We show how the organisation and the reorganisation of the committee can shape the creation of a vision within for the committee members at the first place, of the experts of the committee, of the liaison officers up to outsiders of the field and the institutional level. Three phases in this process can be highlighted.

1. 2005 – End of 2007: London to Singapore meetings. Individual actors fighting for their interests and trying to impose their perspective of the evolution of nanotechnologies.

Created in 2005, TC229's structure, without sub committees and with planning and coordination task groups, points to the need for transversality: the field of nanotechnology is emerging and not well structured. Standards and norms are not yet relevant as the field is still very science oriented and promises have not yet fully been translated into innovations (Larédo et al. 2009). The chairman of the committee thus insisted on the value of «pre normative» work with technical reports, and specifications.

This is also visible in the selection process of new work items. Subjects are widespread in scope and proposed by actors that have a direct interest in them. Actors have their own view of the dynamics of the field and try to impose it by having their projects accepted, and other nations working on it. For example, due to the relative strength of its domestic industry in electronics, Japan initiated a work on the characterisation of carbon nanotubes, which are used in batteries.

There was no selection process as a delegate interviewed at the Seattle meeting recognizes: «at the beginning of the committee, there was definitively a fear of the white page so to say. There was a need to start working on something.» This led to a multiplicity of projects, lacking a common approach and strategy. Actors are trying to make sense out of the field

2. End of 2007 – 2008 : Bordeaux meeting as a turning point. Introducing markets into nanosciences and technologies

In 2007, TC229 CAG started making sense out of the field and produced a first new version of its business plan since 2005. At the end of 2007, the first roadmap for TC229 as whole is produced. This need to organise activities and put order is not only happening at the strategic level of TC229 but also at the national levels.

The shaping of a collective vision of the dynamics continues as a new WG is created June 2008. The creation of WG4 results from a collective thinking at the level of TC 229: for some nanomaterials, markets exist in a short term perspective thus material specifications are required. This reorganisation into 4 WGs acted as a signal for outsiders that nanoproducts were soon to arrive on the markets.

The task group "Nanotechnologies and Sustainability" was created. While the committee recognized that markets for nanoproducts were organising, it acknowledged the need to promote the benefits of these technologies and proposed to foster projects of norms that would help "useful to the society" technologies to reach markets faster.

3. 2008 : Shanghai meeting : introducing society into nanosciences and technologies

Another task group was announced in Shanghai: "consumer and societal aspects of nanotechnologies". It signals the importance of these issues at the top of worldwide organisations. Consumers' representatives but also large companies participate to the discussions. The rationales of this TG are to create acceptability for nanoproducts beyond the dimensions of health and safety that are discussed in WG3.

As the work of TC229 is still on-going the extend to which it will succeed to have its vision shared remains. However, the links that it creates with external international organisations and with other ISO TCs as well as the growing interest shown by the increasing attendance to the meetings are strong supportive elements.

The role of product labelling schemes in shaping more sustainable production and consumption systems

Leonie Dendler^{1, 2, 3}

¹Tyndall Centre for Climate Change Research, University of Manchester Floor H, Pariser Building, the University of Manchester, Sackville Street, Manchester, M601QD, United Kingdom, leonie.dendler@postgrad.manchester.ac.uk, +44 (0)161 306 3700

²Manchester Institute of Innovation Research (Manchester Business School), United Kingdom

³Sustainable Consumption Institute (University of Manchester), United Kingdom

To facilitate more sustainable consumption different actors have introduced various labelling schemes providing information about a product's environmental, social or other attributes. Based on four case studies on the EU eco-, EU energy, Fair Trade and Marine Stewardship Council label this paper shows how labelling schemes try to shape the production and consumption system through two main processes: the facilitation of political consumerist demand¹ for more sustainable products and the reaction of supply chain actors to this demand by using labelling standards to modify their processes into a more sustainable direction. To be effective and retain their policy making authority labelling schemes need to be legitimised by all actors essential for both processes, which can be mainly achieved via including their interests in participatory decision making processes. Labelling schemes can therefore be seen as a new form of governance based on neoliberal ideals of stakeholder participation and market mechanisms.

On the political consumerist side most labelling literature has been based on information deficit models focussing on enabling individual consumers to shape the production and consumption system through their purchase decisions. Taking into account concepts explaining individual consumption processes from a sociological and psychological perspective as well as findings from the case studies this direct influence has shown to be less influential than the information deficit model would suggest. However, political consumerist power has been often used indirectly (in a sense of individual consumers being mentally prepared to discriminate among products because of concerns related to sustainability issues) by NGOs and other societal actors to pressure businesses to transform their supply chains towards sustainability. To be used as a tool for political consumerism labelling schemes therefore not only need to be legitimised by individual consumer but also (and maybe even more importantly) NGOs and other groups like media, academia and governments which form societal demands.

One way for businesses to meet direct as well as indirect political consumerist demand is to participate in labelling schemes legitimised by key societal actors and modify their processes in a way that meets the respective labelling standards. Large scale modifications of the whole supply chain thereby seem to necessitate the participation of and facilitation by large scale mainstream businesses, such as retailers, processors, branders, or other large businesses often located towards the consumer end of the supply chain. Such businesses usually not only face more societal pressure but are also in a powerful position to influence the rest of the supply chain in a way that it adheres to respective sustainability standards. However, their participation risks facilitating the implementation of modular supply chains where large actors impose sustainability standards in a narrow interpretation at the expenses of small actors. Such dynamics are (arguably) not only at odds with sustainability goals but can also threaten the legitimisation of the scheme by actors who are essential to ensure political consumerist demand as well as more rigour acting

¹ Micheletti et al. define political consumerism as "consumer choice of producers and product with the goal of changing objectionable institutional or market practices. It is based on attitudes and values regarding issues of justice, fairness, or non-economic issues that concern personal and family well-being and ethical or political assessment of business and government practice" (Micheletti 200: x-xiv).

companies. This is just one illustration showing that the key challenges for labelling schemes is to find the right balance between the interests of actors essential for the supply chain modification side on the one and the political consumerist part on the other side.

This dependence on market mechanisms and integration of business actors as well as societal demands pose opportunities but also certain risks and limitations for the instrument of labelling. Strengths and opportunities include the compensation for a lack of international governmental policy through the empowerment of non-governmental actors, labelling schemes dynamism and adaptability due to their continual competition and contestation in an effort to gain adherents and legitimacy and their ability to spatialize across national boundaries. In terms of risks and limitations governance systems as represented by labelling schemes working through the market and dependent on its agents face limitations in terms of their ability to fundamentally challenge our current structures. In fact the instrument risks to even enforce dynamics like the favouring of powerful businesses, NGOs and consumers at the expense of already discriminated actors or the focus and dependence of our current societies on mass consumption of goods and resource use without addressing the results from the overall amounts of consumption.

Yet as long as instruments addressing such issues are missing, international regulation still fails to address urgent problems like climate change and society does not seem to be ready for deeper changes market solutions like labelling schemes appear to be the 'better than nothing' solution.

Literature:

Micheletti, M, Follesdal, A & Stolle, D 2006, 'Introduction' in *Politics, products, and markets. Exploring political consumerism past and present*, ed M Micheletti, Transaction Publ., New Brunswick, pp. ix–xxvi.

Technical norms as emerging governance structures

Fokko Jan Dijksterhuis & Adri Albert de la Bruhèze, STePS, University of Twente, f.j.dijksterhuis@utwente.nl; a.a.delabruheze@utwente.nl

In 1916 the HCN was established, the 'Head Committee for Normalization in the Netherlands (Hoofdc commissie voor Normalisatie in Nederland). The task of the committee was to organize and execute the development of 'norms'. The HCN was a collaboration of two professional organizations: the KIVI (Royal Institute of Engineers) and the MvN (Society of Industry).

It was no coincidence that the Dutch established an institute for normalization during World War I. Several actors developed new means of production in which planning, management and research played a central role, with new intervention roles for the national government. Economic pressure was not the only reason an institute for normalization came into being. Internationally a growing rhetoric developed that industry could benefit from normalizing products and parts. New was the idea to consider normalization on a higher level, independent of branches, and to consider the *process* of normalization in a general way. In this regard, the Netherlands were rather pioneering.

The transformation of thinking about normalization can be traced in a series of papers published in the journals of the KIVI and the MvN. Normalization had been discussed from the turn of the century, but initially specific to branches and products. In the middle of the 1910s the first papers on normalization in general appeared, initiating a debate about the ideas and goals of normalization. Normalization was not only considered a matter of economic interests but also of ideals of rationality, scientification, efficiency and coordination.

The fact that the HCN was a collaboration of two professional organizations is significant and reveals an important characteristic of normalization. The KIVI and the MvN represented engineers and entrepreneurs, respectively. The demand for normalization was indeed a combined interest of technological design and economic production. This particular configuration of engineering and management was also typical of the developments of the early twentieth century, reflecting the features of the new engineer.

To the initiators it was clear that users' interests ought to be the starting point of normalization: designers, producers and (institutional) consumers. The HCN started to make a survey of the demand for norms and an inventory of the existing norms. The user-driven idea of normalization is also clear from the (initial) organization of the development of norms. Subcommittees of experts and representatives of actors published a draft norm and collected comments from the field in order to establish a norm that was correct and acceptable for all users. The ideal of disinterested participation did not hold out entirely. For reasons of management a system of 'critique addresses' was created in which specific actors concerned were selected for revision of norms.. Although the HCN would guarantee impartiality, of course the particular selection of reviewers influenced the eventual outcome, and this could be used by companies as an instrument of competition.

The HCN was funded by contributions from participating actors, influence determined by the size of the contribution. The first director played a crucial role in the early years of the HCN, selling the idea and ideals of normalization to the participants. After all, a norm was not a law and the use of norms was voluntary. All actors

involved had been equivocal from the very start that a proper norm could and should not be enforced. The HCNN was thus a typical intermediary organization that existed by the grace of multiple actors aligning and collaborating, but lacked any financial or legal power of its own.

A powerful participant that made efforts to exert its influence was the government. Several government bodies participated: municipal governments as prominent users in the energy sector, and the national government in the form of various departments. In return of their big fee they demanded a part in the management of the HCNN and membership of all committees. The government had a clear interest in normalization in terms of legislative power. Still, even the national government (het Rijk) did not subject the process of normalization to their own ways of working, but aligned itself with other actors and chose to participate in the intermediary structure of the HCNN. This particular alignment of officials, engineers and entrepreneurs was made possible by the dual role of the government as both user and regulator.

Normalization offers a typical example of transnational work. Although international collaboration was established at an early stage, normalization remained to be organized nationally. Still, technological fields crossed boundaries and all kinds of transnational cooperation were reality. The same actors sat on the table of national normalization and thus this middle sphere was naturally present the inner and outer spheres of national institutions and international collaboration.

The emergence of norms in the early twentieth century shows that technologies are societal configurations. In studies of STI norms are relatively understudied, which is surprising because norms are the building blocks of technological design. Norms seem to contrast with the whole idea of innovation, but this is only virtual. Innovation is assemblage; assemblage of robust parts, techniques, expertise and processes. Evolutionary studies of technological development show that 'normal design' is the site of innovation. It is thus obvious that the designer's main tool – the norm – should be studied.

How can standardization and other forms of 'soft' regulation enhance responsible nanotechnological development?

Bärbel Dorbeck-Jung, University of Twente – Netherlands, b.r.dorbeck-jung@utwente.nl

In Science and Technology Studies regulation is often identified with command-and-control legislation. Alfred Nordmann, for example, compared regulation with the governor of a steam machine who intervenes when certain thresholds are exceeded (Nordmann 2009). Nordmann argued that in the case of nanotechnologies certain thresholds are not available and will not be available in the near future. Nanotechnologies do not develop in a linear way and risks are highly uncertain. This is why he concluded that presently nanotechnologies are beyond regulation. Instead of tracking what cannot be tracked he proposed to strengthen constant vigilance structures.

Alfred Nordmann highlighted fundamental problems to regulate newly emerging technologies. Linear regulation is always lacking behind technological development because it depends on evidence on benefits and risks. When evidence cannot be provided 'linear' regulators have to wait. The top down 'steam machine approach' to which Nordmann refers, however, has been proposed only in a few early theories of public administration and law. From the very beginning in the 19th century, technology regulation has taken a 'heterarchic' regulatory stance. Knowing the limits of their technological knowledge governments have built on private standard setting and private oversight activities. Vice versa, industries have often welcomed regulatory collaboration because of the stability, certainty and property protection public regulation can provide.

Today, the regulation of emerging technologies is taking place in the 'era of governance'. In regulatory studies, the language of governance refers to a range of processes and practices that do not operate primarily through formal hierarchic mechanisms of traditional command-and-control legal institutions (De Búrca and Scott 2006). However, the focus lies not on the de-formalization of regulation, but on effective combinations of formal and informal controls ('regulatory hybridization'). Regarding the discussion on *de facto* governance of emerging technologies (Rip 2010), I would like to clarify that regulatory governance has a normative connotation. Regulation is about the control of human conduct in order to achieve certain policy goals (e.g. responsible technological development). Governance methods are used to enhance goal attainment. In its exploration of effective policies regulatory science strongly relies on empirical insights on how and why rules are made, used, changed and enforced. In these research activities *de facto* and regulatory governance studies can meet on common ground.

This paper explores possibilities and limits of soft regulation to support responsible nanotechnological development.¹ It regards forms of soft regulation as components of tentative governance arrangements. I argue that

¹ By responsible development I refer to the balancing of efforts to maximize the technology's positive contributions and to minimize its negative consequences (CRNNI 2006). By 'soft regulation' I understand rules of conduct which in principle have no legally binding force, but which nevertheless have effects in regulatory practice to achieve certain policy goals (Senden 2004).

the regulatory guidance of nanotechnologies can learn certain lessons from the findings of responsive regulation studies. The paper starts with identifying effectiveness problems with which soft regulation of nanotechnologies currently has to cope. To date, private and public regulators primarily rely on soft governance instruments (standards, voluntary self-reporting schemes etc) to reduce the knowledge gaps on the properties, benefits and risks of nanotechnologies. Codes of conduct and best practices have been established to enhance responsible development. First experiences indicate severe effectiveness failures. The UK voluntary reporting scheme, for example, shows compliance problems. Furthermore, it seems that codes of conduct are facing implementation problems.

Discussing these effectiveness problems the paper refers to insights of regulatory studies. It focuses on governance arrangements in which soft regulation is embedded. The discussion builds on the analytical framework of really responsive regulation (Black & Baldwin 2010; Dorbeck-Jung et al. 2010). This framework suggests that regulators should be responsive to the behavior, attitudes, and cultures of the regulatory actors, the institutional setting of the regulatory arrangement, the different logics of the regulatory tools and strategies (and how these interact), the arrangement's own performance over time; and, finally, changes in each of these elements. With its approach of monitoring, probing and adapting the responsive approach seems to be equipped to guide the regulation of emerging technologies (Dorbeck-Jung 2007; Levi-Faur & Comaneshter 2007).

Using the responsive framework the paper explores the lessons that can be learned from empirical regulatory studies on the workings of soft regulation in other regulatory fields. Empirical evidence indicates that sufficient overlap between individual and collective interests, expectations and ideas, attitudes of rule approval, proactive trade associations, as well as knowledgeable enforcement authorities and high social responsibility of the industries are important conditions for the effectiveness of regulation. It shows that regulators never can allow taking a wait-and-see attitude. They continuously have to evaluate the co-evolution between regulatory structures and technological development, as well as to realign regulation according to their responsibilities. If these lessons are taken seriously, the regulation of nanotechnologies can contribute to the innovation of governance.

REFERENCES

- Black, J. and R. Baldwin (2010) Really Responsive Risk-based Regulation. *Law & Policy* 32, 181–213.
- Burca De. G and J. Scott. (2006) *Law and New Governance in the EU and the US*. Hart Publishing, Oxford.
- Committee to Review the National Nanotechnology Initiative (CRNNI) (2006). *A Matter of Size*. Washington DC: The National Academic Press.
- Dorbeck-Jung, B. (2007). Dorbeck-Jung, Bärbel R. 2007. "What Can Prudent Public Regulators Learn from the United Kingdom Government's Nanotechnological Regulatory Activities," *Nanoethics*, 1: 257-270.
- Dorbeck-Jung, B. et al. (2010). Contested hybridization of regulation: Failure of the Dutch regulatory system to protect minors from harmful media. *Regulation & Governance*, 4, 154-174.
- Levi-Faur D. and H. Comaneshter H (2007). The Risks of Regulation and the Regulation of Risks: The Governance of Nanotechnology. In: Hodge G, Bowman D, Ludlow K (eds) *New Global Regulatory Frontiers in Regulation: The Age of Nanotechnology*, Edward Elgar, Cheltenham, 149–165.
- Nordmann, A. (2009). Beyond Regulation, *Nanomagazine* April, 29-31.
- Rip, A. (2010). De Facto Governance of Nanotechnologies. In: Goodwin, M., BJ Koops and R. Leenes. *Dimensions of Technology Regulation*. WLP, Nijmegen, 285-308.
- Senden, L. (2004). *Soft Law in European Community Law*. Hart Publishing, Oxford.

Towards understanding the emerging governance marble cake in multi-level European R&D funding.

Jakob Edler, Manchester Institute of Innovation Research, MBS, University Manchester, jakob.edler@mbs.ac.uk

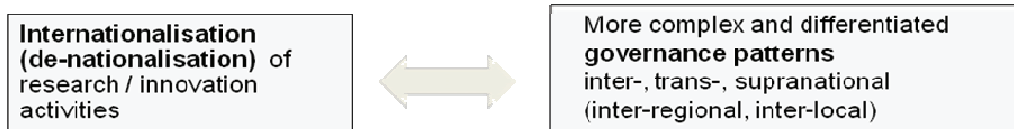
The paper addresses challenges that emerge from the internationalisation in science, innovation and technology both for policy and for policy analysts and argues for a new understanding of governance in transnational Science, Technology and Innovation (STI) arenas.

The paper starts by three observations: We witness

- 1) all sorts of actors increasingly internationalising their strategies, not only firms, but scientific organisations and funding organisations alike;
- 2) national ministries develop internationalisation strategies for STI, which results in all sorts of internal and external coordination issues, and
- 3) new forms of functional internationalisation and transnationalisation of governance – largely as bottom up initiatives by administrators who intermediate between transnational dynamics in the research arena and national policy.

Figure 1 gives a simplified account of the co-evolution of international research and complex transnational governance schemes.

Figure 1: co-evolution of international research and complex transnational governance



The nature and shape of this co-evolution differ between different scientific disciplines and societal issue areas. In combination, this leads to a *marble cake* of governance, whereby for different areas the slice of this cake has different governance arrangements, i.e. marble patterns. In some areas the pattern resembles layers (traditional multi-level governance), in other areas the responsibilities and processes are entirely intertwined between layers. This symbolizes the fact that there is a vivid and constantly evolving mix of (very few) global arrangements, of governance schemes that are largely oriented towards or dominated by European arrangements, of inter-national schemes with flexible geometries and of areas that are still largely shaped by the national level.

The paper argues that we need to understand the emergence of this specific mix, and especially its transnational dimension, if we want to understand nature and content of policies and frameworks (as it is co-constructed of those participating in the governance process), to derive at a better functional fit of policy and STI properties and to increase compliance (responsiveness) and efficiency in STI policy.

The paper critically discusses those issues, based on recent data and a range of recent studies and argues for a new conceptual approach. The illustrations used in the paper are focused on the European arena, they refer to actor strategies (which signify emancipation from the nation state in various dimensions), a mobilisation of internationalisation in national policy and, finally, emergent forms of functional internationalisation understood as attempts to create opportunity structures that are adequate for different knowledge areas and societal problems.

The paper uses a broad definition of governance, whereby governance refers to the solution of collective problems and the production of public welfare (Renate Mayntz) and thus can be defined as the „...ensemble of institutional arrangements (existing in parallel) to regulate collective issues, from civil society arrangements through all sorts of cooperation between governmental actors and non-governmental actors to traditional hierarchical action“. And following Stoker, Governance involves some form of cooperation, persuasion and reflection.

For STI policy this means that governance refers to decisions (and related implementation) on framework conditions, to allocation of private funds and public funds and connected modalities, to location of knowledge and innovation production, to research priorities (normative!), and, in short, opportunity structures for STI. Further, and crucial for the argument of the paper, in the STI field stakeholder involvement is especially important, as dynamics and inter-relations are too complex to be steered, and effective policy is based on a minimal degree of conviction and collective construction of rationales. Governance processes and governance arenas thus shape and enable discourse and learning. However, if stakeholders and their strategies and routines reach beyond national borders, the traditionally largely nationally defined policy space and the nationally shaped STI framework are contested, have potential dysfunctional effects and threaten to delegitimise policies.

Our traditional national innovation systems approach and the governance scheme it implicitly proposes has a limited understanding of governance processes which could bring about *adequate* framework conditions. Our traditional understanding of innovation systems and their governance is certainly not adequate to understand the co-evolution of *transnational* science and innovation dynamics on the one hand and governance arrangements on the other hand.

The paper thus argues that we need models and typologies to understand the new emerging governance marble cake with its contingent, intertwined governance schemes and different modes. We need to conceptualise the relation between governance arenas and levels on the one hand, and the relation between levels on the other hand. Only if we open our analytical frame for the co-evolution of transnational STI practice and governance schemes, can we help to shape functional and democratically legitimate governance schemes. This will need a fresh approach of deductive research which is driven by political science theory as well as by innovation theory and inductive research slicing the cake und examining its structure.

UK Carbon Capture and Storage Governance - Emerging Storage Regulations and Innovation Practices

Benjamin Evar, Scottish Carbon Capture and Storage, Ben.Evar@ed.ac.uk

Carbon capture and storage (CCS) has been viewed as a likely carbon mitigation policy by UK governments for some years now. Recently, a regulatory regime was brought into force with the passage of the 2008 Energy Act, which ensures that the geological storage of CO₂ offshore is a legal activity that may be jointly licensed by the Crown Estate and the Department of Energy and Climate. Since then licensing rules and storage regulations have been issued to comply with the EU Commission's deadline for the transposition of the CCS Directive.

Licensing and regulation is one aspect of CCS governance which is coming into place at the same time as the science behind geological storage and the engineering of capture systems are emerging from the scientific community. The same is true for practices which support innovation. So far the government's CCS demonstration support has been structured as a competition to select four winners. The passage of the 2010 Energy Act supports this approach by permitting a CCS-specific levy. At the same time the door has been opened for the energy regulator, Ofgem, to consider non-competitive support options. One possible option is an emissions performance standard (EPS) that limits the CO₂ output from a power plant. In July 2010 the government launched an inquiry into the possibility of establishing an EPS and which configuration would be best suited to the UK power industry.

With no experience from large-scale commercial operations to draw on, data from demonstration sites, natural carbon leakage analogues, modeling exercises, and past experiences with capturing waste products from flue gases, are all relevant components of the evidence basis to structure CCS regulations and innovation practices. This research asks how legislative knowledge on CCS is being informed: who are the relevant experts in the matter and how is guidance on storage and innovation practices being addressed by regulators? The research arena is viewed as an instance of co-evolving science and policies where emerging regulations and innovation practices are subject to a high degree of scientific and technical uncertainty.

Struggling with emerging instruments in Belgium: how do institutions adapt to contingency of tentative governance ?

Dr. Catherine Fallon, Université de Liège (SPIRAL) – Belgium, catherine.fallon@ulg.ac.be

The Walloon region in Belgium has recently launched new instruments to support university research, with more prominence to short term competitive programmes under the mantra of "open innovation" (Morant 2009), emphasizing the importance of close collaboration within "interorganisational networks of learning". These new instruments interfere with established forms of distributed governance as industry partners are called upon to take the lead in the strategic management of large research programs.

The analysis of the instruments in action

A new avenue for public policy analysis concentrates on the "instruments in action" (Lascoumes & Le Galès 2007). An instrument organizes specific social relations: it is a technical device but, beyond a mere functionalist approach, it carries a concrete concept of the politics/society relationship, as well as meanings and representations, supporting some behaviours and privileging some actors. Being technical and social in nature, instruments contribute to give shape to public policies as specific socio-political spaces. Lascoumes (2004) refers to the "mode of government" as analysed by M. Foucault, with a strong attention to the development of procedures and the materiality of techniques of public actions. The choice of an instrument itself is a dynamic translation process, constructing a socio-political network, thanks to a series of steps of translation constructing 'obligatory passage point', coordinating heterogeneous actors, producing representations, contributing to describe and categorize the social (Callon 1986). The use of methodological approaches derived from ANT help reveals these dynamics.

Field research

The analysis is based on material gathered through interviews with actors of the STI system in Wallonia, in the biomedical field. Emerging instruments have been thoroughly deconstructed and put in perspective with the other policy support schemes used by the same researchers. By considering with a symmetric approach the enrolment of researchers, industry and public authorities in the definition of the instruments, we put in the fore historic and recent transformations of these socio-political spaces, to apprehend the complexity of institutions, norms, discourses and networks of the different stakeholders and to analyse how they adapted to the new set of policy instruments.

Careful analysis of these instruments reveal the diversity of forms of cooperation and control and the possible clash of culture between them (Hood 1998). Funding by the FNRS (a research council) is organised among peers, within a web of mutual cooperation in the on going classification processes which help the group define its boundary and the profile of insiders. Other forms of cooperation are defined within a more strategic approach

organised within oversight control either within universities ("Programmes d'excellence" selected by the rector) or by the regional administration ("Programmes thématiques" defined and organised by the regional administration). The launch of "Poles de compétitivité" gave much more margin of manoeuvre to the industrial partners who are in charge of the strategic steering of the research program: with such a "steering through the users", this program tend to consider as second stage only the control by members of the scientific community as well as by public administration.

Regional administration is trapped with visions of public services somehow at odds with the new rationale for organising university-industry partnerships under the leadership of the industrial partners. During the last years, it had organised regional funding for collaborative research with more industrial support, but it always had maintained a strong say in the organisation of the programmes (thematic of the call, evaluation / selection). Within the "poles de compétitivité", the programme is delegated to the industry-university consortium and the role of the administration is limited to mere public accounting control. Universities accepted to enter this new playing field : the financial incentive was strong enough to mobilise them in new forms of collaboration adopting the logics of "open innovation". But their researchers themselves managed to keep enough freedom to lay back on their own model of scientific research, more adapted to other historically available instruments. In a field such as genomics, which can be qualified as a "divergent" proliferating field (Bonaccorci 2007), researchers tend to make a strategic use of the variety of instruments in order to create their specific "search space". The analysis of the transformation / emergence of instruments contributes to illuminate the diversity of networks, in terms of forms of cooperation, heterogeneity, power relations, time perspectives and representations. This instrumental polyphony can be considered as an asset, particularly for those researchers who have the capacity to make a strategic use of them (Shinn & Lamy 2006).

Discussion

The paper proposes to consider how the diversity of instruments impacts the patterns of configuration of innovative networks (Hood 1998): researchers mobilise the instruments and are also constrained by them, in webs of cooperation with public administration and stakeholders, all struggling for the definition of settings of participation and of administrative and political control (Buisson-Fenet 2008). Careful consideration for adequate procedures is particularly important for an "emerging" field where all the actors are fighting to keep open the rules of the game. Analysts such as Laredo (2006) propose that instruments of science policy for emerging scientific fields are best defined as supporting decentralised spaces of knowledge production while avoiding premature lock in. It is only a second stage that users should be given the chance to cooperate in selection mechanisms for areas whose prospects for innovation are more prominent. Recurrent calls for stronger orchestration of these instruments at policy level (Belspo 2005) and patterns of "governance by the outputs" are somehow at odds with these propositions.

Conclusion

Analysis of science policy through the "instruments in action" reveals the dynamic dimensions of "tentative governance", considering the polyphony of the instruments undergoing continuous transformation to adapt to contingency. The open-endedness which characterizes knowledge production in emerging fields of science demands carefully tuned forms of administration and control, with a careful balance of instruments and forms of scientific control to avoid an overwhelming transformation towards "end users control".

Complexity and co-ordination: reconsidering the 'policy mix' for innovation

Kieron Flanagan¹, Elvira Uyarra², Manuel Laranja³

^{1, 2}, Manchester Institute of Innovation Research, Manchester Business School, University of Manchester

³ ISEG-Technical University of Lisbon, email kieron.flanagan@manchester.ac.uk.

The innovation policy discourse has changed profoundly in recent years. Policy makers and scholars & analysts alike have moved away from talking about 'innovation policy' or 'innovation policies'. Instead debates increasingly focus on policy complexity and policy co-ordination. This shift in emphasis is exemplified by the adoption and uptake of the term 'policy mix' in the research and innovation policy discourse. Imported from economic policy debates, the term implies a focus on interactions and interdependencies between different policies as they affect the extent to which the intended outcomes of public policy are realised. The recent popularity of the term seems to reflect, then, an aspiration towards taking a more realistic view of policy complexity. However, in practice we argue that the term is simply used to 'black box' this complexity.

The emergence of the policy mix concept into common use in the field of innovation policy studies provides us with a (narrow) window of opportunity to re-conceptualise the basic and often hidden assumptions of innovation policy in order to better deal with a messy and complex, multi-level, multi-actor reality. We draw on the mainstream policy studies literature and on evolutionary thinking in order to re-conceptualise the basic building blocks of innovation policy studies and spell out the elements we believe are necessary to an analytically useful conceptualisation of policy complexity. We begin our problematisation of public policy complexity by exploring the setting of policy agendas and the shaping of policy rationales. We next turn to problematise actors and agency in innovation policy processes, arguing that, despite the recent interest in 'multi-actor' innovation policy, this aspect of

innovation policy studies is particularly under-conceptualised. Having considered actors, we go on to consider policy action, exploring the implications of the adoption in much of the innovation policy studies literature of a simplistic approach towards 'policy instruments'. Having considered action, we finally turn to interaction between public policies, exploring the range of dimensions across which interactions can occur. Here we emphasise the need for a genuinely dynamic view of policy interactions.

Our analysis has profound implications for the scope and focus of innovation policy studies and for what such studies can realistically hope to achieve in terms of policy prescriptions. We suggest that innovation policy studies has progressively built up a kind of normative structure around an idea of 'innovation systems' which is derived from and which claims legitimacy from empirical and comparative innovation studies and from evolutionary accounts of technological and economic change. This normative structure assumes an underlying or achievable rationality and coherence to the 'system' as a target for policy action which is almost certainly unrealistic. This normative structure has become self-referencing and a set of widely-repeated policy recommendations have effectively become a kind of STI policy folk wisdom, seldom fully explained and rarely questioned.

Laboratory engagement in for-profit context

Ir. Steven Flipse^{1,2,3}, Prof. Dr. Patricia Osseweijer^{1,2,3}

S.M.Flipse@TUDelft.nl

¹ TU Delft, ² Kluwyer Centre for Genomics of Industrial Fermentation ³ Centre for Society and Genomics

ACKNOWLEDGEMENTS – This study conducted at Delft University of Technology is carried out within the scientific programme of the Kluwyer Centre for Genomics of Industrial Fermentation and is funded by the Centre for Society and Genomics.

Context description

Even though research and development processes within publicly funded institutions have been studied thoroughly within the field of Science and Technology Studies, innovation development in a commercial, for-profit context has been largely understudied (Penders 2009). This is especially the case within the field of biotechnology (and specifically within Europe), a field of engineering where the current and future applications are often poorly appreciated by the public (Gutteling 2002; Dixon 2003; Gaskell 2004). This ill appreciation has probably contributed to industry keeping its doors shut for STS scholars. All the same, actual applications that the public is and will be confronted with, are coming from biotechnological research and development that is generally developed and produced within a commercial context. Additionally, it has been argued that it may be beneficial for research if the researchers reflect on the societal context in which their research is carried out (Schuurbijs 2009; Rip 2009), suggesting that an STS involvement could improve innovation, also in a for-profit context.

For both reasons mentioned above, we felt that it is time to study the field of for-profit knowledge production within biotechnology firms. Based on a good relationship and a non-disclosure agreement we were enabled to conduct a first unique study on the innovation practice within a large biotechnology company, to identify and assess ethical, legal and social issues, and their related challenges and hurdles in the innovation process.

Engagement

In this study we intensively engaged industry scientists based on the approach of Midstream Modulation developed by Erik Fisher (Fisher 2006). Weekly interviews were conducted over a period of twelve weeks. In these interviews we reflected on the ethical, legal and social issues relating to the researchers' daily scientific practice. Additionally, we were allowed to visit weekly lab meetings, and on several occasions the laboratories where the experiments took place were also visited. Since industry projects do not only encompass R&D activities but also have business and manufacturing aspects, also experts from these domains were interviewed. To give an impression of some of the findings, we will present one case study relating to the socio-ethical context of the project we studied, specifically focusing on Life Cycle assessments in biotechnology industry.

Case study

Industrial biotechnology is (among other things) proclaimed to form the sustainable alternative for fossil fuel based production of chemicals and materials. Large effort is put in the development of biobased bulk chemicals, such as biofuels and bioplastics, for which genomics often provides useful new insights and applications. From the point of view of credibility, these new products need to perform well technologically, but also product perception is considered very important. Industrial or white biotechnology wishes to uphold a green character. Sustainability is the key concept, often translated in claims of lower environmental impact and lower CO₂ emissions. Companies perceive the green character of new products as an added value for their reputation management: better perception of these products by various players, including potential (end) customers, may lead to increased sales.

To prove and quantify this sustainability, trustworthy life cycle assessments (LCAs) of the biotechnology based counterparts of chemicals produced from oil would be very welcome. Such LCAs may prove a powerful tool in quantifying and addressing ELS issues in industrial biotechnology, which may aid policy steering for socially responsible innovation. Unfortunately, it proves very difficult to make these required LCAs, from both a technological and a socio-economical perspective. Also, available assessments regularly show that large scale production of biobased chemicals is not always directly more sustainable than production through fully developed and specialized petrochemical processes. This puts industrial biotech companies for major dilemmas, both in incentives for further development and in communicating their assets.

Questions that were discussed were for example 'Does responsibility of a product's life cycle end when the product leaves the factory gate?' and 'What if a competitor claims a high sustainability level for a process that you know is much worse, from your own LCA calculations?' . Further questions addressed other more global ELS issues, including 'What if this new product needs a renewable sugar source that is likely to come at the expense of Brazilian rain forest?'

Conference goals

We will present the results of one case study relating to the socio-ethical context of the industrial innovation process in-situ, specifically indicating some of the current dilemmas that industrial biotechnology faces in relation to novel applications of genomics. Additionally, we wish to reflect upon the use of the Midstream Modulation approach for studying science and technology in a commercial context.

References

- Dixon, B. (2003). "Genes in food - why the furore." Biochemical Society Transactions **31**(part 2): 299-306.
- Fisher, E., Mahajan, R.L., Mitcham, C. (2006). "Midstream Modulation of Technology: Governance from Within." Bulletin of Science, Technology & Society **26**(6): 485-496.
- Gaskell, G., Allum, N., Wagner, W., Kronberger, N., Torgersen, H., Hampel, J., Bardes, J. (2004). "GM foods and the Misperception of Risk Perception." Risk Analysis **24**(1): 185-194.
- Gutteling, J. M. (2002). "Biotechnology in the Netherlands: Controversy or Consensus?" Public Understanding of Science **11**: 131-142.
- Schuurbiers, D., Fisher, E. (2009). "Lab-scale Intervention - Science & Society Series on Convergence Research." EMBO reports **10**(5): 424-427.
- Penders, B., Verbakel, JMA., Nelis, A. (2009). "The Social Study of Corporate Science." Bulleting of Science, Technology & Society **29**: 439-436.
- Rip, A. (2009). "Futures of ELSA" EMBO reports **10**(7): 666-670.

The role of ISO in the governance of nanotechnologies

Ellen-Marie Forsberg, Work Research Institute, ellen-marie.forsberg@afi-wri.no

This paper reports on a research project studying the role of the International Organization for Standardization (ISO) in the governance of nanotechnology. The project involved document and literature studies, interviews and participation in ISO meetings. The main focus of the project was on ISO's technical committee on nanotechnologies (TC229). Having set up this committee in 2004, ISO is now making standards on terminology & nomenclature, measurement & characterization, health, environment & safety, as well as material specifications. The TC expects these to play an important role in national and international regulation of nanotechnology. The committee accordingly has high ambitions with regard to its role in the governance of nanotechnology, as for instance described in relation to the two first working groups: 'The development of standards [...] will support research, commercialisation and trade in materials and products at the nanoscale, stimulating growth through the commonality of metrics and terminology. These standards will also support the development of appropriate national and international regulatory regimes, including guidance documents, in the fields of occupational and environmental health and safety. These regimes will provide certainty and confidence for workers, consumers, manufacturers and users alike.' (Business Plan 2007-2008). The research project explored what should be the case for ISO to legitimately play such a role and discussed how ISO seems to be performing at the moment. In this paper I will focus on issues of science.

Scientific diversity and the lack of scientific knowledge is both the justification of TC229's work and also its problem: TC229 takes upon itself to lead where others hesitate. It is unusual for ISO to start standardisation work at such an early stage in the technology development. In TC229, ISO takes on a new role as an actor coordinating and facilitating basic research, rather than simply standardising applications and processes. This must lead one to ask how ISO can do this job. From a practical point of view, the impression from this project (confirmed by Delamarle and Throne-Holst 2010) is that the lack of scientific knowledge and the lack of available expertise are experienced as practical problems in the working groups. Since the establishment of the TC in 2004 only four documents have been published and these are guidance documents that represent lower levels of consensus. Moreover their content seems

not to be very substantial. But a more principled issue is more important: Why should ISO be an appropriate forum for producing scientific consensus? A potential benefit of ISO is that it can produce standards faster than legislative processes – indeed, efficient standard making is in fact an important competitive advantage in the standardisation market. This means that there will be an incentive to close processes in order to actually produce output. ISO defines consensus as ‘general agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments’.¹ It is stressed that consensus need not imply unanimity. Consensus can thus be produced by good facilitation and negotiations. However, this does not ensure that the result will have legitimacy among experts that were not part of this process. Time will show if ISO really can produce standards with broad scientific legitimacy– or whether TC229 will only succeed in efficiently producing standards at the expense of scientific quality and broad scientific legitimacy of its output.

TC229 seems to be somewhat ambivalent towards its scientific function. On the one hand, they stress that their undertakings are of a purely scientific nature, so there is no need for broad participation by stakeholder groups. On the other hand, it is clear that science and regulation are two sides of a coin. Some scientists reported frustration about the fact that lawyers wanted to check legislative implications of a scientific discussion before agreeing to a conclusion. Indeed, in the TC working groups, public and industry scientists cooperate with representatives from the authorities and industry (as well as to a certain extent other stakeholders) in their quest to develop a common scientific framework. The novelty and potential impact of this way of co-organising the research and regulation process make it important to scrutinise this work. However, broad quality control of the ISO working processes is difficult because the funding regime, where all participants must have their own funding, has the effect that there will be more participants that represent corporate or national industry interests than participants representing other interests. This amounts to an important difference when developing a scientific framework in ISO compared to in other scientific fora, and it might influence the basic value choices that are made when deciding on terminology, measurement methods and risk assessments.² This problem is augmented by the fact that there is limited transparency in the processes.

Finally, even if uncertainties are noted in the TC229 publications and the documents are open for revision and not very substantial, the issue still arises about whether one should publish standards at all at this point in time. Publishing standards may lead people to believe that knowledge is more established and well-explored than what it actually is. If it is true, as for instance Wickson et al. 2010 argue, that the nanotechnology field is characterised by massive ignorance and ambiguity, then this hardly seems like a climate for standardising. On the one hand, in order to gain scientific knowledge in the nanotechnology area there is a need for a common framework of terminology and measurement methods, etc. In that respect ISO’s initiative is to be applauded. On the other hand, standardising terminology, measurement methods, etc. at this point in time may prematurely fix concepts and practices that should remain open and dynamic until more knowledge is gained.

In conclusion, I believe that the scientific issues of nanotechnology standardisation noted above demonstrate that ISO’s new role in the development of science should be subject to critical discussion among STS and governance scholars, as well as among philosophers of science and ethicists.

The Organization of Higher Education and its Publicity

Andres Friedrichsmeier, Muenster University, Friedrichsmeier@uni-muenster.de

This paper recommends considering a “publicity orientation” as a governance mechanism, and, to this end, differentiates between two basic strategies of legitimization, “pricing” and “visibility”.

Accepting, for the moment, the somewhat vague term “publicity orientation”, it is evident that “governance” is also a rather dazzling concept. Rather than having a tangible meaning in itself, the term “governance” represents a tangible shift in both the interpretation and practice of regulation. “Governance” indicates that regulation is not confined to government and to the use of specific (legally binding) instruments.

This shift inevitably affects the publicity orientation of public organizations in higher education. If their relation to the government alters, there is also a governance-related shift of their societal, or, alternatively expressed, public relations. Higher education organizations in continental Europe, that used to be controlled (apparently closely) by the state, nowadays find their public role to be indefinite. The term “publicity orientation” reflects this unresolved constellation. In a nutshell, the shift in governmental governance obscures who or what should form the counterpart of legitimization efforts on the part of public organizations. Is it students in their new role as customers, or their future employers; is it the providers of research grants or even society as a whole?

¹ <http://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/Glossary.htm?nodeid=2778927&vernum=0>

² It also means that the societal quality of the standards, i.e. the extent to which the standards are optimal from the point of view of consumers, workers and the environment, cannot be assumed.

Fortunately, mass media serve as a generalized indicator of public observation and as the major system of public monitoring in society. Therefore, a media orientation, being a vital aspect of a publicity orientation, grants privileged access to measureable public legitimization of higher education organizations. Public relations departments and burgeoning marketing budgets are formalized outcomes of this orientation. There are also noteworthy effects that are less formalized. "Media logic" denotes the adoption of selection criteria that are commonly identified with the fabrication of public attention (and with the global trend of mediatization). By definition, media logic intermixes governance, without establishing separate formal structures. Therefore, its empirical measurement is disputable. The adoption of media logic, as discussed in the literature, cannot be disconnected precisely from the effects of coinciding global trends, such as corporatization.

So how can research come up with phenomena like "media logic"? Analyzing legitimization strategies yields additional indications. In doing so, I propose that "pricing" and "visibility" strategies are integral parts of the phenomenon "new governance of higher education". "Visibility" accounts for formalized and non-formalized aspects of "publicity orientation".

Intention

Yet, a mere "orientation", especially if it lacks formalization or even deliberate acts, may not correspond with one's understanding of governance. Even so, many researches agree that the term "governance" in itself, prescribes a devalued linkage between "governance" and the intention to "govern".

Contrary to the current understanding of governance, the modern nation state has emerged through a concentration of steering efforts on one point. Within this process of classical modernization, the intention to regulate (rationally and therefore inevitably bureaucratically) has been given a distinct representation, namely the (head of) state. In classical political theory, this concentration of regulation is counterbalanced, to some extent, by a free press.

Nowadays, terms like "tentative governance", the topic of this present conference, indicate distrust in the very possibility of precise control by a central authority, not least in the complex field of organizing higher education. Nonetheless, members of organizations need to feel that they are regulated adequately. Otherwise, their cooperation would ultimately break down. Accordingly, there is a need for viable approaches to "post-bureaucratic" regulation. So far, managerial economics is the most widely recognized answer to this need, but their contribution to the accountability of regulation should be reconsidered and stated more precisely.

"Pricing"

Managerial economics does not simply rationalize regulation, for the simple reason that rationalization is more a characteristic of bureaucratic regulation. In a classical bureaucracy, the task of regulation can be understood as social engineering. (Governmental) experts provide for the best possible standardization of processes. In "corporatized" public organizations, especially in modern universities in central Europe, trust in specifications and rules, dictated by experts, is on the decline. Instead, these public organizations trust in regulation by dynamically changing key figures. (Internal) "pricing" attempts to levy preferences of all relevant participants. Therefore, prices and price-like numerical figures imply some kind of participation. Prices, constituted in virtual markets, are employed to back up regulation in a technical manner. Nonetheless, managerial economics amount only to one aspect of the new governance. Public organizations in a knowledge society do not function as technical machines, due to the impossibility of obtaining a technical fixation of public objectives.

"Visibility"

Consequently, public higher education organizations not only engage in optimizing the economic efficiency of their organization, but also in additional modes of accountability. They expand and extend their marketing activities, sharpen their public profile, engage in personality promotion, introduce a form of corporate design and much more besides. An outstanding example of a "visibility" strategy is the personalization of leadership. Many universities in central Europe bolster up the image of their deans and presidents, at the expense of academic boards that are less visible. This strategy is noticeably unfit for responding to the growing disbelief in the capacities of centralized steering, but improves the visibility of activities. All in all, a publicity orientation is not an add-on to governance, but strengthens certain coordinating mechanisms in higher education and weakens or alters others.

One might object that visibility strategies can be attributed merely to economic competition, but technical explanations of that type are surely too narrow. The relationships between higher education organizations and society are far too complex to be accounted for by a manageable series of economic figures – irrespective of how much these figures are synthesized or arranged in impressive score cards. As neo-institutional studies demonstrate, much of organizational change is explainable rather as struggling for improved legitimization, than as a realignment through economic figures and statistics. A "publicity orientation" reflects the uncertainty as to whom exactly, public organizations should legitimize. Legitimization efforts therefore resort to generalized visibility strategies. By seeking media attention, organizations obtain a generalized indicator of opportunities and threads in public legitimization.

So far, a publicity orientation has not been considered with any consistency, but its relevance is clear enough. In order to enhance their legitimization, higher education organizations are expanding their accountability

efforts, for example, by combining pricing accountability with visibility strategies. Hence, the concept of “publicity orientation” may contribute to the understanding of the governance modes of higher education. Due to limitations of space it is not possible here to outline the various approaches to the empirical measurement of publicity orientation, so that I refer interested parties to the research project “The Organization of Higher Education and its Publicity” being conducted at the University of Muenster in Germany.³

Governance of bottom-up standardization processes

Ole Hanseth, Margunn Aanestad, Department of Informatics, University of Oslo, Norway, margunn@ifi.uio.no

The paper addresses tentative governance in the context of inter-organizational standardization within the Norwegian healthcare sector. Achieving inter-organizational standardization is notoriously difficult, as it involves negotiations between multiple actors with different interests. When seeking harmonization of standards (e.g. ontologies or metadata standards) conceptual inconsistencies or outright conflict of interests may emerge (Carlile, 2004; Ribes and Bowker, 2009). Moreover, such processes often imply significant costs, which may be asymmetrically distributed; while benefits are realized by the user/customer, the costs are borne by the organization/entity itself. Moreover, while the costs and investments have to be tackled up front, the benefits may not be realized within a short time frame, and are dependent on the joint efforts of the participants (Millerand and Bowker, 2008). Inter-organizational standardization (or standards harmonization) often happens in constellations where the result depends on the voluntary contribution from the actors.

From this perspective it makes sense to analyze inter-organizational standardization processes as “collective action dilemmas” (Olson, 1965), where there is a conflict between individual rationality (here: the rationality of a single entity or organization) and collective ('global') rationality. Public goods, such as a joint standard for interoperability, may not be effectively provided if individual rationality prevails, since a free-rider strategy (benefiting without contributing) appear most appealing. The slow and cumbersome organizational processes for achieving interoperability seem to exhibit some of these features and call for alternative processes and governance structures. Within information infrastructure studies examples of successful bottom-up initiatives that has also achieved overall success (standardization) are identified: flexible standardization (Braa et al. 2007), bootstrapping (Hanseth and Aanestad 2003), variation/selection cycles (Hanseth and Lundberg 2001). These approaches emphasize iteration, adaptation and interactivity since the learning challenges are significant. However, the limitation of these insight are related to the fact that they usually are strategies pursued by single entities and do not as such address collective action dilemmas. We here want to explore whether these approaches can be adjusted or complemented in this direction by drawing on studies of collective action.

Several alternative production models to the firm (authority-based) or market-based (economic) exist, in the form of collectively coordinated activities. Some well-known examples are “commons-based peer production” including open source software production (Benkler, 2006) or self-governed common resources (e.g natural resources) (Ostrom 1990). These forms represent other ways of coordinating and harnessing collective capacity. The underlying mechanisms that stimulate these forms of collaboration may be motivational, strategic or structural (Kollock, 1998) or a mix between these. Such studies of the organizational and institutional mechanisms that facilitate collective action will be beneficial in suggesting alternative governance mechanisms also for standardization. While there exist a few studies of standardization processes analyzed from the collective action viewpoint (see e.g. Markus et al., 2006), the majority are concerned with commercial entities, where the dynamics of the processes are different from the public sector.

We propose to analyze the experiences with standardization within the Norwegian healthcare sector based on the collective action and information infrastructure perspectives. Empirical material covering major health care standardization initiatives during the last 20 years are presented (building on interviews, participant observation, and document analysis). The analysis centers on the relation between the standardization approach, the design of technological solution, the cooperation format and the outcome of the initiative. We show how some actor and technology constellations allowed a dynamic, exploratory and learning-oriented process of development, where core standards could be identified, serving as initial starting points for further organic growth.

References:

- Braa, J., Hanseth, O., Heywood, A., Mohammed, W. and Shaw, V. (2007): Developing Health Information Systems in Developing Countries: The Flexible Standards Strategy. Vol 31, no. 2.
Benkler, Y. (2006): The Wealth of Networks: How Social Production Transforms Markets and Freedom. Yale University Press

³ Research project funded by the German Federal Ministry of Research and Higher Education, standardized empirical questionnaire survey of 3500 decision makers in the field of German higher education policy.

- Hanseth, O. and Lundberg, N. (2001): "Designing Work Oriented Infrastructures". *Computer Supported Cooperative Work (CSCW)* vol 10, nos. 3-4, pp. 347-372
- Hanseth, O. and Aanestad, M. (2003): "Design as Bootstrapping. On the Evolution of ICT Networks in Health Care". *Methods of Information in Medicine*; vol. 42: pp. 385-91.
- Kollock, P. (1998): "Social Dilemmas: The Anatomy of Cooperation". *Annual Review of Sociology*, vol. 24, pp. 183-214.
- Markus, M.L., Steinfeld, S.W., Wigand, R.T., and Minton, G. (2006): "Industry-wide Information systems Standardization as Collective Action: The Case of the U.S. Residential Mortgage Industry". *MIS Quarterly*, vol. 30, Special Issue on Standardization August 2006, pp. 439-465.
- Millerand F. and Bowker G. (2008): "Metadata Standards. Trajectories and Enactment in the Life of an Ontology". In Lampland and Star (eds.): "Standards and their Stories. How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life ", 2008.
- Olson, M. (1965): "The logic of collective action. Public goods and the theory of groups", Cambridge, Mass.
- Ostrom, E. (1990): "Governing the Commons. The evolution of institutions for Collective Action". Cambridge University Press.
- Ribes, D. and Bowker, G. (2009): "Between Meaning and Machine: Learning to Represent the Knowledge of Communities". *Information and Organization*, vol. 19, pp. 199-217.

Swiss Biotechnology as an Alternative Mode for Radical Innovations – Contingencies, Institutional Practices and Theorization¹

Raimund Hasse and Eva Passarge, University of Lucerne, raimund.hasse@unilu.ch

The development and growth of high technology sectors like Biotechnology depend on different factors. Often, these factors are illustrated with respect to Silicon Valley which has become a world model for the successful involvement in high tech sectors. As a consequence of the success story of technology based innovations in the Silicon Valley, researchers, consultants and political practitioners from all over the world refer to the model of this region in order to learn and to demonstrate what needs to be done to succeed in the utilization of technological innovations. In particular, this holds true for core technologies and radical innovations in ICT, biotechnology etc.

In a sharp contrast to this model, the development of biotechnology in Switzerland has strongly been backed by the big pharmaceutical companies; universities and research institutes played a much less important role. Additionally, the development of the biotech sector in Switzerland could not profit from already existing innovation structures of other technological fields such as information technology. As a consequence, biotechnology was integrated into the established industry of big pharma. Deeply embedded in this context, the emergence and spread of the Swiss biotech-industry has been a success story thus far. Furthermore, participants are fully aware that they have followed a distinct path, and observers and consultants have begun to outline a distinct model which they communicate to policy makers and decision makers even in the USA.

The contribution deals with structural features and institutional forms of the biotechnology sector in Switzerland. It also refers to the modelling ("theorization") of this practice. While the results open up the door for a reflection upon policy implications and issues of competitiveness, crucial academic questions remain unanswered. One of such questions refers to the mode of knowledge transfer and learning which is supposed to be at the heart of any innovation. And, finally, the role of universities – and their relations to both biotech start-ups and industry – deserves a closer look, because it deviates in many respects from what has been said about the US-experience and its modelling.

¹ The issues discussed here are primarily based on diverse data sources and on expert interviews with founders of biotechnology start ups, with venture firms and other capital providers, and with personnel from universities (researchers, representatives of offices for technology transfer etc.). From 2006 to 2009, the project has been funded by the Swiss National Foundation (SNF).

Changing Governance and Authority Relations in the Swedish Public Research System

Tina Hedmo and Lars Engwall (Uppsala University), tina.hedmo@fek.uu.se

During the Postwar Era, the Swedish public research system has, in similarity with most industrialized countries in the Western World, been challenged by a number of radical reforms. As an outcome, the conditions governing the production, coordination and evaluation of scientific knowledge have altered fundamentally (Whitley, 2009). In an era of significant expansion of public research more generally, we can note how the role of the state has changed in steering and funding public research. A reduced or stagnating level of state funding has been followed by a shift towards more competitive and short-term project-based funding. In addition, the changes in the governance of universities more generally have moved systems towards increased “managerialization”, and more lately, towards universities seeking to become more strategic and autonomous in “controlling” their own resources. We can also follow how universities to an increasing extent incorporate *ex post* procedures and quantitative measures like rankings and bibliometrics in order to evaluate their research outcome. They also strive to behave more “entrepreneurial” with the outcome of blurring boundaries between public research and industry. These changes seem to shift the authority relationships governing research priorities and evaluation criteria in most countries, so also in Sweden. What is emerging is a variation between countries dependent on how states manage their relationships with university organizations, how authority is distributed between different actors (i.e. individuals and groups) and administrative levels within universities, and how universities relate to various actors in their surrounding environment. In Sweden, for instance, we can note how universities have become more dependent on the distribution of financial resources from external authorities like research councils and foundations, county councils, private sector companies, EU and international non-governmental organizations, moving the Swedish public research system towards increased fragmentation with new institutional arrangements, authority relationships and power asymmetries.

This paper focuses on the Swedish context and aims at analyzing how the changing governance of the Swedish academic research system from the 1970s onwards has altered authority relations governing research funding, i.e. the control, allocation and evaluation of resources to public research. It seeks to answer how the funding of university research has changed over time and how different actors have managed to influence university research through funding programs. The paper also seeks to assess to what extent these long-term changes have made governance more tentative, “creating spaces of openness” and facilitating the production of public research. The development is reconstructed largely from published sources, i.e. histories of the major state agencies, foundations, universities and other research organizations, official reports, and statistical data, and interviews with key actors.

Cultural Codes for (Self-) Organizing Science and Technology

Alejandro Hernández B¹ Colombia National Bureau of Statistics, aletab79@gmail.com

The hypothesis behind the following ideas is that the scopes of knowledge-based activities in any given society are conditioned by the set of incentives for behavior, action and organization that predominate in that society. As organized activities, Science and Technology (S&T) take part of the more general set of structural arrangements that give shape to social life as they outline its constraints and possibilities². S&T might develop either in tension with or encouraged by other norms and types of social organization depending on whether the symbolic and material conditions necessary for the development of knowledge-based activities are guaranteed or not.

The core sets of norms and values that lay at the basis of S&T have been studied by disciplines of the social sciences and humanities. Some approaches have provided a conceptual framework for a better and interdisciplinary understanding of knowledge-based activities. Big epistemic influence on these approaches come from the cultural and social studies on science and technology (STS), where the contributions of current research on the cognitive, social and cultural dimensions of scientific and engineering practices have received special attention. Such conceptual framework may be useful to give content to what I will refer to as the ‘cultural code for knowledge as a self-organizing process’.

A cultural code in any socially organized activity is traceable through the set of foundational values, expectations and customary practices that lay at the basis of that activity and help to explain why it remains as elements of symbolic appraisal by certain groups in society over time. Cultural codes influence not just the behavior of

¹ Thematic Coordinator of Innovation Surveys at DANE (National Bureau of Statistics), Colombia. M.A. in Philosophy of Science.

² “Societies are organized around human processes that are at their turn structured by relations of production, experience and power, historically determined. (...) The relation between work and matter implies the using means of production based on energy, knowledge and information. Technology is the specific form on that relation” (Castells, 2004: 39)

individuals at their interactions but also the dynamics of society as a whole³. At some point, a cultural code might be tacit or implicit in the interacting mechanisms by which individuals organize collectively to pursue common goals. It might be that those elements are codified beyond the original interactions within which they first took place and so they gain autonomy over time.

I propose the notion 'cultural code for knowledge as a self-organizing process' to refer to the semiotic condition for such autonomy-wise organization of S&T to be possible.

STS research on the anthropological aspects of institutionalized cognitive practices shows that practitioners or members are somehow committed to knowledge as a way of life⁴ and share certain behavior codes. They all have in common a sort of ethical commitment to pursue knowledge as a higher activity ("commitment to truth", "to creativity", "to progress", "to power", for instance). Etymologists teach that *culture* stems in Latin's *colere*, which refers to tending or guarding (the own possessions, a treasure) and the tilling of land. This stem derived into figurative *cultus*: a particular form of worship or religious practices. *Culture* thus denotes the attitude of taking care of, or paying devotion to, something that is highly valued, either materially or spiritually.

The normative ground for individuals and groups to commit themselves to the aims of theoretical and technical knowledge may be still implicitly or explicitly consigned in the codes for their interaction and organization toward goals. A cultural code for knowledge thus encompasses those values, beliefs and expectations that form the 'ethos' or 'sense of community' of those engaged (committed) to produce and apply knowledge as a highly valuable social activity. Such code has been, on the one hand, interiorized by individuals who've committed themselves to science as a way of life, and, on the other hand, institutionalized by groups or scientific communities through organizing rules. When the cultural code for knowledge meets its correlative structure as a stable social organization, such structure may fit or not other predominant organizing norms in society⁵.

In the former case, the possibilities for society to benefit from the social utility of S&T may be at stake. Such social utility is to be understood in the context of a knowledge based society where symbolic and material conditions for knowledge generation have been socially guaranteed. Symbolic conditions relate to possibilities for knowledge as a way of life (intellectual liberties, democratic access to information, education and cultural rights). Material conditions relate, on one hand, to R&D facilities; on the other hand to a positive feedback-based economy by which knowledge outputs can be marginally enhanced (Maldonado, 2003).

Autonomy is not the same as self-organization⁶, but in the case of a knowledge-based society, the former is a condition for the latter. Any S&T mature system requires different conditions for autonomy (institutional, organizational, professional) so as to draw up R&D programs and manage their own incentives to make R&D implementation possible, that is to say, to make fruitful knowledge-production and application possible.

A cultural code for knowledge, implicit in individual and collective commitments, is a functional condition for that autonomy reached. Self-organization is, at its turn, an emergent state of a system beyond central planning, prospection or control. While autonomic organization is still a linear process that implies centralization (central coordination, hierarchical assemblages, authority-based relations, for instance), self-organization is a non-linear phenomenon implying highly decentralized social assemblages⁷.

A core claim of a cultural code for knowledge as a self-organizing system is that on the radical defense of intellectual liberties and rights to knowledge. Such claims may or may not conflict with other interests and codes for social organization such as political/ideological, moral/religious or economic. This should be considered when

³ L. Fleck saw culture as 'the nature' of science and established a correspondence between specialist's knowledge (esoteric) and the popular knowledge (exoteric). The former is characterized by being rational and methodical, while the latter is distinctive for its intuitive and symbolic features. Scientists cannot keep themselves uninfluenced by society's collective consciousness.

⁴ This idea has been inspired by M. Weber's classical conception on 'Science as a vocation' (1922).

⁵ "An institution is at the same time a structural model and a set of collective representations valued in more or less degree. (...) Every institution refers directly or indirectly to a system of values, or in other words, a conception of the good and evil, the fair and unfair, which implies a pro or contra position-taking" (Duverger, 1968: 99)

⁶ L. Winner and J. Ladrière understood the dynamic of science as nearly-autonomous. The scientific process sets up in society a complexity-increasing superstructure that evolves independently from any coordination center or policy. Accordingly, the measure of allocating generous financial resources on scientific and technological programs is just a first-level condition for science to unfold its entire potential.

⁷ "Governance can be taken to imply that the development and control of science and technology is not simply a matter for government or "the state" (Rose, 1999: 16-17). This implies at its turn that "national governments no longer have the ability to direct society toward specific goals. Instead, they must play a part within de-centered networks and shifting assemblages of power". (Irwin, 2008: 584).

analyzing successful and unsuccessful processes of S&T institutionalization in developing countries⁸. It may help to better understand situated knowledge dynamics in societies whose normative basis, values and organizing principles have been sufficiently studied.

Proximity and collaborative Mode 2 knowledge production: The case of non-pharmaceutical Type 2 Diabetes Mellitus research in Europe

Koen Frenken¹, Sjoerd Hardeman², Anne ter Wal³, Ron Boschma⁴

¹ *k.frenken@tue.nl*, Eindhoven Centre for Innovation Studies (ECIS), and Urban and Regional research Centre Utrecht (URU), Utrecht University (the Netherlands)

² *s.hardeman@tue.nl*, Eindhoven Centre for Innovation Studies (ECIS), and Urban and Regional research Centre Utrecht (URU), Utrecht University (the Netherlands)

³ *a.terwal@imperial.ac.uk*, Imperial College Business School, London (United Kingdom)

⁴ *r.boschma@geo.uu.nl*, Urban and Regional research Centre Utrecht (URU), Utrecht University (the Netherlands)

Introduction

If anything characterized the change in scientific knowledge production over the past century, it has been its increasing distributed nature (Wuchty et al. 2007). For research collaborations this rise has not been limited to inter-university research projects. In this respect Gibbons et al. (1994) introduced the distinction between the traditional Mode 1 knowledge production and the alleged increasing new Mode 2 knowledge production.

We propose to operationalize the distinction between Mode 1 and Mode 2 knowledge production for collaborative research using the notion of proximity. Table 1 links five characteristics of Mode 1/Mode 2 knowledge production with five forms of proximity (Boschma 2005) whereby Mode 1 knowledge production coincides with collaborations between proximate partners and Mode 2 with collaborations between less proximate partners.

Table 1. Mode 1 versus Mode 2 knowledge production as operationalized by five forms of proximity

| Mode 1 knowledge production | Mode 2 knowledge production | Basic notion of proximity |
|-----------------------------|--|---------------------------|
| Mono-disciplinary | Spanning disciplinary boundaries | Cognitive proximity |
| Local | Diffusion over a range of physical sites | Geographical proximity |
| Same social context | Flexibility in social relations | Social proximity |
| Single organization | Wider societal context | Organizational proximity |
| Pure academic context | University-industry-government relations | Institutional proximity |

One question then concerns the actual organization of the sciences, that is, how is science organized if characterized along lines of different forms of proximity? Is science organized in a distributed form alongside each and every proximity dimension (i.e. Mode 2)? Is science organized in a non-distributed manner (i.e. Mode 1)? Or, is science organized in distributed form alongside some while in non-distributed form alongside other proximity dimensions? This paper is an attempt to assess this issue.

Method

In addressing the organization of collaborative science we restrict our analyses to the collaboration intensity between organizations involved in non-pharmaceutical type 2 diabetes mellitus (t2dm) research in Europe. We choose this aspect of diabetes because we expect that research therein will typically be of the Mode 2 kind.

The dependent variable in the analysis describes the number of research collaborations between organizations in non-pharmaceutical t2dm research as measured by the total number of co-publications between each two organisations

⁸ Some of the main current constraints on science as an activity that requires public support and institutions, were already present in Colombia during its first years as a republic: i) A gap between political speeches on science on behalf of the general interest and the true actions and policies undertaken to make it real (v.g. hesitation at assigning public resources to training and research programs); ii) “Complex of Adan” or “Sisyphus compulsion”: lack of acknowledgement or abandonment of prior efforts, plus reversing decisions on mere personal grounds, which leads to restarting programs and re-founding pro-science institutions; iii) Disdain toward the maintenance of schools of thought and research programs over time and preference for obtaining immediate results according to circumstances; iv) Predominance of government policies over a long-run state policy, resulting in chronically weak institutions for science and technology; v) High dependence on the efforts of passionate individuals (scientists or statesmen) with mid-run vision (Wasserman, 2010: 9-19).

during the period 2002-2007. As independent variables we included the five forms of proximity. Cognitive proximity is measured by the degree of overlap in the journals in which organizations have published. Geographical proximity is measured by the inverse kilometric distance between the city-level coordinates of the organizations' locations. Social proximity is measured by the number of prior (1987-2001) ties between organizations. Organizational proximity is a binary measure reflecting whether two organizations belong to a single umbrella organization. Institutional proximity is a binary measure reflecting whether two organizations belong to the same institutional sphere.

We estimate gravitation models for both Europe as a whole and individual European countries. Since co-publication data between any organizational pair may deviate from a standard Poisson process, we estimate the parameters using a negative binomial regression model.

Results

Table 2 shows the results for Europe as a whole and the three largest countries in collaborative non-pharmaceutical t2dm research. We find that non-pharmaceutical t2dm research in neither Europe as a whole nor in any individual European country is organized in a Mode 2 fashion. For individual European countries we show that the determinants of research collaboration differ widely among countries. Thus, evidence for Mode 2 knowledge production is rather weak and countries differ substantially in their way of organizing collaborative knowledge production in case of non-pharmaceutical t2dm research.

Table 2. Negbin regression results

| | European Union | United Kingdom | Italy | Germany |
|---------------------------------|----------------|----------------|-------|---------|
| Cognitive proximity | ++ | - | - | - |
| Geographical proximity | ++ | ++ | ++ | ++ |
| Social proximity | ++ | + | ++ | + |
| Organizational proximity | ++ | + | - | - |
| Institutional proximity | ++ | + | ++ | + |

+ reflects a positive impact, ++ a positive and significant impact, and - reflects a negative impact of proximity

References

- Boschma, R.A. (2005). Proximity and innovation. A critical assessment. *Regional Studies* 39(1): 61–74.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, P. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage.
- Wuchty, S., Jones, B.F., Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science* 316(5827): 1036–1039.

Tentative governance in Germany: Too little, too late?

Jochen Gläser (Technical University Berlin), Eric Lettkemann and Uwe Schimank (University of Bremen), Jochen.Glaser@ztg.tu-berlin.de

The German science and higher education systems have several specific features that affect both the speed and the direction of governance changes. These features include:

- its considerable size, which provides most fields with the 'critical mass' for the establishment of national epistemic communities (a process that in the social sciences and humanities is additionally supported by their use of the German language);
- its federal structure, in which funding and governance of universities is the responsibility of the *Länder* (an arrangement that has been reinforced by recent policy reforms);
- its significant state-funded non-university research sector, which modifies the conditions for the emergence and diffusion of scientific innovations in the natural sciences; and
- its relatively recent implementation of limited governance reforms, which are restricted by the largely unchanged position of the German university professoriate and by the reluctance of university management to use their newly gained powers.

The major effect of the transition from recurrent to project funding and of the introduction of evaluations appears to be a relative increase of the authority of academic elites, which become more independent of research organizations and whose influence on organizations increases due to their role in evaluations.

The impact of these features on the opportunities for tentative governance is ambivalent. While the strategic action capabilities and flexibility of universities are still limited and hinder their responses to new scientific developments, their limited control over researchers and the access of researchers to project money with low 'conditionality' and control creates protected spaces for the creation of and experiments with innovations.

Governing by dialogue: Pre-emptive politics in the field of nanotechnology

Christiane Hauser (Institute for Technology Assessment and Systems Analysis at Karlsruhe Institute of Technology, Germany), André Gazsó (Institute of Technology Assessment, Austrian Academy of Sciences, Austria), Mario Kaiser (Science Studies, University of Basel, Switzerland)
christiane.hauser@kit.edu

Unlike any technology before, nanotechnology as so called "emerging" science or technology par excellence, has been "befallen" by a massive amount of dialogue exercises. These range from stakeholder workshops and information "dialogues" to participatory public events and more often than not do not fulfil criteria of "dialogue" in a classic sense such as reciprocity, symmetry or reflexivity. Nevertheless, all these interactions aim at adding something to the "normal" political process that is opened up to a wider number of actors and institutions and in so far add to a "new governance" or "new public management" even if the definition of these terms remains vague. In this rather peculiar realm of *politics beyond (normal) politics*, governance meets dialogue or, more precisely, they become almost synonymous. Thus, we claim that dialogue in the field of nanotechnology constitutes what Irwin has called a "politics of talk" – its nature, however, still awaiting further analysis.

Based on a set of case studies from Austria, Switzerland and Germany, we reflect and analyse three different categories of events in the realm of communication about nanotechnology: Stakeholder dialogues, information dialogues and participatory dialogues. Stakeholder dialogues as we understand them are mostly organised by some governmental institution and focus on specific topics. Participants are either experts or persons with some kind of mandate. Often they are directly connected to decision-preparing or –making processes. In contrast, information dialogues mainly aim at a one-way information transfer and mostly are not connected to political processes. Often, experts are invited as speakers, the audience is supposed to consist of lay people. Lay people are in the centre of participatory dialogues as well, that try to integrate other forms of knowledge (apart from scientific "expert" knowledge) in decision-preparing or –making processes about science and technology. Often, they are connected to political processes and initiated by governmental bodies although the integration of their results into these political processes might not be clear from the beginning.

However, defining the different forms of dialogue by such conceptual means does not account for the discursive reality of dialogue. For this reason, we examine the different dialogues according to what we call their 'infrastructure'. With this notion, we address the concrete order of discourse within such a dialogue on the one, the materiality of a concrete dialogue setting on the other hand. As we e.g. shed light on the ways by which speakers are placed in the room – either together on a round table or divided by an orchestra pit for instance – we seek to reconstruct what can be said in particular dialogues at all: Who is allowed to speak? Who is obliged to listen? Do the utterances exhibit a speculative or a technocratic character?

By examining the particular infrastructure of information, stakeholder and participatory dialogues, we look for correlations on three different levels – the cognitive one (which topics are discussed, what is the outcome), the social one (which protagonists are involved, what is the proposed aim of the event) and the political level (in which ways is the event linked to political institutions and decision-making processes, how is the outcome fed into the political system). As we firstly looked for similarities and differences between Austria, Switzerland and Germany, one can state, that dialogue processes increased significantly in all three countries and are often used to anticipate an assumed public controversy about nanotechnology. It is presumed by the organisers that participants have a negative, risk-centred attitude towards nanotechnology (as observed with earlier technology developments such as nuclear energy or genetic engineering). Where documentation of the events is available this presumption mostly does not bear up against the empirical reality. When looking into further detail for the specific types of dialogue processes one can state that the communicative structure of a dialogue process determines what can be said in the three above mentioned dimensions – and in which way by which protagonist. For example, stakeholder dialogues are characterised by a combination of plenary sessions and specialised workshops. In contrast, information dialogues usually are organised around the opposition of stage (and experts presenting or discussing there) and the audience. Likewise, participatory dialogues are expected to be moderated discussions in small groups where all participants are welcome to speak up for their opinion.

In a second step of analysis, one can ask what implications these observations have for governing an emerging science/technology such as nanotechnology. Interestingly, the empirical findings suggest that this "governing by dialogue" amounts to a kind of pre-emptive politics. Thus, the current governance of nanotechnology by dialogue leads not only to a politics beyond (normal) politics, but rather to a politics before politics. What kind of functions do these pre-emptive politics have? In which way can they be described as reaction to earlier technology

developments and their perceived failure? In the three above mentioned dimensions, the cognitive, the social and the political one, we argue from a Foucauldian viewpoint that different forms of dialogue do not so much *govern* nanotechnology in terms of routine politics, but rather make nanotechnology *governable* in advance. Presumed controversies about nanotechnology are thought to be anticipated (and solved) before they become “dangerous” for technological development. Furthermore, institutions that are likely to be involved in decision-preparing or –making processes can sort out their responsibilities and competences and act in accordance with other institutions in the following processes. In the case of nanotechnology, even the definition of the subject-matter at hand can be negotiated in the one or other type of dialogue process. It is up to discussion, whether there are even more explicit or implicit functions that different dialogue processes have in connection of the (“new”) governance of an emerging science or technology.

Governing Search Regimes

Towards a Co-evolutionary Model of Research, Science, and Society

Gaston Heimeriks, gheimeriks@gmail.com, Innovation Studies, Copernicus Institute, Utrecht University

This paper for the conference “*Tentative Governance In Emerging Science and Technology*” 28 & 29 October 2010, University of Twente, Enschede, The Netherlands is based on Heimeriks and Leydesdorff (submitted) “Emerging Search Regimes: Measuring Co-evolutions among Research, Science, and Society” and Heimeriks (submitted) “Governing science as a complex adaptive system”.

Knowledge is increasingly recognised as a driver of productivity and economic growth, as well as a vital resource in addressing societal challenges. This leads to increased (policy-) attention to the role of knowledge in societal and economic performance. However, the dynamics of codified knowledge are a complex matter. Recent studies on search regimes show that different scientific fields may exhibit very different dynamics while co-evolving with socio-economic environments. For example, scientific fields can be shown to differ in their rate of growth, the degree of divergence, and the level of complementarity. Research fields accordingly exhibit institutional and localised knowledge dynamics that may respond differently to government interventions. How can one understand these differences in terms of relevant co-evolutions?

This paper aims at providing a co-evolutionary model for knowledge dynamics by elaborating the notion of science as a complex adaptive system that allows for empirical operationalisation. Numerous existing studies have focused on different dynamics of knowledge production. However, these studies have several shortcomings. Firstly, only limited empirical work has been carried out to support claims of different modes of knowledge dynamics. Furthermore, previous strategies to understand science often have focused mainly on only a single evolutionary context.

The micro-level of knowledge production (context of discovery) was addressed in laboratory studies. Kuhn’s introduction of paradigm-led developments focused on the macro level (context of justification), and in recent years attention has shifted to the ‘context of application’, that is, the growing importance of the socio-economic environments of knowledge production. However, it is important to take into account all three contexts involved in the dynamics of knowledge because the resulting dynamics of search regimes involve these analytically distinct processes. For example, a field may be characterised by a strong and stable disciplinary identity in terms of publication patterns, while a diverging variety of skills and tools is used in research practices (e.g., genetics).

Furthermore, nations differ in terms of research portfolios. The dynamics of different search regimes are rarely taken into account when governance instruments are designed or evaluated. Most instruments for the governance of science and innovation are applied across several if not all fields in the natural sciences, social sciences, and humanities, and are intended to have the same effects in those fields.

Addressing these shortcomings, the current paper provides a model of science as a complex adaptive system and uses scientometric data to empirically investigate the emergence of search regimes from interactions among (i) the micro behaviour of researchers and (ii) emergent scientific fields within (iii) socio-economic environments.

As cases for our empirical operationalisation of search regimes, we chose Biotechnology, Genomics, and Nanotechnology. Bonaccorsi argues that European science is relatively weak (compared to the USA) in these fields characterized by high growth, high diversity, human capital, and institutional complementarities. Grasping the fruits of these emerging techno-sciences is an objective of many government priority programs in a knowledge-based and globalizing economy.

Although the ‘new leading sciences’—Biotechnology, Genomics, and Nanotechnology—can all be characterised by rapid growth and divergent dynamics of search, there are important differences among the emergent search regimes. The regimes can be distinguished in terms of the extent to which a synergy is self-organized among the three sources of variance. We show that the scope of opportunities for researchers around the world to contribute within the

constraints of the existing body of knowledge is different in each field. Genomics was characterised by relatively low variety in topics across the globe compared to Biotechnology and Nanotechnology. Especially in Nanotechnology the divergent variety of topics can be expected to provide newcomers possibilities to add new knowledge claims

Additionally, the relevance of the context of application contributes to the knowledge dynamics to various degrees. Biotechnology showed the highest level of geographical specialisation with respect to different local contexts in this study. The specialised role of public sector and commercial organisations was initially highest in Nanotechnology, but this division of labour disappeared as the field matured. These results suggest that the surge in funding in the period under study contributed to an intellectual reorganisation of the field of Nanotechnology.

The regimes are systemic, that is, largely beyond (government) control; further developments are based on the self-organization of the interactions among the contexts of discovery, justification and application. The subdynamics can also be considered as different sources of variance which disturb and select from one another. New methods, tools and collaboration patterns are continuously introduced in research practices, the landscape of scientific publications is continuously in flux and new applications are being developed at any given moment. Resonances among selections can shape trajectories in co-evolutions, and the latter may recursively drive the system into new regimes.

As the number of countries contributing to knowledge production increases, these insights become increasingly relevant for public funding of science and innovation. The growth of the global network of science means that nations and regions must take careful stock of the conduct of science at the global level as well as at the national and regional levels, in relation to locally existing absorptive capacity. Research governance thus entails a linking and sinking strategy as proposed by Wagner. It links to global science dynamics and locally 'sinks' efforts by taking into account local stakeholders, infrastructures and human resources and skills.

This means that the location of new research programmes and the geography of scientific knowledge production more broadly, are subject to path-dependent dynamics where research programmes may prosper in some locations and become marginalized in other locations. Governing knowledge production through disaggregated measures means targeting in a distinct way not only different fields, but also, and more importantly, the interactions between local research practices, emergent scientific landscapes, and the field's relationship to its societal context. If all three "levels" are aligned, there is a stable regime.

Policy-relevant uncertainties in an innovative sand nourishment project: identification and classification

Ronald E. van den Hoek, Marcela Brugnach, Maarten S. Krol, Arjen Y. Hoekstra, *University of Twente*, r.e.vandenhoeck@utwente.nl

In our current society, issues like climate change and sustainable development receive increasing attention. Due to this tendency, the Dutch government and dredging companies strive to move the management of water engineering projects from a control-based to a resilience-based approach, by embracing natural dynamics. An example is the pilot project *Sand Engine*: a peninsula that will be constructed by nourishing 20 million m³ of sand along the Dutch coast at Ter Heijde. Natural dynamic processes (wind, waves and currents) will redistribute the sand along the coast over a 20-year period to support the natural formation of the beach and dune area. The objective of this paper is to identify and classify policy-relevant uncertainties influencing the selection of a preferred Sand Engine design.

Before the actual implementation of the Sand Engine or any water engineering project, a policy development process takes place in which uncertainty is a potential cause of project delay or even cancellation. Uncertainty refers to the situation in which there is not a unique and complete understanding of the system to be managed (Brugnach et al., 2008). Before uncertainties can be managed, they first need to be identified and classified. Walker et al. (2003) provide a common classification matrix for the systematic treatment of uncertainty. Kwakkel et al. (2010) made further improvements to the Level and Nature dimensions of this matrix. The Level dimension addresses the uncertainty's degree or severity; the Nature dimension clarifies whether the uncertainty is caused by lacking system knowledge (epistemic), unpredictable behaviour of e.g. the system or people (unpredictability) or different interpretations of knowledge (ambiguity). For this paper, the Location dimension was also adapted. Originally, this dimension expresses where an uncertainty is located in the model used for system analysis; in this paper, it expresses in which phase of the policy development process the uncertainty is identified. The adapted classification matrix was used to study the uncertainties identified in this research.

A water engineering project embracing natural dynamics is expected to bear high uncertainty in its effects, as there is often only partial knowledge and understanding on how the (natural) system functions. Unpredictable natural dynamics (like weather conditions) are an integral part of the project's design and are therefore expected to have limited importance during policy development. It is hence hypothesized that policy-relevant uncertainties in water engineering projects embracing natural dynamics, like the Sand Engine, are mainly due to lacking system knowledge.

For the Sand Engine project, the summary of the Environmental Impact Assessment (EIA) and the EIA stakeholder participation document were studied to identify uncertainties influencing the design selection, since these are most relevant for this selection procedure. Hence, in this paper, uncertainties in two policy development phases are studied, namely the phases in which strategies and actions (i.e. the design) are prepared and stakeholder commitment is created.

Contrary to what was expected, the results (table 1) show that uncertainties caused by the unpredictability of the influence of natural dynamic processes (i.e. weather conditions over a 20-year period) on the morphological development had an influential role during selecting a preferred Sand Engine design. Due to this unpredictability, it is difficult to predict coastal current and wave circumstances accurate enough to assess effects on recreational safety. For one design alternative, the life span is hard to predict; this creates high uncertainty concerning the opportunities for nature to develop and for the project to acquire additional knowledge about large sand nourishment projects. Furthermore, conditions on the beach can change every year due to the project's dynamic character; this causes recreational and commercial opportunities to be uncertain.

Table 2. Policy-relevant uncertainties of the Sand Engine project's design selection

| Uncertainty | Location | | | | Level | | | | Nature | | |
|---|-----------------|----------------------------------|----------------------------|-----------------|-------------------------------|------------------------------|----------------------------|--------------------------------|------------------|-----------|-----------|
| | 3 policy phases | Prepare strategy and action plan | Build commitment to action | 2 policy phases | Level 1 (shallow uncertainty) | Level 2 (medium uncertainty) | Level 3 (deep uncertainty) | Level 4 (recognized ignorance) | Unpredictability | Epistemic | Ambiguity |
| Input factors: | | | | | | | | | | | |
| Influence of natural dynamics on Sand Engine | | X | | | | | X | | X | | |
| System behaviour: | | | | | | | | | | | |
| Morphological development of Sand Engine | | X | | | | | X | | X | | |
| Effects: | | | | | | | | | | | |
| Beach area development at end of project period | | X | | | | X | | | | X | |
| Occurrence of phenomena that can affect recreational safety | | X | X | | | | X | | | X | |
| Expected life span of Island alternative | | X | | | | X | | | X | | |
| (Recreational and natural) circumstances of beach area | | X | X | | | | X | | X | | |
| Commercial opportunities at beach area | | X | X | | | | X | | X | | |

It is concluded that policy-relevant uncertainties of the Sand Engine project's design selection are mainly due to unpredictability, which is contrary to our hypothesis. Apparently, the influence of unpredictable natural dynamics is perceived as more important for design selection than knowledge gaps concerning the coastal system's behaviour. This indicates that policy-makers still evaluate the suitability of a resilience-based project as if it were a control-based one, despite the different rationales behind the two approaches. As shown in our results, policy-makers still expect to reduce unpredictability while ignoring that these uncertainties are the main drivers of the resilience-based approach. However, this paper only addresses the policy development phases in which strategies and actions (i.e. the design) are prepared and stakeholder commitment is created. Thus, our results might not hold for other policy development phases. The goal of our future research is therefore to study the role of the policy development phase in which an uncertainty is identified more extensively for both resilience- and control-based approaches to water engineering.

Acknowledgement

We thank EcoShape for funding this research.

Literature

- Brugnach, M., Dewulf, A., Pahl-Wostl, C., Taillieu, T. (2008), Towards a Relational Concept of Uncertainty: about Knowing Too Little, Knowing Too Differently, and Accepting Not to Know, *Ecology and Society*, **13** (2): 30
- Kwakkel, J.H., Walker, W.E., Cunningham, S.W. (2010), Classifying and Communicating Uncertainties in Model-Based Policy Analysis, *International Journal of Technology, Policy and Management*, accepted
- Walker, W.E., Harremoës, P., Rotmans, J., Van der Sluijs, J.P., Van Asselt, M.B.A., Janssen, P., Kreyer von Krauss, M.P. (2003), Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support, *Integrated Assessment*, **4** (1), pp. 5-17

The technology sourcing of Spanish biotechnology firms

Adelheid Holl, Institute of Public Goods and Policies (IPP), adelheid.holl@cchs.csic.es

Ruth Rama Institute of Economics, Geography and Demography (IEGD), ruth.rama@cchs.csic.es

Biotechnology is one of those emerging fields of innovation which may have the potential to radically transform other industries and economic activities, such as agriculture, the food and drink industry, or pharmaceuticals. In today's fast-paced, knowledge-intensive environment, however, innovation is rarely the outcome of firms own internal R&D efforts. Technology is becoming increasingly complex, multi-disciplinary and dynamic. For technology intensive firms this means that developing all necessary technological know-how internally is increasingly costly. Thus, to cope with this situation and stay competitive, firms rely on necessary knowledge from other firms (Hagedoorn, 1993). In this context, innovation is becoming increasingly the outcome of interactions among multiple actors and both R&D outsourcing as well as networking for R&D have become significant features in current innovation management as ways to develop and gain access to new technologies.

Most of the existing literature on technology sourcing has concentrated on the choice between internal and external sourcing. For example, studying 92 biotechnology projects launched by pharmaceutical firms, Pisano (1990) finds that the firm's R&D experience, the availability of competent partners and the national origin of the technology have an influence on the company's decision to develop new biotech products in house or to buy the technology in the market. Piga and Vivarelli (2004), using a sample of Italian manufacturing firms, find that external R&D conducted with other firms is facilitated by specific determinants such as ownership concentration, the availability of subsidies, and a focus on both product and process innovation.

To date, little is, however, known about the decisions where to source technology (domestically or from abroad) once a firm has decided to engage in external technology sourcing and through which channels. Regarding the "where" question, the empirical literature on innovation networks has frequently argued that such networks are bounded by proximity. Technological knowledge is to an important degree tacit knowledge that requires face-to-face contacts to be transferred effectively, and distance makes the exchange and creation of knowledge more difficult. The literature on knowledge spillovers has shown the importance of knowledge spillovers for innovative activity, productivity and competitiveness and has at the same time underlined that knowledge spillovers are geographically localized (Jaffe et al. 1993) and primarily intra-national in scope (Branstetter, 2001). However, recent studies show that knowledge flows are not necessarily bounded by national borders (Malerba et al. 2007). The literature has also documented a rise in international R&D sourcing and international collaboration for innovation (Dunning and Lundan, 2009). Since the second half of the nineties, technology offshoring has started to become part of the growing phenomenon of globally distributed work organization. The technology necessary for global competitiveness is often dispersed internationally. In this context, international collaboration can provide firms with access to country-specific advantages and allow them to tap into the comparative advantages of foreign countries. However, companies that decide to establish international R&D cooperation and outsourcing relations need to cope with the costs of distance between its home country and the foreign country as well as different environmental contexts (legal, cultural, etc.).

In practice a wide range of sourcing arrangements exists such as: arms-length licensing arrangements, research contracts, joint development agreements, joint ventures, alliances or acquisitions. In this paper we study two alternative mechanisms that firms can use to acquire knowledge externally: Outsourcing and cooperative arrangements. With outsourcing we mean tasks and processes that are contracted to a third party company. Under cooperative arrangements we understand that two or more separate organizations join forces to share and develop knowledge in order to enhance their innovative performance.

We use data from the Spanish Technological Innovation Panel (PITEC) conducted by the Spanish National Statistic Institute (INE) for the year 2007. The PITEC includes data on the technological innovation activities of all the main sectors in the Spanish economy, including services and manufacturing. In this paper we focus on the biotechnology sector in order to study the boundaries of innovative networks and the plurality of actors (e.g. firms, research centres, suppliers) involved in innovation. We have information on approximately 12,000 firms. 407 of the surveyed firms carry out some type of bio-technological activity. Compared to other sectors, biotechnology firms show a greater propensity for international outsourcing of R&D as well as for international cooperation for innovation.

Approximately 20% of bio-technology firms in our sample report some degree of international R&D outsourcing. Almost 60% of our bio-technology firms report some form of cooperation for innovation with most of them report having cooperation partners abroad.

Our analysis of different types of partners in R&D outsourcing relations shows that bio-technology firms outsource internationally to a lesser degree within the same company group compared to non-bio-technology firms where almost a third of international outsourcing relations occurs within the same company group. In contrast, bio-technology firms maintain a greater share of international R&D sourcing relations with universities and public administrations. Bio-technology firms that outsource R&D internationally tend to be more R&D intensive compared to domestic outsourcers. They also belong more frequently to company groups and multinational companies. A key characteristic of the bio-technology firms with international R&D sourcing and international cooperation for innovation is that they are in general more internationalized. Thus, international R&D outsourcing as well international cooperation for innovation cannot be viewed in isolation. These decisions are part of a firm's internationalization strategy that also goes hand in hand with its product market (e.g. exporting).

The micro-economic literature has highlighted different channels for the international transmission of technological knowledge: imports of new capital and differentiated intermediate goods, learning by exporting, foreign investment by multinationals, and the movements of workers and specifically scientists. International networks of cooperation and international R&D outsourcing arrangements are further catalysts for knowledge transfer across borders. A better understanding of the factors related to such international R&D sourcing decisions will also help to contribute to the analysis of international knowledge spillovers. Research cooperation is at the heart of EU innovation policy which aims to create a single European Research Area. A central objective is to make it easier for knowledge and technologies to circulate freely.

References.

- Branstetter, L., (2001). Are Knowledge Spillovers International or Intranational in Scope? Microeconomic Evidence from Japan and the United States, *Journal of International Economics*, vol. 53, pp. 53-79.
- Dunning, J.H., and S.M. Lundan. (2009). "The internationalization of corporate R&D: A review of the evidence and some policy implications for home countries." *Review of Policy Research* 26:13-34.
- Hagedoorn, J. (1993). Understanding the rationale of strategic technology partnering: interorganizational modes of cooperation and sectoral differences. *Strategic Management Journal* 14, 317-85.
- Piga, C.A., and M. Vivarelli. (2004). "Internal and external R&D: a sample selection approach." *Oxford Bulletin of Economics and Statistics* 66:437.
- Pisano, G. (1990). "The R&D boundaries of the firm: An empirical analysis." *Administrative Science Quarterly* 35:153-176.
- Malerba, F., Mancusi, M. L. Montobbio, F. (2007) Innovation, international R&D Spillovers and the sectoral heterogeneity of knowledge flows, Cespri WP 204.

The right prescription for therapeutic innovation? Exploring modes and impacts of the tentative governance regime on new UK therapeutic firms

Michael M. Hopkins¹, Philippa Crane¹, Paul Nightingale¹ and Charles Baden-Fuller²

¹SPRU – Science and Technology Policy Research, University of Sussex

²Cass Business School, London.

Contact m.m.hopkins@sussex.ac.uk

Emerging technologies are often supported by new firms, rather than the incumbent firms in existing industries (Freeman and Soete 1997). However where emerging technologies have financially challenging incubation periods (for example long and/or expensive product development cycles), it is necessary for new firms to have access to external sources of finance rather than relying on sales revenues to generate funding for internal R&D. Such investment may come from a wide range of potential sources of funding, both public (e.g. innovation award schemes) and private (e.g. venture capital, stock markets). Organisations supplying this investment form a key part of the National System of Innovation (NSI) (Lacassa et al. 2002). Furthermore, the pre-existence, acceptance and functioning of institutions and social technologies related to finance is of crucial importance (amongst other factors, such as a strong science base) in explaining rapid progress in particular technological fields (Nelson 2008). However in many cases, financial investment for technology companies has been difficult to obtain, due to problems such as information asymmetries, particularly in Europe (Revest and Sapio, 2008). This raises questions about modes of governance in the financial system and the possibility of interventions to maximise social benefits where markets may fail (ibid).

One of the clearest illustrations of the importance of external finance for innovation is to be found in biotechnology, and in particular the development of therapeutics. Biotech firms routinely require external support for

periods of a decade or more, with current estimates of capital requirements to reach sustainability of being as high as \$1-2 Billion (Ernst and Young 2010).

This paper explores the co-evolution of the small firm sector developing new therapeutic technologies and the institutions and social technologies that facilitate investment in these firms. The paper explores the extent to which the governance of finance might be considered 'tentative' and how this has aided or hindered the development of the sector.

The site of study is the UK. The UK is interesting because while the UK has deep capital markets, the UK's investor community has a long and difficult relationship when it comes to the financing of new technology ventures (Engineering Technology Board, Biotechnology, Innovation and Growth Team 2009). Yet the UK has developed the largest 'pipeline' of therapeutic projects in Europe (BIS 2010). We track the evolution of the UK small firm therapeutic sector from 1980 to 2009 in an effort to explore how changes in the financial environment facilitated the growth of this group of firms.

The empirical core of the paper comprises a dynamic illustration of the funding routes taken by 247 firms founded in the UK since 1980. The changes in funding routes over time are linked to changes in the funding environment, which in turn are related to the performance (in investment terms) of the therapeutics firms. The longitudinal nature of the study allows key trends such as changes in the amounts of money firms raise, who supports them, and whether firms successfully develop and launch new drugs. Trends in trade sales are also reported.

Key findings include the observation that over 40% of UK therapeutics firms founded in the period 1980-2009 no longer exist as independent entities but surprisingly few are out-right failures (25/247). We find that most firms no longer independent are acquired, and at increasingly young ages, due to changes in the investment environment, with profound effects on the nature of business models in the sector.

The paper demonstrates that the UK sector has been relatively unsuccessful at producing firms that can be called enduring successes. In particular we highlight the increasing emphasis within the industry, and now growing recognition in policy, that a key role of the sector has become growing firms for acquisition. This has implications as policy objectives (e.g. employment) and investor objectives (e.g. return on capital) diverge. The poor performance of the small firm sector in the UK also has profound implications for the prospects for therapeutic innovation in the pharmaceutical industry as a whole.

The contribution of the paper is to build on prior critical accounts of revolutionary technological change in the sector and accompanying institutions (Nightingale and Martin 2004, Hopkins et al. 2007, Martin et al. 2009, Bains 2008) by highlighting the slow nature of supporting institutional changes for the industry in the UK and the difficulties of supporting this industry, such as the long time taken to develop the most profitable exit routes for investors. We also highlight the reversibility of 'progress' made in the creation of a supportive financial environment during the 1980s and 1990s that has been witnessed in the 2000s.

Governing ICT Standardisation

Kai Jakobs RWTH Aachen University, kai.jakobs@cs.rwth-aachen.de

Background

The US and the EU continue to be the powerhouses in ICT¹ standardisation. This may change, though, with the increasing influence of Asian countries, most notably China. The standards-setting environments of the three regions have very different characteristics. The US favour a virtually exclusively market-based approach to (ICT) standardisation. At the other end of the spectrum, the Chinese approach is strictly government-led. In between, the European Commission applies an element of regulation.

The Differences in Standards Making – US, Europe, China

There are over 250 ANSI-accredited national Standard Developing Organisations (SDOs) in the US, three European Standards Organisations (ESOs; CEN, CENELEC, and ETSI), plus 30 National Bodies, and basically one central entity in China – the Standardization Administration of China (SAC). These numbers are perhaps best suited to highlight the different approaches. The US system is highly decentralised and comprises organisations each typically serving one specific industry sector. The US administration does not intervene in the process, nor does it mandate any standards. In such a distributed environment, maintaining a coherent set of standards with no conflicting specifications is next to impossible. Accordingly, the United States Standards Strategy only requires that "*The process encourages coherence to avoid overlapping and conflicting standards*". The individual US-SDOs are accredited by ANSI. ANSI is also the only US representative to international bodies (such as ISO and IEC). In Europe, the ESOs basically represent regional mirror organisations of the three international bodies (see Figure 1 below).

¹ Information and Communication Technologies.

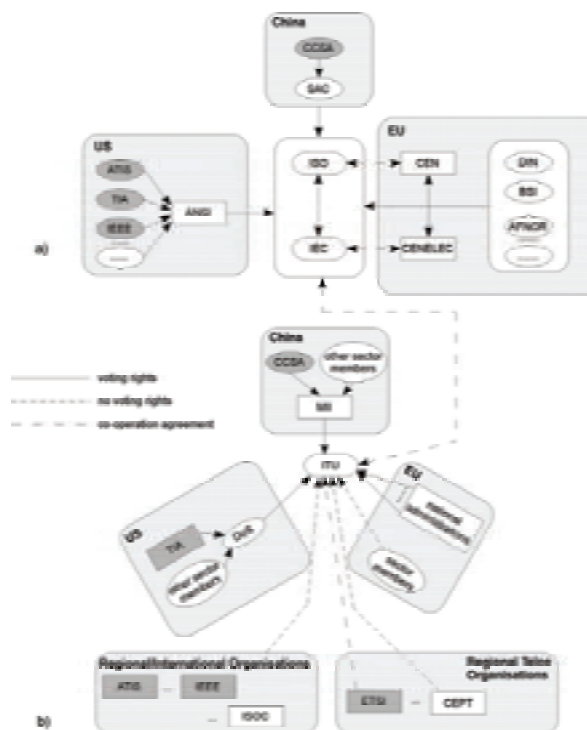


Figure 1: Relations between SDOs
a) IT sector, b) Telecommunication sector

The European approach differs in several respects. For one, it is much more centralised. Moreover, the EC pro-actively influences standardisation *"The Commission takes a role both in initiating and facilitating the development of standards ..."*. Also, not all standards are equal. European standards, while still strictly voluntary in nature, clearly enjoy priority: *"... the authorities are obliged to recognise that products manufactured in conformity with harmonised standards are presumed to conform to the essential requirements established by the Directive."* There are rules governing the co-operation between the individual ESOs, and between ESOs and national bodies. As a result, neither are European standards in conflict with each other, nor are national standards in conflict with European ones.

Going one step further, China has established a strictly centralised standardisation system. The ultimate power in (ICT) standardisation rests with the State Council that supervises SAC. That is, SAC it is not an SDO, but a government agency *"... in charge of the unified administration of standardization throughout the country ..."*. SAC does not develop standards. Rather, the Chinese Standardisation Law states that *"Competent administrative authorities under the State Council shall, in line with their respective functions, be in charge of standardization in their respective departments and trades"*.

A Brief SWOT Analysis

Strengths

- Close co-operation with international counterparts (CEN, CENELEC).
- A simple standards landscape (providing contradiction-free standards).
- Well-established, consistent system with close links to European policy makers.
- Well respected internationally.
- Pioneers in innovative approaches towards 4G (Partnership Projects).
- Flexible approach to standardisation (part of ISSS, ETSI).
- At least some representation of users and, specifically, consumers.

Weaknesses

- (Financially) dependent on policy makers.
- Slow-moving process, not 100% suitable for fast-moving technologies (CEN, CENELEC).
- Sub-optimal type of representation (through national delegations; CEN, CENELEC).
- 'New Deliverables' lack necessary level of consensus (all).
- Standardisation policy largely ignores standards consortia.

- Limited links between R&D and standardisation.
- Overly European focus (CEN, CENELEC).

Opportunities

- Good links to international bodies can be used to strengthen the EU position.
- High reputation can attract both European and international know-how, and members.
- Flexibility will be helpful to address emerging topics.
- Wide participation can be exploited to increase democratic legitimacy.

Threats

- Financial dependency may lead to reduced international importance (too much focus on EU policies).
- Slow processes, European focus, and national representation may lead to international marginalisation.
- Lack of an adequate level of consensus for the 'New Deliverables' may render them irrelevant.
- Ignoring consortia may leave Europe stranded with possibly irrelevant European standards.
- Poor links to R&D make it difficult for ESOs to exploit state-of-the-art technical knowledge.

Some Final Remarks

The ICT sector is characterised by an extremely high rate of innovation, and accordingly by comparably short product life cycles. 'Traditional' standardisation has had major problems adapting to these characteristics. Attempts to overcome these difficulties include streamlined processes, the introduction new types of deliverables, and attempts to better incorporate current R&D findings into the standards work. Externally, the mushrooming of standards consortia, and the ensuing marginalisation of the formal bodies in some areas, also resulted from these difficulties to adapt. Despite the increasing number of standards consortia, the standardisation landscape has been fairly stable during the last couple of years (the major consortia have been around or quite a while now). Standards setting in the ICT sector has been led by European and US multi-nationals. However, this situation may change with the advent of China as a power to be reckoned with. Chinese delegates are increasingly populating international bodies' working groups. Likewise, a considerable number Chinese companies are active in the ITU. Huawei Technologies, for example, is active in over 70 international standards bodies.

The centralised Chinese standardisation system is a double-edged sword. It can be – and is – used to support national policies in the international arena. In this respect, it is far more efficient than the highly decentralised US system, with the EU system somewhere in between. On the other hand, such a centrally governed system lacks the flexibility to quickly adapt to a new situation or to upcoming new requirements. It may, therefore, be expected that the priority areas for ICT standardisation will not change much, and that they will be powerfully addressed. Europe should be prepared to face a new strong player in ICT standardisation in the medium term.

Nano S&T in the Global South: Assessing risk discourses

Minna Kanerva; Maastricht University, m.kanerva@maastrichtuniversity.nl

UNU-MERIT

Despite its potential for good, nano science and technology (nano S&T) causes a significant amount of concern in terms of related health, environmental, ethical and societal risks, and it is increasingly recognized that addressing these concerns requires appropriate governance of nano S&T, involving a number of different stakeholders. Particular positive and negative implications are predicted for the Global South, and it appears that discourses around such issues in the South have not yet been systemically researched. Most nano S&T (media) studies (1) have been done in the Global North, and (2) have looked at the risk-opportunity dichotomy, with rather quantitative means. This paper, however, concentrates on nano S&T discourses in South Africa, India, Hong Kong and Kenya, analysing newspaper media in these countries, and further, addresses and tests concepts such as risk actions and complexity in the context of media discourse analysis, in place of merely concentrating on the risk vs. opportunity viewpoint. Theoretically, the discussion is linked to literature on risk governance.

A typology of risk actions is presented and used in the analysis. Risk actions denote any action, taken related to risk, and including conscious as well as unconscious actions, such as ignoring. By first grouping all actions related to risk together, a way of evaluating these actions on a more leveled way can be achieved. At the same time, this method points out the vast differences between various risk actions, also in terms of valuing risk outcomes and the emotions related to various risk actions. Risks can be seen as something to be avoided, controlled, eliminated etc. when preventing the potential impacts is given high enough value. Alternatively, risks can be seen as something to be ignored, when preventing the potential impacts is given a low value, i.e. the impacts are not seen as something to worry about.

The concept of complexity of discourse in this study relates to the inclusion of various elements (attributes, actors and risk actions), number of viewpoints and the inclusion of uncertainties related to the technology.

Employing both qualitative and quantitative methods, a range of risk actions contained in the newspaper stories is examined, and the complexities included in the discourse, as well as the general framing of nano S&T, are analysed. Finally, the results from the included countries are compared with each other, as well as with similar studies done in the North. Within the chosen newspapers, in neither Hong Kong nor South Africa, is the nano S&T discourse very complex, but in Hong Kong, nano S&T is presented significantly more certain and risks are mostly not touched upon, whereas in South Africa, a clear risk discussion exists, and increasingly so. In India, the general discourse is the least complex and risks are generally not presented as something to be concerned about, although a very small number of articles touches upon relevant risk issues. In Kenya, the media discourse on nano S&T is only beginning.

For the North, the discourses see nano S&T mostly as a positive thing, where benefits outweigh risks. Scientific progress exemplified in discoveries and applications dominate as topics, and risk related topics are relevant only in a minority of the articles. It seems that in the smaller (European) countries, nano S&T is viewed more as a necessary vehicle for scientific and economic progress, and therefore risk discussion matters less. It also seems that in several countries, newspapers have struggled to define and explain nano S&T to their readers.

It is argued in this paper that - although they share some features, such as overall positivity towards nano S&T - media discourses around nano S&T, and the meanings attached to it, vary considerably, between individual countries and between different parts of the globe. This highlights the potential significance of conducting case studies in a larger variety of countries.

At the level of risk action and complexity analysis, in all the four countries included in the data for this paper, the most common media risk action regarding nano S&T is ignoring risk, and the discourses are relatively simple, although again with considerable variability between countries. A fledgling media discourse on risk does exist, but the general tendency to ignore risk hinders public discussion on nano S&T, and consensus-building regarding the relevance of risk governance. In conclusion, a more methodological argument is made. Looking at risk actions and complexities included in various discourses can be an interesting analytical method, which could contribute to analysing risk discourses, for example, as part of risk governance. This methodology could also be extended to other emerging technologies or other risk related topics, such as climate change.

Governance of STI Policies: Re-Thinking the Coordination Challenge

Erkki Karo - erkki.karo@ttu.ee, Rainer Kattel - rainer.kattel@ttu.ee, Tallinn University of Technology, Estonia

In this paper we tackle the often-quoted problem of coordination of science, technology and innovation (STI) policies.¹ We argue that STI policies and governance structures do not evolve in vacuum. On the one hand, STI policies (and expectation of ideal-type policies) are influenced by technological (and accompanying socio-economic) developments creating pressures for changes of policies and governance structures that have emerged during the existing and previous technological life cycles.² On the other hand, STI policies are also influenced by the generic logic of policy-making and governance itself (e.g. governance reforms are planned by both STI makers and also general public managers who tend to have different perspectives) characterized by its own trajectories and processes (external pressures, convergence, path-dependencies). These may not overlap with the trajectories and logic of technological development and expectations set by STI policies.³ Thus, contradictions and clashes are highly likely as the 'desirable' (ideal-type) governance structures of STI policies may not be 'feasible'.

¹ It is possible to find discussions about the challenges of 'policy coordination' in STI policies on several levels of analysis, e.g.: *how do interest groups (and coordination of interest group participation) affect policy-making in both developed and developing countries* (e.g. **Edquist C. and Hommen L. eds. 2008, *Small Country Innovation Systems*, Edward Elgar Publishing; **Evans P. 2008, *In Search of The 21st Century Development State*, CGPE Working Paper Series 4**); *how does the theoretical understanding of innovation (e.g. broad vs. narrow approach to systems of innovation) affect the definition, scope and depth of innovation policy and policy areas to be coordinated* (e.g. **Lundvall B.-Å., Johnson B., Andersen E.S. and Dalum B. 2002, *National systems of production, innovation and competence building*, Research Policy 31: 213-231.**); *how to design governance models in STI policies to increase the capacity for policy coordination* (e.g. **OECD 2005, *Governance of Innovation Systems*, Volume 1: Synthesis Report**, Paris: OECD Publications; **European Innovation Progress Report 2009**, ProlInno Europe and European Commission).**

² I.e. technological life-cycles (or paradigms) (e.g. **Perez C. 2002, *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*, Cheltenham: Elgar**) partly affect the perceptions of ideal-type STI policies (e.g. **Soete, L. 2007, *From Industrial to Innovation Policy*, Journal of Industry, Competition and Trade, 7/3-4: 273-284**; **Radošević, S. 2009, *Policies for Promoting Technological Catch Up: Towards a Post-Washington Approach*, International Journal of Institutions and Economics, 1/1: 22-51**).

³ E.g. **Peters, B.G. 2005, *Institutional Theory in Political Science: The 'New Institutionalism'*, London: Continuum**; **Verhoest K. and Bouckaert G. 2005, *Machinery of Government and Policy Capacity: The Effects of Specialization and Coordination***, in Painter M. and Pierre J. eds. *Challenges to State Policy Capacity: Global Trends and Comparative Perspectives*, pp. 92-111, Basingstoke: Palgrave Macmillan.

This paper proposes, building on developing synergies between Neo-Schumpeterian economics and New Institutional theories (both from economics and political science), to conceptualise this STI policy challenge through the concept of ‘coordination’ that runs through both theoretical strands as one of the core policy governance issues.

The paper builds a framework that underlines different levels of ‘coordination problems’ that the STI policy may face and highlights how these different levels interdependently influence one another:

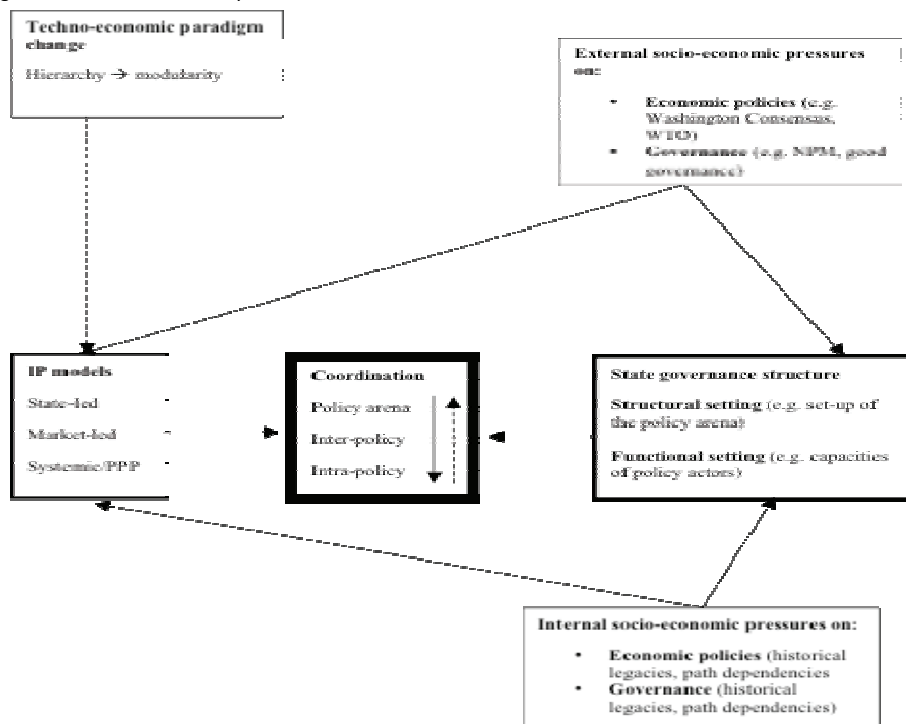
Coordination of the policy-making arena – whom (defining stakeholders) to include and how (defining the level and tools of ‘embeddedness’) to include them in the policy-debates over STI, its priorities (or strategies) and tactics (or measures).

Inter-policy coordination – to what extent (how widely) and how (with what instruments) to coordinate different policy fields (e.g. economics, education and research, labour market, finance etc.) that define STI policy.

Intra-policy coordination – given a defined scope of STI (e.g. science and technology – S&T-based view vs. broader institutional understanding of systems of innovation), how to design the policy cycle and what type of management (and coordination) mechanisms to prefer.

The framework proposes that governance of STI policies is conditioned by several independent variables (external pressures – e.g. WTO rules and neo-liberal policy and managerial reforms – have affected the policy space of both developed and developing countries; internal pressures – path dependencies of policies and governance systems – limit the feasibility of radical changes) that need to be taken into account while analysing and researching the trajectories of STI policies and supporting governance structures (see Figure 1).

Figure 1. Framework for analysis



The three levels of coordination problems indicate the potential sources from where policy failures or coordination challenges may emerge. Based on the framework that projects the relevance of other variables, several conclusions are drawn about the need to reconsider the meaning of policy coordination in STI debates:

given the rather narrow (or one-sided) approach of conventional STI and governance research, it is likely that both fields pre-define coordination problems according to their respective expertise – STI research is more centred on the inter-policy coordination level and governance research on the intra-policy level;

these levels can also potentially highlight the contextual or developmental differences – it can be hypothesised that more developed economies (in search for more efficient and effective STI policies) face coordination challenges at

lower levels of 'coordination problems' (inter- and intra-policy) than developing economies that need to start developing STI policies from scratch through defining the policy arena and stakeholders to begin with;⁴ it could be hypothesised that changes of and dynamics within techno-economic paradigms/trajectories (or technology life cycles) re-introduce higher-level coordination challenges also into the STI challenges of more developed economies.

In sum, it is argued that the level of pre-existing state (policy and administrative) capacity will influence the ability of different STI systems to deal with the complexities of technological trajectories. Policy failures in these areas can be looked through the proposed levels of coordination challenges. Overall, STI policy research may need more detailed and analytical understanding of traditional governance research, as pursued in the fields of public management and administration. Many of the coordination problems defined by the STI research have already been at the centre of public management and administration research for quite some time. In addition, conscious analytical emphasis on the dynamics and inter-linkages of STI policy content and broader STI governance context may highlight more complex causes of coordination problems than the current approaches to STI policies are able to encompass.

High-quality patents for emerging science and technology through external actors: Community scientific experts and knowledge societies

Evisa Kica, Victor Rodríguez, Nico Groenendijk

University of Twente, e.kica@utwente.nl, v.f.rodrigues@utwente.nl, n.s.groenendijk@utwente.nl

Over the past two decades, the number of patent applications and granted patents has doubled. The emergence of new scientific and technological fields with little "prior art" has overwhelmed the ability of patent authorities across Europe to assess whether inventions meet the patentability requirements (novelty, industrial applicability, and inventive step). This increase in patent activity has also raised the issue of patent quality. Amongst the main concerns raised by policymakers, businesspeople, practitioners, academics and examiners is the extent to which patent examiners have adequate resources to fulfil their examination duties. A careful examination reduces the need to review patents in opposition cases, diminishes litigation costs and contributes to the validity of granted patents. However, the shortage in the number of examiners, the scarcity of time allocated to file examination, the inflation of filings, the rapidity of developments in emerging science and technology fields have increased the uncertainty in the interpretation of the patentability criteria.

Acknowledging the importance of high-quality patents for the innovation and diffusion of knowledge, this paper explores new mechanisms to achieve high-quality patents. Generally, such mechanisms can run within legislative, executive and judicial functions of patent matters among separate and independent bodies. To narrow down the scope, this paper focuses on administrative mechanisms dealing with third parties' participation during patent prosecution at European level. In this jurisdiction, search and examination is the principal process for a patent application leading to a grant. Article 115 of the European Patent Convention foresees the inclusion of third parties to provide input to the search of prior art and communicate relevant information to the examiner in charge.

This paper aims to understand and assess how and when third parties are participating during the patent prosecution. In particular, in this paper we provide answer to the following research questions. First, to what extent have the current patent examination practices and the "peer-topatent project" been effective to increase patent quality? Second, how can external actors specialized in the field contribute to provide information about the patentability of new inventions and be officially recognised by patent agencies?

The research analyses the field of human genetic inventions, within the wider field of biotechnology. In our view biotechnology differs considerably from other sectors, in that it is the only sector to have a unified, sector-specific patent law. Moreover, the Biotechnology Directive 98/44/EC has brought new types of human intervention into the patent arena. To identify the patent infringement cases involving human gene patent we searched the Westlaw database, espacenet, and the EPO Registrar. The data retrieval strategy included the international patent class C12 and the keywords "gene", "gene sequence", or "human DNA", and "gene & patent & opposition" in the patent claims or case-law documents from the EPO and its Board of Appeal.

The empirical findings of this paper show that the participation of third parties is usually done after patents are granted. Only a limited number of human gene cases have made use of Article 115 for the years 1999-2009. Because of this imbalance of third parties participation in pre- and post-grant phase of patent prosecution, the paper urges the participation of knowledge communities during search and examination. The paper recommends the involvement of two types of knowledge communities: learned societies and advisory bodies specialised in particular emerging scientific and technological domains.

⁴ For empirical analysis see, **Karo E. and Kattel R. 2010, Coordination of innovation policy in the catching-up context: Estonia and Brazil compared**, Paper prepared for the GLOBELICS 2010 Conference, Kuala Lumpur, Malaysia.

New technologies are not longer regarded as entirely passive entities developed by inventors and used by customers; instead, they consist of complex actors and networks that involve laboratories, patients, technicians, families, geneticists and other stakeholders. This premise was tested empirically in the research presented in the paper. It is shown that certain stakeholders participated in the creation of the patent biotechnology regime, but that these stakeholders differ from the new stakeholders who participate in the pre- or post-grant phase. For example, in 2007 and 2008, the EPO's Opposition Division revoked several patents on human genes. The decision was a win for the French association of research institutes and hospitals, Greenpeace and a number of genetic societies and patient organizations, scientific associations, cancer researchers and special interest groups.

In European biotechnology, there are established several advisory bodies both at the national and European level (for example, National Bioethics Committees, the European Group on Ethics in Science and New Technologies) and learned societies (for instance, European Human Society of Genetics, the European Federation of Biotechnology). In this paper, the policy recommendation is instead of following the American approach of third party involvement, Europe should create a funnel for participation through advisory bodies and learned societies. By doing so, the search and examination can be pondered judiciously in order to increase patent quality.

The paper is organised as follows. Section 2 highlights the current European patent examination system and presents the review of the literature on external actors in patent prosecution. Section deals with the "peer-to-patent" pilot programme which has been established by the USPTO to encourage public participation on "prior art" inventions. Section 4 investigates empirically the involvement of actors in search and examination process on recent human gene patents. In this section we also explore the potential of certain external actors specialised in the field to improve patent quality and complement the work of the patent examiners in the search and examination phase. Finally, section 5 makes policy recommendations and concludes this paper.

The interaction of multiple champions in innovation networks: conflicts and complementarities

Laurens Klerkx^a and Noelle Aarts^{b, c}

laurens.klerkx@wur.nl

a: Communication and Innovation Studies, Wageningen University

b: Communication Strategies, Wageningen University

c: Strategic Communication, Faculty of Social and Behavioral Sciences, University of Amsterdam

Introduction

Innovation champions are individuals who make a decisive contribution to an innovation by actively and enthusiastically promoting its progress through the critical stages. Such champions are seen as key in removing the several barriers that emerge in innovation processes, such as lack of resources, opposition of the incumbent socio-technical system, and innovation network coordination problems. While innovation champion roles have mostly been studied in the intra-organizational context of large firms, the notion that innovation takes place through networks implies that the role of innovation champion is played out in several parts of multi-organizational innovation networks [1]. This involves actors that actively contribute to 'producing' the innovation in a functional role of supplier, manufacturer, or user – so-called input-output stakeholders. It also involves actors that have a stake from a policy, regulatory, or advocacy perspective – so-called enabling and constraining stakeholders. Lastly, it involves intermediary organizations that catalyze innovation in a facilitating capacity, i.e. facilitating stakeholders.

Noting the complementarities between the different kinds of innovation champions in broader innovation networks and the apparent absence of attention to this in the literature, the construct of 'innovation communities' has been defined as "an informal network of likeminded individuals, acting as universal or specialized champions, often from more than one company and different organizations that team up in a project related fashion, and commonly promote a specific innovation, either on one or across different levels of an innovation system" This connects to the notion of management or orchestration of innovation networks. Such orchestration has been earlier found to evolve on a scale from participant governed, to being brokered by a lead organization or hub firm in the network, or brokered by an independent network broker (network administrative organization- NAO [2]). The assumption is that such an innovation community does such orchestration, as champions often take the role of brokers in networks. While earlier research has shown that different kinds of champions in such innovation communities complement each other, the question of how and whether this is achieved easily remains largely unaddressed: little research appears to have been done with a specific focus on the interplay between the different kinds of innovation champions in 'orchestrating' the innovation process.

Goal and method

The central research question is: which complementarities and conflicts between different kinds of innovation champions interacting in innovation communities emerge in relation to orchestrating the broader innovation

network? By answering this question, the paper hopes to make a number of theoretical contributions: 1) addressing the question to what extent different champions act as a team and how this interaction evolves [3], and 2) to the question on how innovation intermediaries are positioned within the multilateral networks in which they operate [4], and 3) contributing more broadly to the gap on institutional mechanisms for facilitating innovation networking [5]. Using a multiple case study approach in which three innovation journeys are analyzed (based on respectively 32, 24 and 22 interviews with different key stakeholders from three innovation networks), the purpose of the paper is to explore how these different kinds of champions interact during the innovation process, and what this entails in terms of role complementarities and conflicts.

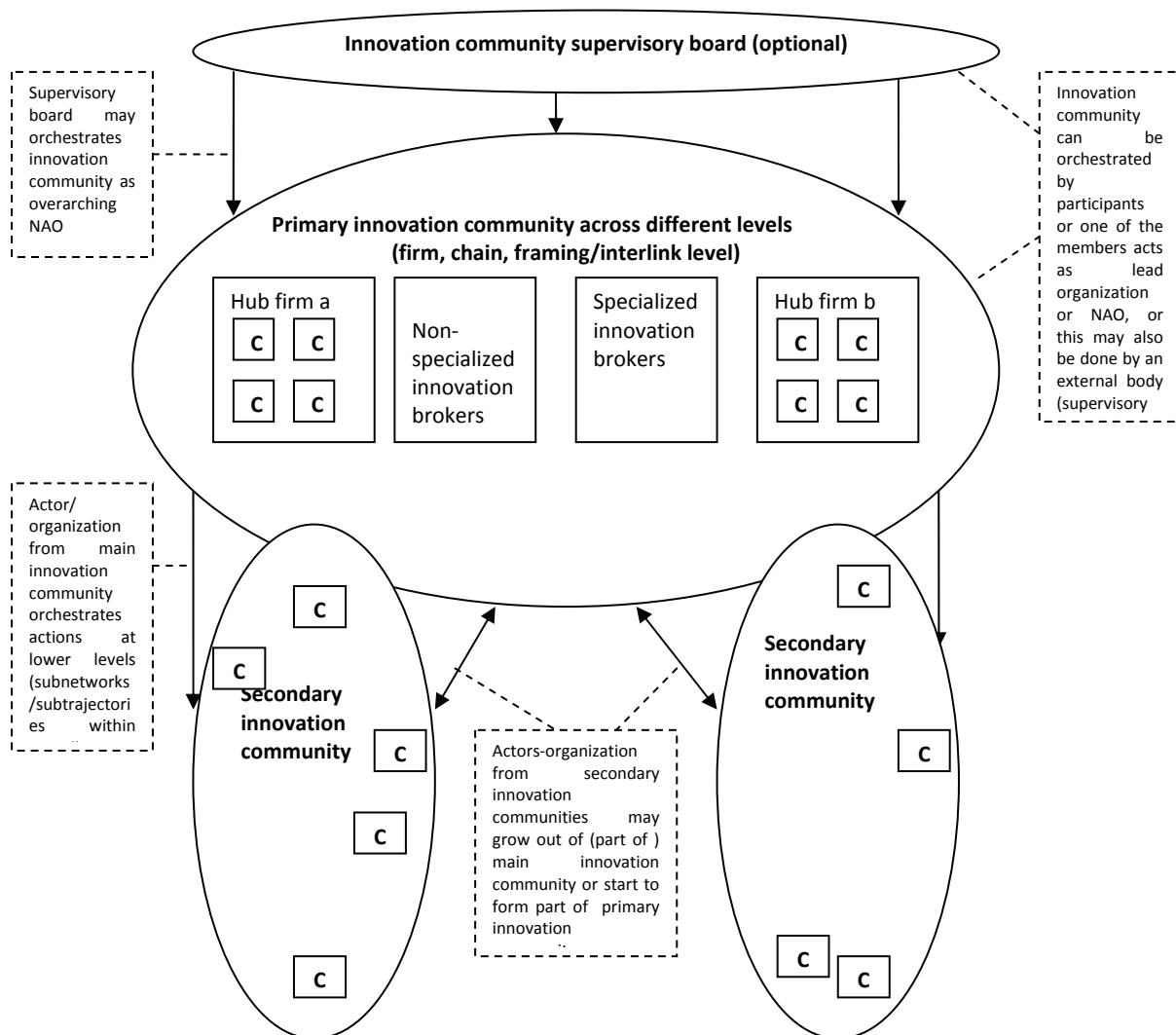


Figure 1: schematized representation of the stratification within innovation communities. Dotted lines and text boxes give supplementary information on relationships. C stands for champion.

Main findings

The study reveals that the construct of an innovation community composed of different sorts of innovation champions is useful as both an analytical concept and a managerial concept. It is however not a single community, but in fact a primary innovation community that jointly orchestrated the innovation network as an 'aggregated orchestrator' (see figure 1), that interacts with several secondary communities that emerge over time. Complementarities lie in different champions reinforcing each other actions, or supplementing these with additional actions, or in case of counterproductive behavior buffering and counteracting such behavior. An over-simplified notion of innovation communities as unified champions of innovation should be avoided however. Complementarities are negotiated in interaction, and lack of reflection on each other's roles may also result in role conflicts on diverging visions, lack of focus, unclear network leadership, conflicts of strategic interests. These conflicts may again lead to new complementarities (i.e. alignment in focus, better coordination, interest convergence) but also to network failure. Thus, a) innovation communities are not stable but dynamic entities due to actor entry or exit, and may also have subdivisions b) although essential to the innovation process, they are not automatically beneficial, and c) they need active reflection on role divisions and coordination between the different kinds of champions and hence some form of orchestration themselves, but at the same time should allow for informality and flexibility.

Conclusion

The main findings lead to the conclusion, that a situation exist that network/process champions as a team of network orchestrators are there to enhance interaction and coordination in the network, but when these roles are distributed this team also needs orchestration. This also shows that innovation network orchestration is layered, and not as straightforward as orchestration archetypes may suggest. The current research prompts the need for further enquiry on the idea of stratification of innovation communities and issues such as what are the optimal moments to actively address multiple innovation champion interaction and make a strategic choice for a certain orchestration form (of both the innovation network, and the innovation community).

References

1. Fichter, K., 2009. Innovation communities: the role of networks of promoters in Open Innovation. *R&D Management* 39, 357-371.
2. Provan, K.G., Kenis, P., 2008. Modes of Network Governance: Structure, Management, and Effectiveness. *J Public Adm Res Theory* 18, 229-252.
3. Hauschildt, J., Kirchmann, E., 2001. Teamwork for innovation - The 'troika' of promoters. *R&D Management* 31, 41-49.
4. Howells, J., 2006. Intermediation and the role of intermediaries in innovation. *Research Policy* 35, 715-728.
5. Pittaway, L., Robertson, M., Munir, K., Denyer, D., & Neely, A., 2004. Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews*, 5-6, 137-168.

Establishment and embedding of innovation brokers at different innovation system levels

Laurens Klerkx¹ and Cees Leeuwis, laurens.klerkx@wur.nl, *Communication and Innovation Studies, Wageningen University*

Introduction

In innovation systems, the existence of several system gaps (e.g., information, cultural and institutional gaps) hinders multi-actor interaction. Therefore, attention is increasingly being focused on systemic intermediaries who connect the different components of innovation systems and facilitate their co-operation, to prevent system and network failure [1-3]. They take the position of relatively neutral facilitator and functions include demand articulation (visions and related resource needs, partner search and matchmaking (network composition) and facilitating the multi-stakeholder learning process (trust building, mediating, process monitoring). While such systemic intermediary functions are also performed by organizations that do this as a side activity (e.g. research organizations) [4], it is increasingly a core function of so-called 'innovation brokers' [5].

Goal and method

Since specialized innovation brokers are a relatively new phenomenon, this calls for research on the relationships they develop within the innovation system, an issue that has remained under-addressed. The work underlying this extended abstract [6] conceptualizes the positioning of innovation brokers (dealing with it being a core identity or not) and their embedding in the innovation system, and provides an empirical illustration from the Dutch agricultural sector based on a total of 36 interviews with innovation broker staff, analysis of external assessments, and three in-depth case studies undertaking an environment scan of innovation brokers. It thus analyzes the emergence and

¹ Corresponding author : laurens.klerkx@wur.nl

embedding of different types of innovation brokers at different levels of system aggregation and different ambition levels of innovations (incremental, radical, system innovation, societal transitions), and constructs a typology.

Main findings

Main findings on the embedding of innovation brokers include that innovation brokers, despite catalyzing innovation system interaction, face a number of principal tensions. First there is a 'neutrality paradox': innovation brokers often need existing parties and networks for referral and matchmaking purposes, but may need to destroy existing networks to make new combinations, which threatens their credibility as neutral brokers. Furthermore, they have to balance the interests of different parties in their role of brokers (e.g. clients, financiers), to maintain social and financial resources and future brokering flexibility. However, resource dependencies may force them to allow topical steering by certain parties which has implication for their perceived neutrality. Second, there is 'functional ambiguity': given that intermediation and brokering can be a function both of 'traditional' knowledge intensive service providers and of a dedicated organization (i.e. a specialized innovation broker), innovation brokering as an autonomous identity has not yet been fully accepted. Third, there is a 'funding paradox': whereas innovation brokers wish to tackle various market and systems failures in the innovation system, they suffer themselves from the same systems and market failures, including the difficulty for clients and financiers to grasp their activities which are quite invisible and intangible, assess the effect of their activities on the innovation, and related to this funding impatience due to which funding is withdrawn too soon causing innovation brokers to collapse or become traditional consultants.

Conclusion

These tensions prompt a critical evaluation of the role that government has to play as an innovation system facilitator, and the role of innovation brokers as an innovation policy instrument. Arguments in favor of government support include the 1) difficulty of making the basic functions of demand articulation and network brokering self-sufficient; 2) the contribution to systemic interaction and the role as catalysts of innovation, and 3) the fact that innovation brokers can more neutrally fulfill the role of facilitator than parties that have a substantive stake (as a technology developing firm, a research provider, a policy maker) in the subsequent research or innovation process. Nevertheless, there are also some dilemmas in this regard, which include 1) the justification for public spending on innovation brokers, as impact evaluation appears to be difficult, 2) the proper demarcation of the mandate of publicly financed innovation brokers, as activities that go beyond demand articulation and matchmaking for network formation are sometimes perceived as competition by traditional R&D and KIBS, and 3) the risk that due to resource dependencies the innovation broker may become a more or less 'hidden messenger' for government or another party.

References

1. Pollard, D., Innovation and Technology Transfer Intermediaries: A Systemic International Study, in *Advances in Interdisciplinary Studies of Work Teams*. 2006. p. 137-174.
2. Smits, R. and S. Kuhlmann, The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 2004. 1(1/2): p. 4-30.
3. Van Lente, H., et al., Roles of systemic intermediaries in transition processes. *International Journal of Innovation Management*, 2003. 7(3): p. 1-33.
4. Howells, J., Intermediation and the role of intermediaries in innovation. *Research Policy*, 2006. 35(5): p. 715-728.
5. Winch, G.M. and R. Courtney, The Organization of Innovation Brokers: An International Review. *Technology Analysis & Strategic Management*, 2007. 19(6): p. 747 - 763.
6. Klerkx, L. and C. Leeuwis, The emergence and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change*, 2009. 76(6): p. 849-860.

How to Read the Fine Print of Science's Social Contract and Deal with the Knowledge Paradox?

Roy R. Kloet and Tjard de Cock Buning

Roy Kloet (corresponding author) and Tjard de Cock Buning are at VU University Amsterdam, roy.kloet@falw.vu.nl;

Problem and Research Question

Science, technology and innovation (STI) practice, policy and theory today are continuously moving – or 'dancing' (Kuhlmann 2007). This is difficult, both for scientists who study- and for decision makers who manage and evaluate STI. However, there is a strong need to get grip on STI. The relationship between science and society is changing (e.g. Hessels, 2009), which urges researchers to engage others and to reflect and anticipate on potential research consequences. Furthermore, increased coherence of R&D practices is necessary to tackle contemporary complex societal issues (Kaiser and Prange, 2005). But coherence is troublesome; scientists, politicians, industrial actors and CSOs tend to have different ideas about desired directions for R&D. They often demand either more freedom & less

bureaucracy (Bennetzen, 2009), or more responsiveness & accountability (Feretti and Pavone, 2009). In relation to this complexity various management problems can be observed, including the 'knowledge paradox': excellent scientific research but a low degree of academy-external use. Especially in the Netherlands this paradox persistently complicates STI governance. We therefore like to address the question: *How can we increase insight in contemporary R&D processes, so that new modes of dynamic ('tentative') EST governance can be unlocked that can help to overcome the knowledge paradox?*

Focus and Approach

The focus in our research is on the dynamics of large public-private research programs. Various social science fields have contributed to our understanding of research dynamics. For example, over the past two decades researchers of Science, Technology and Society studies (STS) have developed approaches to better understand research dynamics at the micro-level – especially engagement and learning – paving the way to open up research agendas (e.g. CTA; Rip, 1995). Furthermore, organizational and management studies have increased our insight in developments at the macro-level of research; and for instance measured and discussed the output of scientists, universities and research collaborations (in terms of publications, patents and spin-offs). However, we still seem to know rather little about research dynamics that occur in between 'research agenda-setting' and 'final outputs and long-term trends'. Especially there seems to be a gap for in-depth understanding of the dynamics of large, collaborative research programs. To zoom in on this, we selected an approach that is currently used in a different research context: the multi-level perspective on technological transitions (MLP). We suggest that this perspective can also meaningfully be applied to the context of research programs, and that it can contribute to the understanding of research program dynamics (agenda-setting *and* agenda-acting).

Geels' (2002) developed the MLP to study major historic changes entailing new technologies as well as changes in markets, user practices, policy and cultural meaning (*socio-technical transitions*). Although long-term system transitions are not the focus of our research, we believe that (with several minor adjustments) the MLP is also applicable for studying research program dynamics. The MLP distinguishes three (interacting) analytical levels to describe technological transitions which are relevant for comprehending and predicting research program dynamics – the sociotechnical *regime* level, the sociotechnical *landscape* level, and technological *niche* level (Geels, 2002; Geels and Schot, 2007). The MLP allows for a contextualized analysis of the dynamics of emerging science and technology in a longer term, but also makes it possible to zoom in on specific interactions that take place at the research program level.

The MLP (when applied to understand, describe and assess research program dynamics) might serve as a generalized model to manage multiple scientific perspectives on knowledge production, and for instance enables researchers to study the founding of a new 'social contract' for science or to find new STI policy options. Furthermore, it can be used as an instrument for research policy makers to design and assess EST programs. To demonstrate the value of the MLP for a research program context in practice, we applied it to a multi-million (>20 M. €), publicly co-financed (Bsik), innovative R&D case: the Dutch Ecogenomics Consortium. We intensively monitored the program for its full (six-year) lifespan, and included an elaborate CTA engagement initiative to find out how early stakeholder engagement might influence research agenda setting and –acting. Finally we obtained unique insight in the program's research dynamics.

Preliminary Results

The Ecogenomics Consortium on paper was a convincing strategy to overcome the knowledge paradox, but its research outputs have mainly fuelled various academic debates. The CTA initiative that was organized here to include various stakeholders early-on and continuously in the research process was successful in stimulating reflexivity in the consortium and in the identification of socially more 'robust' research agenda options (Roelofsen et al., forthcoming), but could not overcome forces that finally pushed the consortium's R&D in line with standard (incrementally innovative) research trajectories. As a consequence, the program's societal promise is not (yet) fulfilled today. Moreover, follow-up initiatives (NWO, FES) even seem to select against socially more 'robust' (radically innovative) research options.

Our longitudinal analysis and MLP framing of the research dynamics in the Ecogenomics Consortium indicate that fundamental flaws might exist in the governance of large scale innovative research programs in the Netherlands. Examples are: a lack of insight in motives of researchers and research directors to participate in research collaborations, a 'linear perception' of innovation, and problematic incentives for the funding, management and evaluation of R&D. Besides a potential loss of relevance and transparency and a rise of bureaucracy in research programs, we demonstrate for our case that 'traditional' management instruments to overcome a knowledge paradox – i.e. promotion of technology transfer and of large interdisciplinary research consortia – can become counterproductive, when the implications of the MLP are overlooked. At this level it seems that variations of these flaws potentially occur in innovation programs worldwide.

Governance of and by expectations

Kornelia Konrad, Science, Technology & Policy Studies (STePS), University of Twente, NL, k.e.konrad@utwente.nl

In recent years, various studies have examined how expectations create shared and contested socio-technical futures, shape technologies and coordinate innovation actors in emerging science and technology fields. At the same time, expectations are themselves continuously coordinated and shaped in public discourses, in professional communities and in organizations. Furthermore, policy and corporate actors increasingly initiate dedicated forms of systematic envisioning and assessment, largely under headings as roadmapping, foresight or technology assessment, which do more than mapping out possible futures: they explicitly aim at coordinating actors and supporting priority setting and strategy building. In parallel, professionalization and commercialization of expectation-building has taken place with forecasting organizations playing a decisive role in organizing expectations in specific fields. Hence, expectations play a decisive role in 'governing', that is, coordinating and shaping processes in emerging science and technology and they are themselves 'governed' in distinct ways.

In this paper, I propose the concept of governance of and by expectations, in order to capture a) the different modes of shaping and coordinating expectations, ranging from the seemingly 'unbound' expectations in societal discourses to expectations 'tamed' in dedicated foresight, visioning, forecasting and technology assessment processes (governance of expectations), and b) the different modes of how expectations coordinate and shape socio-technical developments (governance by expectations). This conceptualization is supposed to provide a comprehensive approach which sharpens our attention for different modes of producing and coordinating expectations, which at the same time is broad enough to capture, compare and relate these different modes. This analytical perspective opens up a number of important questions. What are the specific roles and effects of different modes of governing expectations in coordinating and shaping socio-technical developments and how are different governance modes related? For instance, what is the specific role of collective expectations and expectation dynamics in public discourses compared to expectations shaped in systematic foresight, vision-building or TA processes and how do both 'governance modes' influence each other? That is, does it matter for the performative role of expectations how they are produced and coordinated? If it matters, how and why does the governance of and by expectations evolve and change over time – as a general trend and within specific societal settings as technology fields, societal spheres and organizations? And to what extent is it possible to modulate and shape these processes?

In a first step, the paper elaborates the concept of governance of and by expectations. In general, the concept of governance draws attention to the different modes or institutional rules of coordination within and among organizations, societal subsystems and states, ranging from hierarchical steering to networks and market-like forms of coordination organized by both formal and informal rules. In a similar way, the concept of governance of and by expectations raises the attention for different modes of how expectations contribute to the coordination of innovation processes and for the different modes how these expectations themselves are coordinated among individuals, organizations, communities and arenas. As is explained in more detail in the paper, general concepts for analyzing modes of coordination as governance by markets, networks and hierarchies, different degrees of bindingness and the distinction between intentional and de-facto governance can be usefully applied for our interest.

This framework is then used to examine modes of governance of and by expectations for recent developments in the field of stationary fuel cells and nanotechnology. In particular, it is shown that these modes changed over time as a result of reflexive relations between the expectations and the actors and institutional arrangements within an innovation field. Expectations contribute to coordinating actors, strategies and institutional arrangements, but their form and content depend also on these actors, strategies and institutional arrangements. In a dynamic perspective, this implies that the expectations which emerge within a given societal domain may feed back on the structure that shaped - and in a sense generated - them, and thus such structures may change affecting further processes of expectation-building and coordination (similar to the translation of discourse into institutional arrangements described by Hajer).

For the case of stationary fuel cells we show that a recent fuel cell hype cycle affected constellations of actors involved in fuel cell innovation and institutional arrangements. As a result, we observe a change from a basically competitive, market-style mode of voicing of expectations into a more network-based and partly also more formalized mode of coordination. This affected the overall expectation dynamics contributing to a mitigation of hype. In the field of emerging nanotechnologies the emergence of certain collective expectations, here in particular a specific type of risk concerns, fed back on actor constellation and institutional arrangements as well, which resulted in an increase in dedicated and formalized modes of expectation-building. These changes are likely to affect the further dynamics of societal expectations as well.

Different governance settings in the adoption of eco-dynamic designing

Dorien Korbee, MSc, Environmental Policy Group, Wageningen University, dorien.korbee@wur.nl

Marine infrastructural projects should be integrated with ecosystem dynamics, rather than being imposed on the natural environment. This is the underlying vision of the innovation program 'Building with Nature' [1, 2]. To put this in practice ecodynamic design principles are being developed. These are the building blocks that allow practitioners in the field to plan and design marine infrastructural projects using natural dynamics. An example of a *building with nature* project is the sand engine that is being developed at the Dutch coast [3]. To understand how this innovative approach can be applied in other contexts, we will focus on the governance aspects of marine infrastructural projects.

This paper focuses on governance aspects of marine infrastructural projects, notably port expansions, land reclamations and coastal protection schemes. These projects are developed at the interface of coastal governance and project governance of marine infrastructure. Governance of marine infrastructural projects is characterized by decreasing state governance capacity. Increasing project sizes, decreasing time frames and complicated engineering challenges have led to a lack of sufficient resources and adequate policies to manage and control these projects by states. To overcome risks of cost overruns, delays in planning and execution and to overcome gaps in their knowledge base, states make alliances with other actors in the marine infrastructure industry, such as private companies, international financing and regulatory agencies and consultancies [4-11]. Governance of these projects is transferred from state to private and international arenas. This results in a change towards global (environmental) norms with subsequent consequences for the project outline. These projects are always build in a specific context: the coastal zone. The coastal zone is characterized by increasing intensity of anthropocentric activities, under conditions of long-term natural processes, such as beach erosion [12-14]. The intensive use of the coastal zone, coupled with competing claims of anthropocentric activities, has resulted in integrative management regimes. Governance of the coastal zone has moved away from state-centered approaches, towards ecosystem based approaches, in which stakeholder participation is at the center of governance [15-19]

Both spheres of governance have been subject to change in the recent years, resulting in mismatches, questions of legitimacy and terminated or delayed project executions. To counteract these mismatches, the two spheres of governance should be integrated. In this paper we address the issue by analyzing project arrangements, and the possible role of eco-dynamic design principles herein. We have analyzed data and documents on 25 marine infrastructural projects. These projects are being executed worldwide. The focus of this analysis has been on four primary roles of actors in these projects: principal, financier, consultant and constructor [4, 20]. The focus of the analysis was on the later stages of the planning and design phase; notably the project decision phase, the project design phase and the project execution phase. We have analysed what actors had influence in setting the Terms of Reference, what actors had influence in the final design of the projects and what (environmental) rules and regulations are adhered to. This has resulted in four actor coalitions, in which different actors have dissimilar authority on the terms of reference and design of these projects.

To move from mere actor coalitions towards more inclusive project arrangements, we apply the policy arrangement approach. Actors involved are bounded and structured by power relations, the institutional setting and by specific environmental and social regulations. These dynamics and interconnections can be understood by using the four dimensions of the policy arrangement; actors and their coalitions involved, division of resources between these actors, rules of the game currently in operation, and discourses used. These dimensions are interrelated, which is often visualised by a tetrahedron, in which each of the corners represents one dimension. Any change in one of the dimensions may induce change in other dimensions. To understand the implications of new actor coalitions all four dimensions of the policy arrangement are included in the analysis. [21-24].

The first project arrangement is a confirmation of the conventional approach. This constellation has one important distinguishing characteristic: the hegemony of the principal, prescribing and controlling the project development. Other roles and actors are subordinate of the top-down governance mechanisms prescribed by this actor. The second project arrangement identified has as its main distinction that the financier defines terms of references and governance mechanisms. Generally, the money has an international source, resulting in the adoption of global standards and norms. A clear example is the reconstruction of Vilufushi Island, Maldives. The third project arrangement identified is based upon a private principal, working in closely with the constructor in setting the terms of reference and the actual design. Risks and resources are divided between these two primary actors. An example is: construction of Maasvlakte 2, Port of Rotterdam. The fourth novel project arrangement identified focuses on the inclusion of local stakeholders in defining the terms of references. An example is: coastal protection in Newbiggin, UK.

The project arrangements differ substantially from each other, and not only use different inputs for the allocation of the terms of references, but also use different mechanism of legitimacy, either towards local stakeholders or to international defined best practices. Whereas the fourth project arrangement clearly opts for legitimacy by including local stakeholders in the allocation of the terms of references, the other project arrangements focus on accountability in the sphere of project governance, by dividing risks and resources.

The focus on the planning and execution phases of marine infrastructural projects, as interfaces between the sphere of coastal governance and infrastructure project governance shows that connections between these

phases is critical both because of differences in the ways governance capacity is transferred from state to other actors, and in terms of the relation to nature. The division of stages in the project development trajectory allows for a closer analysis on how these connections are made, and to distinguish critical moment in this process where legitimacy is at stake. Furthermore, it allows for an examination on critical moments for the adoption of ecodynamic design principles in the design of these projects.

References

1. Ecoshape. 2008. *Programmavoorstel Building with Nature 2008 – 2012*. Dordrecht, the Netherlands
2. De Vriend, H & Wesselink, A. 2009. *Buidling with Nature: ecodynamic design in practice*. Keynote paper, presented at the 2nd German environmental sociology summit. Reshaping nature: old limits and new possibilities. 7 November 2009, Leipzig, Germany.
3. Dalfsen, J.A. & Aarninkhof, S.G.J. 2009. *Building with Nature; Mega nourishments and ecological landscaping of extraction areas*. Paper presented at the EMSAGG Conference, May 2009, Rome, Italy.
4. Flyvbjerg, B, Bruzelius, N & Rothengatter, W. 2000. Megaprojects and risk: an anatomy of ambition. Cambridge university press, UK.
5. Flyvbjerg, B. (2007), 'Policy and planning for large infrastructure projects: problems, causes, cures', *Environment and Planning B: Planning and Design* 34 pp. 578 – 597
6. van Wee, B. 2007. Large infrastructural projects: a review of the quality of demand forecasts and cost estimates. *Environment and Planning B: Planning and Design*. Vol. 34, 611.625
7. Vining, A & Boardman A. E. 2008. The potential role of public.private partnerships in the upgrade of port infrastructure: normative and positive considerations. *Maritime policy and management*: vol. 35 no. 6, 551.569
8. Priemus, H. 2007. Development and design of Larger Infrastructural Projects: Disregarded alternatives and issues of spatial planning. *Environment and Planning B: Planning and Design* 34 (4), pp. 626-644
9. Priemus, H. 2009. Do Design & Construct contracts for infrastructure projects stimulate innovation? The case of the Dutch high speed railway. *Transportation Planning and Technology*. Vol. 32. No. 4, August 2009, 335.353.
10. Ivory, C. 2005. The cult of customer responsiveness: is design innovation the price of a client-focused construction industry? In: *Construction management and economics*: 23. pp 861-870
11. Hartman, A., I.M.M.J Reymen, & G. Oosterom. 2008 Factors constituting the innovation adoption environment of public clients. In: *Building research & information*: 35 (5), pp 436-449.
12. Philips, M.R. & Jones, A.L. 2006. Erosion and tourism infrastructure in the coastal zone: Problems, consequences and management. *Tourism Management* 27, pp 517–524
13. Cipriani, L. E., Wetzel, L., Aminti, D. L., & Pranzini, E. 2004. Converting seawalls into gravel beaches. *Management of coastal recreational resources—beaches, yacht marinas and coastal ecotourism* (pp. 3–12). Malta: ICoD.
14. French, P.W. 2001. *Coastal defences : processes, problems and solutions*
15. Agardy, T., J. Alder, P. Dayton and S.Curran (2005) *Coastal systems in: Ecosystems and Human Well-being: Current Status and Trends*
16. DFID. 2001. Integrated Coastal Zone Management: a policy review. (Bangladesh)
17. Milligan, J., O'Riordan, T., Nicholson-Cole, S.A., and Watkinson, A.R. (2009), Nature conservation for future sustainable shorelines: Lessons from seeking to involve the public *Land Use Policy* 26 (2009), pp. 203–213
18. Sales, R.F. M. 2009. Vulnerability and adaptation of coastal communities to climate variability and sealevel rise. Their implications for integrated Coastal management in Cavite city: Phillipines. *Ocean & Coastal Management* xxx (article in press)(2009), pp. 1–10
19. Norman, B. 2009. 'Principles for an intergovernmental agreement for coastal planning and climate change in Australia', *Habitat International* 33 (2009) pp. 293–299
20. Warner, J. 2008. *The politics of flood insecurity: Framing contested river management projects*. Dissertation Wageningen University.
21. Van Tatenhove, J., Arts, B en Leroy, P. (eds.) 2000. Political Modernisation and the Environment: The Renewal of Environmental Policy arrangements, Dordrecht/Boston/London: Kluwer Academic Publishers
22. Liefferink, D. 2006, The Dynamics of Policy Arrangements: Turning Round the Tetrahedron, in: Arts B, Leroy P, (eds.). *Institutional Dynamics in Environmental Governance*. Dordrecht: Springer, pp. 45-68
23. Pestman, P. 2000. Dutch infrastructure policies: changing and contradictory policy arrangements. In: van Tatenhove, J, Arts, B & Leroy, P (eds.) 2000. *Political modernisation and the environment*. Kluwer academic publishers.
24. Arts, B. & P. Leroy (Eds.) 2006. *Institutional Dynamics in Environmental Governance*. Dordrecht: Springer.

Interaction, networking, integration: a challenging route for the Turkish ICT sector in Europe?

Aygen Kurt, Middlesex University, UK , a.kurt@mdx.ac.uk

This presentation is part of a PhD project completed in early 2009 which aimed at examining the Turkish information and communication technology (ICT) sector and its probable roles in integrating Turkey into the European information society building strategies. It is set into the context that although there have been numerous innovation and ICT related policy adjustments in place at state level in Turkey, the significant roles of the producers, traders and operators of ICTs have not been sufficiently recognised and systematically researched. Thus, the main argument is driven by addressing the mismatches of technology policy governance structures between a supra-national entity (EU) and an acceding country trying to build a well-functioning national innovation system in relation to the EU's guidelines. The research is grounded within the co-evolving theories of the information society and innovation studies that realise research and innovation-related actors and the institutional frameworks (S&T governance mechanisms) as constituting components of a bigger system. In this respect, an empirical field work with a qualitative approach was needed to take a "snap shot" of the sector. The empirical data collection was largely based on interviewing with 27 owners/entrepreneurs of technology producing firms and 14 experts from public/private sectors assessing the position of their firms in innovation networks and processes, and considering their views on the European information society strategies and the sector from three thematic perspectives: (1) technology; (2) networking; and (3) policy. The focus of this presentation will particularly centre on addressing the firms' own interpretations of their networking activities within the sector (and beyond) and their views on research and development (R&D) funding mechanisms within the country and at European level. One of the key findings suggests that Turkey's integration into the European information society and research area is directly related to the reinforcement of its national networking and innovating capabilities nourished by a strong innovation governance mechanism at national level which would lead firms to learning to collaborate within the sector primarily.

Networked Governance of Innovation Policies: the "Technological Plan" in Portugal

Manuel Laranja - Instituto Superior de Economia e Gestão, Universidade Técnica de Lisboa,
Portugal, mlaranja@iseg.utl.pt

The need for new more flexible forms of governance has been on the innovation political agenda for some time. However, policy makers are responding to the challenges of governing increasingly complex dynamic innovation systems and broader multi-sectoral domains of policy, with different approaches. This paper analyses how the coordination of a wider innovation policy agenda was recently dealt with in Portugal. We argue that the Technological Plan – PT 2005-2009, is an interesting case of Network Governance – NG that contrasts with closed corporatist structures, vertical path dependencies and cleavages that characterised Portuguese governance of innovation policies in the past. Although Network Governance is not a new phenomenon, there is no comprehensive study to help explaining under what conditions can NG be a solution to the need to have more flexible forms of innovation policy governance. Our main focus is to see the effects of such new networked coordination in terms of better articulation, control of implementation and monitoring of progress towards pre-defined objectives, over a wider innovation agenda.

The rationales and processes of the European Research Council

Philippe Larédo, Université Paris-Est (ENPC, IFRIS and LATTs) and University of Manchester (MBS, MIOIR), philippe.laredo@enpc.fr

Abstract

There has been a number of analyses of the rationales and processes that explain the creation of the ERC. Many analysts see its roots deep in the construction of the European Community, and more specifically at the creation of the European Commission and its perspective about European research with its 4 dimensions (Guzzetti, 1995, André 2007, Larédo 2009). Nedeva (2010) proposes an elegant answer to the unfolding of the ERC with her notion of science built as a relationship between “research fields” and “research spaces”¹. She sees the ERC as an answer to the tension “between the inherently global nature of the research fields and the localised, mostly national, research spaces”. She suggests that such a social process can only materialise if three conditions are fulfilled: the existence of a change champion (here the elite of life sciences, see the 2003 Paris meeting organised by ELSF and EMBO), some level of institutionalisation and organisation building (here the Commission which strikingly changed his views on the issues within one year, see Dublin conference 2004), and the progressive emergence of conditions (commensurability of funding rules, organisational set-up for research) that render the enlargement audible by national spaces (here the dominance of the agency model of funding with in particular the creation of the French ANR, and the central role given to universities as research performers in most countries at the turn of the 21st century).

I fully share this approach. There is however one aspect that is not explained with this analysis that is the institutional focus given to the ERC: it is not simply academic or fundamental or basic research, the classical OECD categories (though extract 2 in box 1 also mentions it); it is focused on ‘frontier research’ as is well outlined by the few extracts taken from the 2008 work programme (Box 1). At the same time these extracts show that the concept is not that clearly established: is the research ‘frontier’ per se, or is it ‘frontier’ because it is located at the ‘frontiers of knowledge’ (which could correspond to the fields that the ISI web of knowledge defines as frontier), or is it qualified as such because it is ‘unconventional’ (others say heterodox) and/or of a ‘groundbreaking nature’?

Box 1- Extracts of the 2008 work programme of ERC

- The fundamental principle for all ERC activities is that of stimulating investigator-initiated frontier research across all fields of research, on the basis of excellence.
- Support excellent, innovative investigator-initiated research projects
- ERC Advanced Grants provide an opportunity to established scientists and scholars to pursue frontier research of their choice.
- Advanced Grants are intended to promote substantial advances in the frontiers of knowledge, and to encourage new productive lines of enquiry and new methods and techniques, including unconventional approaches and investigations at the interface between established disciplines.
- (projects should) demonstrate the ground-breaking nature of the research.

The focus of the presentation is not to inquire how such a focus was arrived at. It is to take it for granted and discuss the coherence of this objective with the organisational arrangements arrived at.

In a first part, we shall come back on this burred concept of frontier research, through practice first, mobilising the work by EC expert groups and enlarging it to the US, with the NSB report on ‘transformative research’, NIH developments and the recent (2009) initiative by the DoE on ‘energy frontier research centres’. I propose then to demonstrate that existing literature on breakthrough innovation and science dynamics offers resources to cope with the organisational aspects of this politically driven rationale (Bach 2007). In turn this will enable to assess how much the present EU choices (ERC and its implementation) foster or not this objective. Taking hold of a number of experiments (in particular ESFRI and ERA-Nets, this will drive me to propose a further step, turning the ERC also as the agency of agencies, a solution that might be not so exotic and more pragmatic that it may sound.

¹ “Research fields” are empirically outlined by three inter-connected elements, namely converging *knowledge communities*, consistent *bodies of knowledge* and *research organisations*. “Research spaces”, on the other hand, are defined by the ‘essential’ relationships of the research organisations and by notions of utility of knowledge. The emphasis is on the relationships and the exchange(s) in which the organisational actors are involved rather than on the attributes of the organisations.

The strategic responses of university researchers to the challenges of the higher education and research reforms in England and The Netherlands

Dr. Liudvika Leišytė, Center for Higher Education Policy Studies, University of Twente

E-mail: l.leisyte@utwente.nl

The theoretical and empirical evidence suggests that the governing of research in the Western European countries has become multi-dimensional and multi-layered. Competition for resources and changing state steering of research through various policy mechanisms, such as performance-based funding, accountability, intermediary bodies, quality control and performance measurement has been brought to the fore. In part, higher education and research reforms incorporated the New Public Management approaches of restructuring the public sector in order to make it efficient and effective and give more power to the managers in the public organizations, such as universities. In such context, external funding bodies and university managers have increasingly attempted to steer research and change the rules of the game for researchers. It is still questionable how university researchers respond to the changing rules of the game in their changing institutional environment. The presentation addresses this knowledge gap by providing insights based on the longitudinal comparative study on how university researchers in biotechnology use strategic action to respond to the higher education and research reforms¹. The goals of this paper are therefore twofold: (1) to characterize the policy changes in higher education and research systems in England and the Netherlands (2) to explore the strategic responses of researchers to their institutional environment in biotechnology.

The theoretical underpinnings of the sociology of science and the sociology of organizations prove to be helpful to understand the dynamics between the institutional environment and the strategic action of researchers. The laboratory studies within the sociology of science in 1970s produced a conceptual understanding of how scientists function within their institutional environment. In particular, the credibility cycle model introduced by Latour and Woolgar has been helpful in understanding academic research practices in which inputs (ideas, problems, methods) are turned into outputs (funding and reputation) in order to build academic credibility (Latour & Woolgar, 1979). The model draws attention to the importance of reputation and credit within the academic community. The extension of this model in later accounts points to the shifting audiences that academics address and the possible conflicts this may cause. Changing institutional environment may mean different expectations from academics of what and how to research. In essence, what counts in the end is the ability of the academic to convert the work to make it count for different audiences (Knorr-Cetina, 1982; Lehenkari, 2003). Thus the creation of credibility occurs in several areas that interact with each other – research sponsors, the scientific community, regulatory authorities and university management (Leisyte, 2007). These audiences are important in the institutional environment as they influence the rules, norms, values, and beliefs that may either facilitate or obstruct the credibility building process of research groups.

To understand how research groups react to changes in their institutional environment, Oliver's (1991) typology of strategic action is useful. According to her, based on the resource dependence and the neo-institutional theories from organizational sociology, research groups act through particular strategies created and implemented in response to the changes in the institutional environment. Based on her typology we derive the following strategies:

- Passive compliance and conformity to external rules and norms and interests of stakeholders. The compliance strategy means adherence of research groups to the myths and ceremonies within their institutional environment even if it means changing their core activities.
- Symbolic compliance. The symbolic compliance strategy means the buffering of research groups' actual activities from the formal structure.
- Pro-active manipulation and negotiation of the environment. This strategy is seen as a high level of resistance to an institutional environment and even influencing the environment according to the research group's preferences.

The type of strategy implies the ability or inability to maintain the status quo in the activities of the researcher. If a researcher uses a compliance strategy, it may imply a change of the core activity, such as setting the research agenda according to the requirements of the institutional environment and thus, restraining the academic freedom to a certain extent. On the other hand, if a researcher chooses a manipulation strategy, it can determine his/her own research agenda and even influence the agenda setting within the institutional environment.

The empirical data of the study come from documentary evidence as well as interviews with researchers in four research groups in biotechnology. The selection of the cases is based on theoretical sampling of research groups in research universities in England and the Netherlands. Biotechnology is selected as a representative of

¹ I acknowledge the support of my PhD supervisors Prof. Enders and Dr. H. de Boer for their support while writing my PhD. I also would like to thank the PI of the project, Prof. Enders for giving me the opportunity to work on the study funded from the German Research Foundation (DFG) "Comparative Study on Management and Self-governance Models" from 2003-2006. I also acknowledge the further support of the DFG during 2006-2009 for a second stage of the overall project. This allowed me to revisit the countries and research groups under investigation in this paper, to investigate into further cross-national comparisons, and analyze research policies at the supra-national EU level.

multidisciplinary field of research. Researchers are selected according to the perceived amount of credibility within the field. The longitudinal data includes around 100 interviews. 60 semi-structured interviews were collected in 2005 with research groups, university managers, and policy makers in England and the Netherlands and were repeated to the extent possible with the same interviewees in 2008.

The analysis has shown that respondents indeed employ strategic action when it comes to 'playing the game' of university management or receiving external funding from the financial donors. They employ compliance strategy when they do not possess high credibility and do not have sufficient external funding to carry out their research. In the cases of high credibility, however, they are active in using manipulation strategies to maintain their status, funding and research activities intact. All researchers are successful despite their credibility in using symbolic compliance strategies, although the degree of success depends on the type of activity they try to seal off.

Tentative positions: the positioning of intermediary organisations in the context of emerging technologies

H. van Lente¹, Utrecht University, h.vanlente@geo.uu.nl and W.P.C. Boon¹, Utrecht University, and L. Klerkx², Wageningen University
h.vanlente@geo.uu.nl

Introduction

The roles of intermediaries in infrastructure networks cannot be taken for granted. This paper examines and evaluates the roles that intermediary organizations seek to play and investigates the governance of positions that is needed. The analytical challenge is to account for the negotiation processes that go with positions and coordination of activities. The paper builds on two theoretical strands. A first intellectual background is the innovation systems literature (Lundvall, Nelson), where various roles have been studied and classified. This approach emphasizes the learning processes between firms, government agencies and research institutes. Second, it elaborates positioning theory (Harré, Van Langenhove), a dynamic version of sociological role theories, to study the construction of roles within the analytic triad of speech-acts, positions and story lines. In a case study on intermediaries in the energy utility service in the Netherlands it is shown that the actual position of an intermediary organization is beyond the power of an individual organization: it is the result of collective action.

Objective of the study

The indeterminate and uncertain character of emerging technologies raises questions about which actors will be involved and how they will relate to each other and to envisioned future technological options. In this paper we will address this question for the case of intermediary organisations where the question of role and legitimacy is more pronounced than for other actors. Intermediary organisations, by definition, operate between other actors. As a consequence, they, do not have a fixed, established role, but need to position themselves towards other actors in discourses and in their activities and practices (Van der Meulen, Nedeva et al. 2005). Especially in the case of emerging technologies, they do not have a well-defined 'ticket' based on which they operate. They can have several different roles and are sometimes denoted as 'schizophrenics'. The central question that is answered in this paper is: how to characterize and understand the positioning of innovation intermediaries in the context of emerging technologies?

Theory

Positioning theory is used as a starting point for this paper. Positioning theory is relatively new, although its roots, social constructionism and discourse analysis, are in place for several decades (Harré and Van Langenhove 1999). In the approach of positioning theory roles are not taken for granted, but the outcome of implicit negotiations in conversations (Harré and Van Langenhove, 1999). Within conversations, understood in a broad sense, social reality is constructed and altered. Key terms here are speech acts, positions and story lines.

Positioning theory can be seen as a dynamic version of role theory in social psychology; it draws on work of Erving Goffman and Harold Garfinkel and has been applied in domains as the study of autobiography and cultural studies. Note that positioning theory is a framework or explanatory scheme to study social phenomena, rather than a well-articulated and elaborated theory. The basic idea is that social and personal life can be understood from the positions that people have with respect to each other and to respect to available story lines. Social acts can only be meaningful against a background of moral rights and story lines. The theory was primarily developed to understand the dynamic attribution of roles of individuals but has recently been extended to analyse collective actors in emerging technologies like Lab-on-a-Chip and theranostics.

Methodology

Innovation intermediaries in three fields (agricultural research, health systems and new energy technologies) were followed over time. We structurally recorded (1) the expectations and objectives they voiced, (2) their strategies, (3)

positions within story lines and infrastructures (4) positions others attributed to them, and (5) the resulting positions for emerging technologies. These aspects were included in a database and dynamics of positioning were subsequently visualised. This allows for comparison and contrast between the three fields.

Conclusion & (governance) implications

Intermediary organizations are part of encompassing networks of linkages, which can be conceptualized in the innovation system approach. How, then, should we understand the roles they have obtained in the networks of linkages? How to explain the shifting of roles and of actors? What is the ground of new roles that actors can take up? The perspective of positioning theory, with its triad of speech-act, position and story lines, appears to be an interesting addition. Positions are not seen as given 'things', but are defined as the negotiated set of rights and obligations within moral universes. They are invoked in the various actions and statements of players ("speech-acts") and draw from the mutually constructed storylines that structure the range of possible positions. The analysis of mutually reinforcing speech-acts, positions and storylines roles helps to explain the construction and governance of positions. Intermediaries, by definition, have to operate between parties, and, therefore, have to be more explicit about their position and their credibility to operate. In the paper we have more specific conclusions on how intermediary organisations relate to emerging infrastructures and networks; how this positioning is related to the development of these organisations and their mandates; how their financing is influencing and influenced by the character of emerging technologies. By doing this, we obtain insight into how the dynamics of intermediary organisations relate to the dynamics of new and emerging technologies.

"Steering from a distance" or "too close for comfort"? How Dutch university governance reforms influence career systems and individual research lines

Grit Laudel and Jürgen Enders (University of Twente) , g.laudel@utwente.nl; j.enders@utwente.nl

The emergence of new research fields largely depends on researchers' decisions to change their topics, methods, and empirical objects. The aim of this paper is to establish the consequences of Dutch governance reforms for national career-shaping institutions, and through these institutions for the opportunities of researchers to change their research practices.

The Dutch public science system is characterized by a relatively small size and of (semi-)public research organisations next to the universities. The early implementation of higher education reforms allowed for a substantial organisational autonomy in the sector and it was based on the concept "steering from the distance" (de Boer et al. 2007) It was followed by multiple reforms in funding, quality assurance and evaluation, staffing, research priority setting. Elements of New Public Management have been implemented since the beginning of the 1990ies. As a result of these reforms, the Dutch career system is distinctly hierarchical in two respects. First, intra-university governance is characterized by strong hierarchies regardless of formal changes that were intended to weaken the traditional hierarchies. Second, academic careers are worldwide increasingly influenced by external funding systems through providing job positions and project funding (Laudel and Gläser 2008). However, the project funding system is less developed than in other countries, and is more strongly focused on the scientific elites. While several grants that support intellectual innovation are accessible to the elite, access to project funding is characterized by fierce competition, curbing prior to peer review, and overall low success rates. Thus, it seems that the governance reforms have made innovation a privilege of established elites. In terms of the career positions, we expect to find two opposite tendencies: an increase of externally funded job positions with a high degree of autonomy on the one hand; an organisational management of academic careers on the other hand.

We will discuss the effects of the Dutch reforms by comparing the opportunities for mid-career topic changes provided by the Dutch career system. We draw on empirical data from ca. 20 semi-structured interviews with early and mid-career researchers in one science field (molecular biology) and one humanities field (history).

References:

- De Boer, H., Leisyte, L., and Enders, J. (2007). "The Netherlands - Steering from a Distance. B.M. Kehm and U. Lanzendorf ", in B. Kehm and U. Lanzendorf, (eds.), *Reforming University Governance*. Bonn: Lemmens.
- Laudel, G., and Gläser, J. (2008). „From apprentice to colleague: the metamorphosis of Early Career Researchers". *Higher Education* 55: 387-406.

The Limits to Governance

Catherine Lyall, James Smith and Robin Williams

ESRC Innogen Centre, University of Edinburgh, c.lyall@ed.ac.uk

Many of the complicating factors identified in the application of the governance agenda to emerging science and innovation-related issues arise from complex interactions between the still-necessary, state-centric, government-based regulation and the more participative forms of interactive technology assessment and policymaking that are being fostered both to promote national competitiveness and encourage public acceptance of new technologies.

Concerns about risks, ethics and the north-south dimensions of emergent biotechnologies and their implications pose new and intricate policy questions. Some contend that developments in the life sciences, such as stem cells, genetic databanks and GM crops, are evolving more rapidly than the relevant policy and regulatory systems.

We argue in this paper that the multifaceted policy and regulatory situation that applies to the life sciences places limits on the seemingly pervasive notion of 'governance'. Despite the political and academic rhetoric about new governance approaches, we perceive the enduring capacity of the state (in the North at least) to control and also to frame debates about this technology – hence 'the limits to governance'.

This may require new rules of engagement in the governance process in order to deal with the contrasting and sometimes incompatible requirements for policy decisions to be both evidence-based and at the same time for a greater degree of stakeholder engagement in policy decision-making. The relationship between government and governance is thus dynamic and evolutionary with a shifting frontier between the two that must be negotiated on a case-by-case basis depending on the policy and technology context. The prevailing tendency to accentuate public participation in the policymaking process ignores these underlying complexities – and limits – to governance.

Stakeholder interaction around new technologies is frequently seen as a learning process. Such deliberations on emergent technologies can broaden and enrich their development and help achieve a balance between proscriptive and permissive regulatory regimes. Social learning between producers and users of information and communication technologies, for example, may lead to learning labs and a greater acceptance of experimental regulation. But we cannot assume that the same approaches will work for all emerging technologies. This paper will draw on a number of cases to illustrate specific problems of legitimacy and effectiveness surrounding the governance of the new life sciences before offering some tentative suggestions of how we might learn from successes and failures in the regulation of other technologies in order to develop a research agenda to better support policymaking for the life sciences.

Assessing nanotechnologies: the future of reflexive co-evolution

Harro van Lente (University Utrecht), h.vanlente@geo.uu.nl

Arie Rip (University Twente), a.rip@utwente.nl

Peter Stegmaier (University Twente), p.stegmaier@utwente.nl

Promises and concerns about nanotechnology are currently being evaluated, but more is happening. In this paper we address questions about what is happening in and around nanotechnology, and review the methods to increase the reflexivity of the co-evolution between nanotechnology and society. We will also discuss whether they are applicable more generally. Most of empirical details and theoretical underpinnings in the book are based on studies and interactions funded by the Dutch NanoNed research consortium and the European Union Network of Excellence Frontiers.

Technologies emerging on the nanoscale may neither always attract the attention nor have such a publicly visible lead character as, for example, genomics or, earlier, nuclear technology. But, nevertheless, nanotechnology is subtly entering and changing many areas of life as an 'enabling technology'. In combination with associated technologies, it provides the means to generate enormous leaps in precision, performance and capabilities. Therefore, it is a technology that has become both for engineers and entrepreneurs, civil society and social scientists a target of deeper consideration and assessment at a very early stage in its development.

After the societal contestations about technologies since the 1980s, and the innovation of having parallel ELSI (Ethical, Legal and Social Issues) studies since the Human Genome Project of the 1990s, a next stage is emerging where co-evolution of technology and society is becoming reflexive. Besides all the ELSI additions and other lessons from the past, nanoscientists have different ideas about what their task is and other, more reflexive, ways of doing things are introduced. The different relevant actors, ranging from technology developers, policy makers, insurance companies to NGOs and other civil society groups, now increasingly operate and co-operate from the acknowledgement of the interdependences between research activities, scientific fields, funding opportunities and societal visions. This is one example of increasing interactions, up to public dialogues, and calls for "responsible development" which are now common in nanotechnology.

In this paper we will discuss the methods (such as scenario workshops) that have been developed in the Netherlands and elsewhere to increase the reflexivity of the co-evolution between nanotechnology and society. We will discuss the overlap and contrast with vision assessment and concern assessment. In particular we will discuss the issues of 'endogenous futures' and sociotechnical scenarios and the method of and experiences with Multi-path mapping. We will also review the question of what actually happens in workshops with researchers and other stakeholders. The question is, how workshops work and how to insert yourself in ongoing developments, create a temporary bridging space.

We will investigate how future developments of nanotechnologies in their context can be analyzed, and how to build scenarios for possible embedding in society. In particular, we present and discuss scenarios which were actually used in strategy-articulation workshops in which a variety of actors participated and learned about each other. This amounted to what has been labelled as 'soft intervention' in the patterns of interaction.

What then are the merits of such reflexive approaches that appear in nanotechnology, in the Netherlands and elsewhere? The paper discusses that the main yield is the distributed governance patterns that emerge in this way, and will be available also for other emerging technologies. A key element of the reflexive co-evolution is the ongoing and integrated learning amongst stakeholders about the dynamics of emerging technologies (and their governance) and about the variety of mechanisms to influence the dynamics. We will analyse how the attempts to anticipate the possibilities and risks of nanotechnology have led to a subtle mode of interaction between stakeholders, including the rise of dedicated professionals of co-evolution. The new mode can be labelled as a distributed governance pattern of the emerging set of nanotechnologies. Parts of the new mode have their roots in the earlier attempts to question and embed biotechnologies and other emerging technologies, but other, more reflexive parts, are new for nanotechnologies. Yet, we finally hypothesize that this achievement will be available also for other emerging technologies as well. The concluding idea, therefore, is that assessing nanotechnology may well become a model of how society can recognize, anticipate and manage an emerging technology.

How Emerging Technologies Conquer the World:

Diffusion, Differentiation, and Transformation into Research Technologies

Loet Leydesdorff, Amsterdam School of Communications Research (ASCoR) & Ismael Rafols, University of Sussex
loet@leydesdorff.net and i.rafols@sussex.ac.uk

Grasping the fruits of "emerging technologies" is an objective of many government priority programs in a knowledge-based and globalizing economy. However, what is considered as "nanotechnology," "genomics," etc. varies from different perspectives and changes over time. Can these dynamics be specified? In this study, we focus on two more fine-grained—and therefore specific—emerging technologies: (1) small interference RNA (siRNA) and (2) nanocrystals. The first one, triggered by a publication in *Nature* in 1998, has huge promises for therapeutic interventions in the DNA (Sung & Hopkins, 2006), and the second (with substantial numbers of publications since the mid-1990s) will find applications, among other things, in solar cells. In both areas, specific patents emerged during the 2000s.

How do such emerging technologies develop? Is there a first-mover effect? In recent years, instruments have become available for measuring the spread of publications both geographically and in the socio-cognitive space of publication patterns. In this study, we further develop socio-cognitive and geographical maps of techno-scientific developments as baselines against which one can measure diffusion patterns.

The expectation is that emerging technologies are first developed in a specialty area along a specific trajectory although the authors may exhibit geographical spread. In a next stage, diffusion is reinforced because standards are developed and the knowledge contents are further codified. In the geographic dimension one then can expect the development of an oligopolistic regime, manifest as a core-periphery structure. While the socio-cognitive development thus is increasingly transformed into a research technology on which patents can be based, control remains heavily dependent upon further scientific developments in knowledge production systems (Shinn, 2005).

One can operationalize these theoretical questions in terms of the scientometrics (Small & Garfield, 1985). We elaborate on "the global map of science" (Leydesdorff & Rafols, 2009; Rafols *et al.*, forthcoming) as a possible baseline in the socio-cognitive dimension and use overlays to Google Maps for the geographic dissemination (Leydesdorff & Persson, 2010). The data, harvested from the *Science Citation Index* for each year on the basis of an informed search string, can be analyzed in both dimensions using network analysis tools. Thus, the centralization tendencies can be studied quantitatively.

The parallel mapping of socio-cognitive and geographical dynamics provides us with a perspective on how governance develops as an emergent phenomenon at early stages of a technology. The cognitive breadth and physical spread of the actors enables us to indicate the shaping of trajectories and regimes. We argue that this understanding of the diffusion process is a helpful input to open discussions on the timeliness of government interventions.

References:

- Leydesdorff, L., & Rafols, I. (2009). A Global Map of Science Based on the ISI Subject Categories. *Journal of the American Society for Information Science and Technology*, 60(2), 348-362.
- Leydesdorff, L., & Persson, O. (2010). Mapping the Geography of Science: Distribution Patterns and Networks of Relations among Cities and Institutes, *Journal of the American Society for Information Science and Technology*, In print.
- Rafols, I., Porter, A., & Leydesdorff, L. (2010). Science overlay maps: a new tool for research policy and library management, *Journal of the American Society for Information Science and Technology*, (forthcoming).
- Shinn, T. (2005). New sources of radical innovation: research-technologies, transversality and distributed learning in a post-industrial order. *Social Science Information*, 44(4), 731-764.
- Small, H., & Garfield, E. (1985). The geography of science: disciplinary and national mappings. *Journal of Information Science*, 11, 147-159.
- Sung, J. J., & Hopkins, M. M. (2006). Towards a method for evaluating technological expectations: Revealing uncertainty in gene silencing technology discourse. *Technology Analysis & Strategic Management*, 18(3), 345-359.

Synthetic biology in the UK: tentative governance or speculative ethics?

Dr Claire Marris, c.marris@lse.ac.uk, London School of Economics and Political Science

Synthetic biology is being promoted as an "emerging" technology which promises to be the foundation for the "next industrial revolution". Key actors involved in the governance of S&T are responding in a customary fashion: accepting as given fantastic claims about the potential technological developments in this field and then searching for ways to predict and control potentially harmful impacts. This paper analyses initiatives for the governance of synthetic biology in the UK and describes how they display three familiar overlapping attributes. Firstly they are largely motivated by synbiophobia-phobia (adapted from Arie Rip's "nanophobia-phobia") and therefore encourage public engagement activities that treat "the public" as a potential barrier to innovation rather than seeing publics as a useful epistemic and political resource. Secondly, while synthetic biology is recognised as displaying the classical "Dilemma of Control" described by Collingridge, governance initiatives fail to develop the kind of "theory of decision making under ignorance" that Collingridge advocated. Instead, current initiatives engage in "speculative ethics", as described by Alfred Nordmann, which deflects consideration from the transformative technologies of the present and distract us from comparatively mundane, yet no less important and far more pressing issues. Thirdly, they are framed within a standard technocratic discourse of scientific innovation, well-characterised in STS. Thus, technological development is portrayed as a politically neutral linear process that necessarily leads to "progress" and economic growth and the central actors are assumed to be scientists, engineers and regulators, with users and publics playing a role only with respect to "downstream" applications.

The dominant form of governance for synthetic biology in the UK to date has consisted in working groups leading to the production of reports which attempt to: define the field; identify its health, environmental and industrial applications; predict the time line of its technological progress; and to characterise its "ethical, legal and social issues" (ELSI). Discussions have focused on whether synthetic biology should attract additional targeted public-sector funding, how to "engage" with the public "upstream", whether additional safety regulations for health and environmental risks might be necessary, and how to control security risks that might arise if synthetic biology were to deliver its promise of "making biology easy to engineer". In addition, two "Public Dialogues" have been conducted.

The key players in these initiatives are public sector research funding agencies, science and engineering academies, small groups of university research scientists (including biological, mathematical and engineering disciplines, as well as humanities and social sciences) and public engagement professionals. Social scientists have been massively enrolled into the UK synthetic biology R&D network, but their role is still unclear and mostly interpreted in terms of predicting negative consequences, identifying ELSIs, and helping to anticipate public concerns. NGOs have been invited to oversee the two Public Dialogues but have no other entry points. Other potential groups of users or affected/concerned groups are not involved, and industry appears to be keeping a low profile. This analysis suggests that important social groups are currently absent from the innovation networks, or are being diverted into "public engagement" activities that play little part in shaping innovation trajectories. Whereas "upstream public engagement" was conceived by UK social scientists (notably Brian Wynne) as assigning an *epistemic* role to publics, current practice in the UK applies this concept in a *chronological* fashion, conducting activities "early on" in the development of an S&T field, but with little shift in underlying assumptions about the nature of technological change and of the role of publics.

Although approximately six "ELSI" are commonly pre-defined, bioterrorism and "garage biology" emerge from this research as the issue that scientists in the field are most comfortable discussing. This is at first sight appear surprising, given the negative connotations of the use of their technology by terrorists and uncontrolled amateurs, but the analysis presented here helps to explain how encouraging discussions on biosecurity helps to bolster the particular view of synthetic biology and its governance envisioned by these actors. Biosecurity concerns assume that synthetic

biology *will* deliver its promise to produce biological components that would behave like "WetWare" and would be publicly available through Open Source. Thus, anyone would be able to design living organisms by Computer-Aided-Design and produce them through "do-it-yourself biology" in their garage, shed or kitchen. This is an example of what Nordmann described as a "radical foreshortening of the conditional", and "if-and-then statement that opens by suggesting a possible technological development and continues with a consequence that demands immediate attention. Hypothetical issues are displaced (To what extent will: biological components ever function in a modular and predictable fashion, in a variety of cellular environments? To what extent will "BioBricks™" escape more traditional restrictive intellectual property regimes? To what extent will CAD of biological functions ever be possible?) and more immediate mundane questions are sidetracked, such as: How and by whom are the problems addressed by synthetic biology defined? What are the visions embedded in current technological trajectories? What are the conditions for the promised benefits to be delivered? In addition, focusing on biosecurity emphasises the so-called "dual-use" nature of synthetic biology, which serves to reinforce assumptions about the neutrality of S&T which only become infected with social and political dimensions when it exists laboratories. In this scenario, governance initiatives need only find ways to distinguish between "good" and "bad" users.

In conclusion, this research identifies few symptoms for the emergence of a "tentative" form of governance characterised by the organisers of this conference as creating spaces for openness, probing and learning and designed as a dynamic process to manage interdependencies and contingencies. Moreover, this paper argues that the concept of "Emerging S&T" requires critical appraisal, because characterising particular fields of S&T as "emerging" contributes to the trends identified and criticised here.

International research programs: research dynamics and governance

Barend van der Meulen, Janneke Hoedemaekers

Rathenau Institute, The Hague, b.vandermeulen@rathenau.nl; j.hoedemaekers@rathenau.nl

Internationalisation of research occurs in different forms, ranging from intergovernmental agreements to bilateral collaborations between researchers. As there is no overall institutional framework for the internationalisation of research, the actual governance patterns may develop closely in relation to research dynamics. In this paper we analyse how research dynamics of three fields of science affect the governance of international research programs. Research dynamics are conceptualised by using Whitley conceptualisation of research fields in terms of technical uncertainty and strategic dependencies between researchers, as well as the more recent conceptualisation of Bonaccorsi in terms of search regimes. Governance of research is conceptualised in terms of research programming, funding of research, and the aggregation of local results into program outcomes.

Three cases are studied. The first one is CERN as an example of internationalisation of Big Science. CERN now has 20 member states, but researchers from more than 80 countries are in one way or another involved in the CERN research. Internationalisation was driven by the costs of equipment and the actual research collaborations used to be framed by the locality of the equipment. Traditionally the field is conceptualised as one with high strategic dependence and low technical uncertainty. It is also used by Bonaccorsi as an exemplar of a low growth, converging (or rather converged) field. However, more recently the possibility to share data through the internet – itself a spin off of the CERN collaboration – has created a new balance between the locality of the infrastructure and researchers' home bases, creating more independency for researchers. Moreover, the actual research being done is not confined to particle physics, but includes advanced engineering and physics research to enable the equipment, eg on superconductivity and magnetics, as well as, research for the data infrastructure.

The formal governance structure is characterised by is structured by intergovernmental arrangements about sharing the costs of investments and maintenance of the research facility. In addition to these intergovernmental arrangements, programming is characterised by processes of building coalitions of researchers around competing experiments. These coalitions also structure the aggregation of local results into program outcomes.

The second case is from the life sciences, in which internationalisation is an emerging phenomenon (apart from the European Molecular Biology Laboratory, which tried but failed to mimic the CERN success). The Census of Marine Life (CoML) was a large international taxonomy program, initiated by individual researchers and driven by the opportunities of data exchange and development of new databases. It is international, but the program knows no member *states*. Its internationality is based on the involvement of research from over 80 countries. Research is distributed globally and includes oceanic expedition requiring joint investment and collaborations as well as individual field work in coastal zones. The works I organised in 18 projects. Dependency between researchers and technical uncertainty are medium, also depending on the accessibility of the marine species, and framed by the joint ambition to build new taxonomic databases. There is a formal governance structure, around the Consortium for Oceanographic Research and Education in Washington D.C., a scientific steering committee and a number of national committees and contact points. Funding has to be raised by participants and the number of sponsors exceeds six hundred governments, research councils, private funds, research organisations, international research funds and the like.

The third case is the International Human Dimension Programme on Global Environmental Change, one of the international climate programs that contribute to the work of the IPCC. Unlike some of the other climate programs, in which research activities and results converge into climate modelling tools, the environmental social sciences have no 'integrator'. As a social science program the research dynamics display the typical characteristics of high uncertainty, low dependency fields.

The IHDP program has ICSU, ISSC and the UNU as its institutional sponsors, which indeed implies that these organisations supply some organisational practices to maintain the status of the program and give access to the world of international politics. Monetary sponsors are distributed and mostly linked to specific projects and activities, rather than to the whole program. Like the CoML program, the program itself is coordinated by an international secretariat and national committees.

Three cases are too few to draw hard conclusions on the relationships between research dynamics and governance of international programs. There are some evident relationships between the search regimes and some of the governance modes. The costs of CERN require some sort of intergovernmental agreements to share these costs, and the size of experiments (in time, costs, manpower and geography) requires good planning and a mix of hierarchical and professional management. The low costs of social sciences, its divergence in methodologies, research problems and theories as well as the global nature of the IHDP, makes it much more difficult to manage the borders of the field and the program itself. The most interesting case is probably the CoML, which has grown enormously without much central coordination.

To characterize governance of international programs, two dimensions seem to be crucial. The cases show the importance of scientific planning and projectisation of the actual research for making a research program. These processes do not only act as frameworks for the actual work, but also as processing of gate keeping. Gate keeping involves recruiting new participants as well as controlling who is getting in. The other dimension is infrastructure and equipment. Traditionally costs of equipment are seen as a driving force for internationalisation. Our three cases suggest that the role of infrastructure in this sense is becoming of less importance to understand governance of the programme. Instead the large grids developed for e-science are getting central in the dynamics and governance of international research programs.

Open Spaces and the Single European Sky

Reflexive Governance, Two Scholars and a Third Way

Dr. Marc Mölders, Univ. Dortmund, marc.moelders@tu-dortmund.de

Concerning the governance of science and technology, the approaches of the STS-tradition and those with a systems theoretical (ST) background differ in many respects. But at least in one respect they do not: the production processes as well as the regulation of innovations face the conditions of what is commonly called “co-evolution”.

The shared assumption: The functional realms within modern society (law, politics, science, economy etc.) do have their very own evolution; what differs is that ST postulates that their coeval development produces so many mutual effects that these become uncontrollable. On the contrary, Arie Rip, e.g., claims that intersystemic *discourses* might mediate different functional imperatives or interests. His understanding of discourses is less towards solving problems, but towards creating and maintaining *spaces* for working towards solutions. Reflexivity and the *openness* of a discourse provide for productive governance arrangements.

From a systems theoretical perspective it is fairly easy to explain, why “ambassadors” of different functional systems may not understand each other – but how to explain those cases, where intersystemic communication works, i.e. cases in which, for instance, political, legal, scientific and economic communications do not “talk at cross-purposes”? One side (STS) defends the thesis “discourses can do that”, the other (ST) negates this claim. In a somewhat pessimistic way, both approaches seem to meet again when the question is at stake, whether what is learned in discourses will be selected and will solve the problem, the discourse was designed for: In Luhmann’s words: planning can be part of an evolutionary process – but never its result (cf. Luhmann 1997: 430). In Rip’s: “Reflexive governance is good, because it maintains the illusion of governance” (Rip 2006: 94).

I would like to propose a “Third Way”, claiming that intersystemic learning in discourses is possible *and* that we can make statements about more or less promising governance arrangements. But what do I mean by “promising”?

It is striking that some results from intersystemic discourses are selected (implemented) while others are not or just “end up in a drawer”. So, is it contingent and left to chance alone, what kind of discourse is promising with regard to its chances of selection (implementation)?

My claim is: No, it is not. If we look at successful discourses – successful concerning their results being selected – a pattern gets visible: Those discursive learning results are implemented that solve a problem, the *authority of selection* cannot solve by itself but needs others (with other expectations). Not reflexivity and openness alone facilitate promising governance arrangements – if the result of a discourse should be selected, one should know by whom. But what do I mean by “authority of selection”?

In brief: This is the authority that eventually decides whether an innovation will enter the world. In the field of science and technology governance it is not unlikely (yet not necessary) that a political authority will be in the *decisive* position. So, at least two questions arise: Is this thesis – that a discursive learning result will be selected, if it solves a problem for the authority of selection – generalisable? What changes, when political expectations enter the field?

I want to treat these theoretical questions empirically. A highly instructive case to study the possibility of a “discursive shaping of co-evolution” at is the EU policy initiative “Single European Sky” (SES). This initiative aims at the harmonisation of air traffic management (ATM) and the regulation of airspace throughout the European Union. It started at the end of the 1990s; its implementation is expected in 2020. Currently we are facing the so called “Development Phase” (2008-2013) in which the required new generation of technological systems, components and operational procedures is developed to fully harmonise the air transport activities in Europe.

These tasks are organised by the Single European Sky ATM Research Programme Joint Undertaking (SJU) which started with a collaboration between the European Commission and EUROCONTROL, the European Organisation for the Safety of Air Navigation. The SJU is characterised by the principle of inclusion, aiming at involving all relevant parties in the field of air traffic. By now the SJU has members and stakeholders with as heterogeneous backgrounds as: administration, regulation, military, industry, the scientific community and many more.

It is easy to see that this is an excellent case to study questions of intersystemic governance arrangements at. From what I mentioned at the outset first and foremost two questions arise: 1. Will it succeed that participants from different functional realms (politics, law, military, science, economy etc.) coordinate their expectations? 2. Even if that will be the case: Will these results be selected?

In order to examine both questions, interviews and document analyses will be conducted. What do participants expect from the Single European Sky? What did they learn from each other, what they could not come up with on their own? What blocks learning processes? And of course: What does the authority of selection expect? If we assume that the European Commission will have the final say, we will have to ask, whether there is a (political) problem the Commission wants to solve with this inclusive initiative called Single European Sky. But I do not want to speculate on conceivable answers – the overarching aim of my project is to answer them empirically: Towards a Third Way means to propose an empirically substantiated governance theory.

References:

- Luhmann, Niklas (1997): Die Gesellschaft der Gesellschaft. 2 Bände. Frankfurt a. M.: Suhrkamp.
Rip, Arie (2006): A co-evolutionary approach to reflexive governance – and its ironies. In: Voß, Jan-Peter; Bauknecht, Dierk; Kemp, René (Hg.): Reflexive Governance for Sustainable Development.

New modes of governing pharmacovigilance: a contribution to responsible innovation

Ellen Moors, Wouter Boon and Albert Meijer
Utrecht University, e.moors@geo.uu.nl

The need for fast drug innovation to meet unmet medical need and the increasing public demand for risk-free drugs create a dilemma for regulatory authorities: rapid market access conflicts with increased uncertainty about benefit/risk profiles of new drugs. When drugs are approved, risk is monitored and regulated through pharmacovigilance activities, such as systematic monitoring of adverse side effects and spontaneous reporting. These efforts are additional to the ex-ante risk regulation that is performed in the context of clinical trials. Pharmacovigilance becomes increasingly important when, in order to stimulate innovation, ex-ante risk regulation is relaxed, e.g. through earlier, conditionally approving new drugs.

Regulatory frameworks for post-marketing surveillance have been developed, but resulting practices of governing pharmacovigilance are not in line with the intentions underlying these forms of regulation.

There is a regulatory governance problem: present governance arrangements for stimulating collective action into the direction of responsible pharmaceutical innovation fall short. Intensive procedures for pre-marketing approval do not seem to match the technological and societal dynamics of diseases identification and public demand for appropriate pharmaceuticals. Furthermore, very advanced novel therapeutic drugs are emerging with new (and still unknown) forms of regulation (e.g. for DNA vaccines, stem cell therapies). Little new research have been conducted on the functioning of these governance arrangements. The effectiveness of current pharmacovigilance governance arrangements is debatable. This paper aims to fill this knowledge gap by answering the following question: *How do pharmacovigilance governance arrangements respond to the demands for public safety and satisfy unmet medical needs, and how can improved modes of governing pharmacovigilance contribute to responsible pharmaceutical innovations?*

The relevance for policymakers is to design a coherent set of governance arrangement guidelines of pharmacovigilance to increase 'responsible innovativeness' in the form of enhancing public safety and satisfying unmet medical needs. After all, responsible drug development is providing safe, effective, innovative and affordable medicines especially for unmet medical needs on a global scale, unaffected by the economic status of the patients.

To understand these multi-actor governance constellations, we draw on two theoretical strands. Firstly, the conceptualisation of post-marketing surveillance and risk assessment as a crucial element in the process of innovation is based upon theories in the field of innovation studies that stress the involvement of multiple stakeholders in technological development. Secondly, ideas about the social construction of risks and the role of epistemic cultures, perceptions and interactions in the construction of these risks are adapted from science and technology studies. Various publications in the field of innovation studies highlight the non-linearity of innovation processes. In terms of governing risks, ex-post risk evaluation becomes more prominent in favour of ex-ante risk profiling. This shift triggers changes in the interactions between epistemic cultures regarding drug innovation, from a traditional linear, one-way process of research-development-approval-use towards a iterative, feedback and -forward model in which various epistemic communities are actively involved. These communities are centred around medical professionals, regulators, industry and user/patient groups, bringing in their specific knowledge in various stages of drug development, and at the process-level contributing by setting boundary conditions, e.g. supporting clinical trials, increasing public trust, etc.

A specific group of actors proves as a prominent example in this regard: the users / patients. In ex-post pharmaceutical risk evaluation, the role of users/patients is becoming increasingly important, bringing in their creative potential and experiential knowledge, which may improve the pharmaceutical innovation process. Other reasons for user involvement are a political one, based on the idea of democratisation, and a moral one based on the fact that users have a right to actively participate in decisions that affect their lives.

Secondly, ideas about improved forms of governing pharmacovigilance are adapted from the field of governance studies. The balance between risk and market access of novel drugs involves a wide range of stakeholders (from industry and regulators to medical professionals and patients) who all have their own perceptions of risks and benefits. In this context, the organisation of this governance constellation, including interactions, rules, etc., is of interest.

The empirical emphasis of this study is on the governance of pharmacovigilance for conditionally-approved medicines. Conditional approval is a regulatory pathway in the EU for early access to drugs. Intended disease areas of conditional approvals are a) seriously debilitating or life-threatening diseases; b) medicines used in emergency

situations, and c) medicines designated as orphan drugs. For these medicines the balance between speedy market access and drug safety is most prominent. Based on these categories we selected our cases. The case studies are about conditional approvals in the fields of HIV/AIDS (for a long time a life-threatening disease) and pandemic influenza (emergency situation) in the Netherlands.

Results from these two case studies are presented, coming from the qualitative analysis of post-marketing surveillance, and based on qualitative interviews with a wide range of stakeholders in the field and extensive desk research, complemented with the results of expert workshops to test the improved/new institutional guidelines for pharmacovigilance.

In the context of these two case studies, different patterns of interaction, exchange of information, power relations, network rules, role perceptions, incentives, and interests were observed. This leads to the identification of modes of governance of pharmacovigilance for the two disease areas that, for example, differ in the way these actors are involved in risk definition, risk communication and decision-making. Special attention is paid to aligning various epistemic cultures, i.e. those of medical professionals (physicians, pharmacists) and industry involved in clinical trials, regulators, and patients (through experiential knowledge).

The case studies showed two different epistemic cultures involved in ex-post pharmaceutical risk governance. In the HIV/AIDS case a rather small, closed culture was constructed, from different involved epistemic communities such as AIDS medical specialists, a proactive, radical AIDS patient community, HIV nurse practitioners and a well-working monitoring system. These relevant social groups had shared visions on HIV treatments and risks and when the first experimental drugs came on the market, these groups were heavily interacting and learning from each other. Closure took place, achieving alignment and stabilization with regard to their shared interpretations on drug access and safety issues.

In the pandemic influenza case the new vaccine had been introduced top-down, driven by urgency, within a more enforced, militaristic culture. Within the various epistemic communities involved, such as scientists, regulatory bodies, government, RIVM, patient, critical voice groups, the visions are not shared, and rivaling interpretations still co-exist, the governmental enforced vaccination not being accepted without effort.

Accelerated drug approvals as in the HIV/AIDS and pandemic influenza case call for innovative ex-post pharmacovigilance approaches. Thereby, different epistemic cultures in the governance arrangements could be discerned, an small, closed scene in HIV versus a militaristic drills in the pandemic influenza case. It is important to intensify the involvement of patients at all stages of the drug development process by assessing their medical needs and perceptions of risk/benefit ratios and using their input to establish more meaningful benefit/risk ratios for drug treatment. After all, the patients are the experts of their disease. Regulatory authorities should change their attitude from 'gatekeepers' towards a more intermediary role. They can help the social construction of pharmaceutical artifacts by sharing information, assist in constructing sound clinical studies, help to assess benefit/risk ratios and allow conditional approval of drugs under active surveillance schemes, taking into account the complete life cycles of a drugs.

Keywords

Pharmacovigilance, drug risk/benefit, conditional approvals, epistemic cultures, governance

Gearing research councils towards funding of emerging science and technology

Frank van der Most, Lund University, Sweden, frank.van_der_most@circle.lu.se

New emerging fields of science and technology all are acclaimed interdisciplinary fields to some degree. Besides, acclaimed ranges of applications and societal benefits of new fields often cover multiple sectors in society. This double sided incongruity accounts for many governance problems. It may help to explain why initial governance of these fields necessarily is tentative: only after this mismatch is somehow solved, either by shaping the new field according to existing organizational/institutional classifications, which would imply a partial drain of its innovative potential, or by reshaping existing classifications can governance take place.

This paper discusses how research funding organizations (RFOs) dealt with the problem of disciplinary mismatch between the field of nanotechnology and the RFOs' disciplinary organizational structures. The behavior of RFOs in Finland, the Netherlands, Norway and Switzerland was studied in detail through documents such as policy papers, strategy plans, annual reports, program brochures, evaluation reports and web pages. In addition 25 semi structured in depth interviews were held with around 30 policy advisors, program managers, program committee members and council board members. RFOs in Denmark, France, Germany, the United Kingdom and Sweden were studied less detailed through written sources only.

The overall result is two sided. Firstly, RFOs have instruments for early and usually small scale support of the new field, a form of 'tentative governance' of a field possibly even before it has a label. Secondly, and usually at a later point in time, RFOs deliberately addressed the new field of nanotechnology, but in part did so through existing disciplinary structures. In addition, they further fraction the field through the distinction between technology agencies

and basic research councils, and through applying multiple funding instruments which are not necessarily coordinated in terms of the new fields' requirements. Thus they show a response of shaping the new field according to existing classifications.

However, some RFOs - and governments - responded through different approaches, taking the new field's boundaries and its national resource needs as point of departure. Based on these findings, this paper rounds off with suggestions for organizational models of funding through RFOs. Simply establishing different categories, for new disciplinary divisions for example, may help but will only temporarily solve the problem. Instead, solutions that circumvent categorization or deal with categorization in a more flexible way, in other words making tentative a structural mode of funding, may prove more effective and sustainable.

Biosecurity regimes and the rise of synthetic biology

Keelie Murdock, k.murdock@rathenau.nl

Dirk Stermerding, d.stermerding@rathenau.nl

Barend van der Meulen, b.vandermeulen@rathenau.nl

Rathenau Institute, The Hague, The Netherlands

The potential for scientific materials and methods to be misused or abused to serve offensive agendas and facilitate bioterrorism has stimulated wide-spread concern about the sensitivity of R&D in biology. These concerns coincide with the dramatic imagery of 9/11 which had a profound impact on the social and political consciousness. Not long after, letters contaminated with anthrax spores were disseminated via the US mail system by a then unknown assailant. Global insurgency and the weaponization of infectious disease were therein juxtaposed in the minds of politicians and security experts around the world. The threat of bioterrorism now seems especially daunting because it combines the intimidation of international terrorism and the potential for mass destruction.

Bioterrorism is a very difficult threat to manage. This is because the biological agents which can be used to harm or destroy living organisms are also used peacefully by scientists, with the promise to improve and/or protect human, plant or animal life. In addition, the pervasiveness of bioscientific materials and the perceived social value of modern biological developments preclude the possibility for the outright eradication of dangerous agents and restrict opportunities for pre-emptive control.

The main legal instrument prohibiting the offensive use of biological agents and toxins is the Biological Weapons Convention (BWC). In this context, proposed protocols based on methods of disarmament, such as confidence building measures and a verification regime, failed to achieve consensus or adequate support. Moreover, the presupposition of disarmament was primarily focused on State programmes and behaviour without due consideration of the criminal intent of individuals. Given the domestic security implications, the concept of biosecurity was developed to enable member states to devise their own systems of legislation and regulation.

In this paper we analyse how the concept of biosecurity developed at the Biological Weapons Convention to manage the boundary between peaceful and offensive purposes or good and bad ethical behaviour; the challenges of adapting the concept of biosecurity to fit within the existing regulatory framework in the Netherlands; and the development of a biosecurity infrastructure within Dutch laboratories. However, we believe it is also important to look to the future to provide insight into the stability of the emerging biosecurity system and its capacity to cope with new uncertainties, tensions and expectations. We will thus also consider the potential for adaptation and innovation in response to the competing narratives of unease and excitement surrounding synthetic biology and novel scientific and technological developments.

As opportunities for the weaponization and/or transmission of harmful organisms has been realized and gaps in the existing governance regimes have been identified, various actors and institutions in the Netherlands have been compelled to re-evaluate and respond to the risks. In their efforts to develop a comprehensive biosecurity system, a vast number of ministries and institutions are currently considering new rules and regulations. Meanwhile, the evolving concept of biosecurity is being adapted locally by proactive individuals and communities. These activities have engendered significant overlaps in the areas of biosecurity policy-making and policy-related action.

Biosecurity builds on a long-standing tradition of occupational safety, a highly developed biosafety infrastructure and a typically top-down approach to security. It thus sits in an uncomfortable position in the governance structure and at the intersection between several governance regimes. While historically, security and safety from biological weapons, terrorism, and disease have been separate matters of concern, within separate institutions, bioterrorism is multi-dimensional and does not fit neatly into any one of these frameworks. It is an issue which spans across different disciplines of thought and action.

Science and its accepted modes of organization and regulation are being challenged by the values of the security community, which views scientific actors and activities as both a potential threat and an essential resource in the prevention of and protection from bioterrorism. Meanwhile it is not clear where the boundaries between biosafety and biosecurity can be drawn. The conflicting value-systems of science and security stresses the interactions

at the interfaces and problems at the peripheries, while the over-lap between biosecurity and biosafety is challenging the integrity of the regimes as professional actors attempt to adapt to new conditions and environments.

While it is still uncertain how biosecurity will finally be implemented or how it will operate, the security risks which could potentially emanate from developments in synthetic biology are now being carefully considered at the Biological Weapons Conference (BWC). The opening of the Pandora 's Box of synthetic biology suggests that this area of research will soon be pulled under the blanket of biosecurity. This emerging field of research can no longer continue under the radar of biosecurity policy-makers and biosecurity policy must now incorporate a new set of risks factors.

In our research into the influence of the existing regulatory regimes on the development of biosecurity in the Netherlands we expect to find a complex interplay between the objectives of science, security and safety. We view the development of biosecurity definitions, practices and related regulations, including considerations for the inclusion of synthetic biology, as coping strategies that can be considered as forms of tentative government in a period of regime destabilisation.

Regimes are sets of explicit regulations and tacit rules that guide actor behaviour in recognizable practices. Three specific regimes of thought and action have been identified to guide the discussion. Namely, the logic of command and control (often referred to the 'guns', guards', and gates' approach to security) which seeks to isolate and suppress threats to security; the biosafety track deeply reliant on the ideas and infrastructures developed to prevent the accidental release of biological agents and toxins; and the scientific model of self-regulation which favours non-intrusive means of encouraging responsible scientific conduct.

The data on which the analysis is based comes from a discourse analysis of the working documents submitted to the Biological Weapons Convention inter-session review process, interviews with researchers, scientific project leaders, biosafety and security officers and from an on-going technology assessment of activities and advancements in synthetic biology.

Emerging stabilization in genomics. Governance and practices of valorization

Roel Nahuis & Dirk Stermerding, Univesity of Twente, r.nahuis@utwente.nl, d.sterderding@utwente.nl

With the rise of genomics as a new international research field we see, in the field of human genetics, significant changes both in the agenda and the organization of research. Research is now developing in the context of large-scale consortia, characterized by international, multidisciplinary collaboration, use of high throughput technologies, strategic public investments and public-private relationships. We study and evaluate the modes of governance which respond to the challenges created by these changes.

In the context of the Netherlands Genomics Initiative (the national genomics research program) *valorisation* for the benefit of society is emphasized as a crucial goal of Dutch science policy in genomics. The NGI defines valorization as an effort "to ensure that society and economy benefit from the breakthrough enabled by genomics in important fields like health, sustainability, enabling technologies and society" (NGI homepage). But the way valorization actually works as a mode of governance is via quantified valorisation targets (dissertations, patents, start-up companies, industrial matching), which are established in 'valorisation plans' of consortia along with a specification of IP arrangements and the role of Technology Transfer Offices in research. Valorisation is furthermore promoted with additional financial instruments (Venture Challenge, NGI Pre-SeedGrant, BioGenerations Ventures, and NGI Valorisation Award). Clearly, these instruments embody a particular economic and rather narrow understanding of valorization. For example, they are ill-suited to appreciate clinical relevance in terms of better diagnostic criteria or the identification of promising search directions.

In principle, valorization could take on different meanings. It may focus on problems of co-ordination which arise in the emerging genomics innovation regime, aligning a complex diversity of public and private actors, goals and interests within the confines of this regime. It may also focus on broader questions of accountability, involving both short-term and long-term interests and concerns in society at large. By opening the black box of valorisation we want to contribute in this project to the articulation of, and reflection on, various practices of valorisation and the economic and clinical values embodied in these practices: how indeed is society to benefit from genomics as a new innovation regime in human genetics?

Based on the notions of innovation regimes and hybrids we propose a broader conception of valorization. Innovation regimes govern the interactions of actors from different domains – science, industry, the clinic and public policy domain – which participate collectively in knowledge production, appropriation and translation. These interactions comprise the exchange of entities, such as data, knowledge, products or money. Hybrids are entities that link heterogeneous actors, because they have relevance for different domains at the same time. An example of a hybrid entity is indeed a patent, which relies on scientific knowledge and has implications for industrial activity. We pose that scientists are engaging in practices of valorization when they are producing hybrids.

Framed in this way, the different meanings of valorization can be clarified with the distinction between socio-economic hybrids and bioclinical hybrids. Socio-economic hybrids are mediators that blur boundaries between

university and industry or public and private organisations. Bio-clinical hybrids are simultaneously laboratory tests and medical devices, biological results and clinical indications. The meaning of valorization depends on the kinds of hybrids scientists are engaging with.

We are conducting two case studies to highlight the role of hybrids in different innovation regimes. The first case is genetic research into Duchenne Muscular Dystrophy. This is an interesting case, because DMD is a monogenetic disease that was already a major object of research in the clinical genetics regime of the 80s and 90s. The current focus on therapeutic interventions by both academic researchers and industrial partners illustrates the evolution of this regime. Socio-economic hybrids feature prominently in this case. A spin-off company ProSensa exploits a patent owned by Leiden researchers. Recently pharmaceutical multinational GlaxoSmithKline and ProSensa negotiated a strategic alliance. For NGI these activities count as a best practice of valorization.

The notion of bioclinical hybrids points to another dimension in this practice. Exon skipping is a biomedical concept that, in the context of DMD, denotes a pathological mechanism explaining the severe symptoms, but also denotes the therapeutic intervention. By means of so-called AON treatment one more exon can be skipped from pre-mRNA resulting in a much milder Becker-like phenotype. This raises questions for governance beyond economic valorization. For example, how will the division of the DMD population into treatable and untreatable patients impact on solidarity among patients? Will there be sufficient numbers of patients for clinical trials with DMD already being a rare disease?

The second case study is genomics research into Alzheimer's Disease. This research is governed by a typical genomics regime: a multifactorial disease agenda, use of large biobanks and association studies as an emerging paradigm. Despite valorization instruments, no socio-economic hybrids (spin-offs, patents, industrial sponsoring) figure in this case, but a number of bioclinical hybrids are worthwhile investigating. The first is the organisation of biobanks, which are used for research purposes but would not exist without many efforts by health care practitioners. The second bioclinical hybrid are diagnostic criteria for AD. NINCDS-ADRDA criteria are internationally accepted and used both clinically (for diagnosis) and scientifically (in-/exclusion in population study). These two bioclinical hybrids highlight practices of valorization beyond its economic meaning. Should (unexpected) findings be fed back to donors in biobanks? New diagnostic criteria propose the category of pre-clinical AD, but what does it mean to be diagnosed without certainty that AD symptoms will become manifest? seem ill-suited to address these issues for governance.

To conclude, hybrids seem to be an appropriate starting point to characterise innovation regimes and to study practices of valorization therein. Especially bioclinical hybrids raise questions that are poorly covered by the narrow NGI definition of valorization and addressed by its governance instruments. This conclusion prepares the ground for an evaluation of valorization policy based on further interrogations of actors involved in the governance and practices of valorization, whom will be confronted with the results of our study.

Mapping the Elsa-discourse on humanization trend in social robotics

Dr. Ir. E.C.J. van Oost, University of Twente, e.c.j.vanoost@utwente.nl

In the 21st century the two techno-scientific trends of "biology becoming technology" and "technology becoming biology" are expected to converge and intermingle, resulting in increasingly vague borders between humans and machines with its related fundamental ethical and social questions (van Est et al 2009). In human enhancement, mind/body dualisms are blurred by an increasing tendency to conceptualize the human mind as a product of the brain and thus becoming a bodily and mechanical entity, open to the engineering approach.

As important as these developments are in themselves, there are strong arguments that its ethical and social assessment cannot be separated from the other technoscientific trend: that is the human body and mind increasingly is becoming the ideal reference model to engineer the future intelligent devices. Especially in social robotics, there is a clear recognizable trend to construct "artificial humans", capable of autonomous acting, emotional bonding, and learning by experience. This other route (technology becoming biology) to the formable man raises similar, but inversely distributed over situated socio-technical configurations, ethical and social questions concerning morality, responsibility, identity, and free will.

This latter route to the future of the formable man is rather limited articulated in the current Dutch Elsa-discourses (cf. Swierstra et al 2009). The aim of this paper is to map the actor perspectives on relevant Elsa-aspects on the "humanization"-trend in social robotics, based on in-depth interviews with core roboticists, social scientists, ethicists and policymakers, and representatives from civil organisations. The outcome is linked to the current Dutch debates on the social and ethical impacts of blurring boundaries between humans and machines.

References:

- Est, R. van et.al (2009) *Making Perfect Live. Bio-engineering (in) the 21st Century*. Rathenau Institute, Den Haag.
Swierstra, T. et al. (2009) (red) *Special Issue: Converging technologies, shifting boundaries*. Nanoethics 3 (3).

New Perspectives for Technology Assessment?

Carsten Orwat, Christian Büscher, Karlsruhe Institute of Technology, orwat@kit.edu, or buescher@kit.edu

The modern functionally differentiated society produces more and more organizational and technological means to achieve a variety of goals, but simultaneously generates more and more unanticipated consequences as *externalities* (ecological crisis, climate change etc.) and as *inefficiencies* to produce 'common goods' in functional spheres of society like economics, education, health care systems or politics. Governance reacts on such fundamental problems of modern societies and experiences of past failures in finding appropriate solutions. In particular, monocratic governmental measures have been regarded as insufficient and ineffective, and under the label of 'governance' new forms of collective decision-making emerged, with a plurality of private, civic, semi-public and public actors involved, often at multiple levels of decision-making, and with negotiations, communication and influences as main types of social interaction. Correspondingly, the governance of science and technology has changed and, with it, the forms of technology assessment as one of the basic attempts to cope with the aforementioned problems.

However, within the multitude of possible governance types especially the roles and functions of government actors and 'traditional' politics and regulations within governance arrangements seem to be less clear and less analysed. In governance structures, governmental activities can be necessary for moderation of governance processes, for the final enforcement of governance outcomes, as fallback option when governance failures emerge or to modulate or abandon ineffective or illegitimate governance structures. Immediate governmental action is also necessary to treat harmful externalities resulting from the adoption of (nascent) technologies or scientific knowledge. Governmental activities can also be necessary to promote and moderate participatory governance at an early stage of technology development, especially for emerging technical infrastructure systems with path dependences and low chances to exit development paths later. Furthermore, the example of converging nano-bio-info-cogno technologies demonstrates a field without a central 'steering authority' and with reciprocal processes of expectation building, specifications of scientific and political agendas among a multitude of actors.

It is assumed that specific types of technology assessment are adequate for specific types of governance structures, for which in turn the degree and kind of government involvement is one of the characterising determinants. An abstract spectrum might have, at one side, governance approaches with high decision rationality by a broad inclusion of actors and mutual learning and, at the other side, approaches with high action rationality with capabilities of quick response or strong enforcement and collective binding.

In our contribution, we review the governance debate with a special focus on the relationships between governmental and non-governmental actors and activities within complex structures of science and technology fields and related approaches of technology assessment. A particular focus is on the roles of different mechanisms of social coordination leading to common goods and avoiding externalities. It is attempted to categorize different governance arrangements, which may depend, among other things, on the type of science and technology considered, its novelty or maturity, its structure of existent or possible impacts and its societal contexts. Different concepts of technology assessment are sorted within these categories.

Assessing Expectations. Promises and Silences in Discourses of Websites of Producers of Telecare Technologies

Nelly Oudshoorn, n.e.j.oudshoorn@utwente.nl, University Twente. The Netherlands

Technologies cannot exist without promises. Biographies of technologies are therefore fascinating to read because they often describe expectations and promises that are no longer part of our collective memory or else have become part and parcel, the 'essence', of the technology as we know it today. Although promises thus may come and go, they are never innocent. The field of science and technology studies (S&TS) has a rich literature that indicates that expectations play an important role in the development of technologies. One of the important insights of studies of the sociology of expectations, one of the themes in S&TS, is that promises can be considered as 'wishful enactments of a desired future' (Borup et al. 2006:286). Expectations are not merely rhetorical but 'constitutive' or 'performative' in attracting the interest and mobilizing the support of actors considered necessary to make the technologies work, such as other innovators, investors, policymakers, and users (Borup et al. 2006:289). Expectations not only define the relevant actors, they also allocate specific roles to them as well as to the (future) technology. Expectations are thus understood as containing a script or scenario of the future world (Lente and Rip 1998:203). This scenario specifies how people and things should act, and is, in this sense, obligatory: it is 'an implicit warrant to others that they should use that tool or procedure' (Borup et al. 2006:289).

Although these studies provide useful insights into the role of expectations in technological development, they are largely restricted to understanding how expectations and promises shape the early development of technologies within Research & Development (R&D) departments in industry and academia. I suggest it is relevant to study promises in a later phase of technological development, after artefacts have left the R&D departments to

become part of the world outside the laboratories. This shift in focus is important because studies in the sociology of expectations tend to camouflage the risks, anxieties, and other socio/cultural processes that may constrain technological innovation. This absence can be ascribed partly to the fact that negative expectations are often not articulated in the early phases of technological development. To attract the interest of relevant actors, early promises often contain utopian, technology-driven dreams about how the world would look if everyone were to use the new technology. Or as the historian Marvin put it, every age tends to 'read the future as a fancier version of the present' (Marvin 1990). Moreover, early promises tend to downplay the cultural and organizational processes on which the future of a technology depends (Borup et al. 2006: 290), which may explain their absence from the sociology of expectations. However, the fact that anxieties and socio-cultural aspects are understudied can also be ascribed to the research agenda in a field that focuses on understanding how expectations shape R&D practices and science policies. Adopting the view that promises are important not only in shaping R&D but also in trying to define future use, I think it is important to study both positive and negative expectations and, when the latter are not articulated, to analyze the absences and silences in these discourses. Which actors, roles, perspectives and concerns have no voice in expectation statements?

This paper investigates the promises about one specific technology, telecare devices for heart patients currently implemented in the U.S. and Europe, as articulated in websites of producers, press bulletins that announce the clinical testing and implementation of telecare devices, and brochures to promote the new technology among healthcare professionals. Based on my analysis I conclude that promises on these telecare devices paint a rather rosy future of the new technology. By merely articulating the positive, enabling 'characteristics' of telecare devices, the expectation statements do not address the concerns, anxieties, or resistances involved in the implementation of these technologies in healthcare. The articulation of positive expectations at the expense of constraining aspects is thus not only part and parcel of the promises articulated during the early phase of technological innovation. They are also an important characteristic of the dynamics of promises when technologies are introduced into the market, not because constraints on the acceptance are not yet known, as is the case with promises in the early phase of technology, but because innovators are under pressure to make the introduction of new technologies a success because of the economic interests at stake. This may include the selling of telecare devices (Philips), or investment in telemedical centers (Achmea, Vitaphone and Hartis) or the economic position of the firm itself (Vitaphone and Hartis). In this context, websites are used as tools to create a positive and attractive image of the new technology. Another, related economic interest at stake in these promises is the contribution telecare technologies are expected to make to reducing the costs of healthcare. By portraying telecare technologies as tools to make healthcare more cost-effective and efficient, innovators contribute to the dominant discourse on the political economy of care by trying to convince policymakers of the relevance of the new technologies.

However, the emphasis on positive expectations cannot be ascribed only to economic concerns but is also related to the view of technology underlying these promises. In the websites and other information tools, telecare devices are (implicitly) considered as instrumental tools that facilitate healthcare. Consequently, they can simply add to or replace existing healthcare practices and traditions if potential users are convinced of the advantages of the new technology. As sociologists of technology have argued, the successful implementation of new technologies involves much more than simply introducing a device into its context of use. As described elsewhere, the introduction of telecare technologies implies a new geography of care (Oudshoorn forthcoming). The social and cultural changes involved in the redistribution of care over different places and actors, including changing responsibilities and interdependencies, are, however, largely absent in the promises articulated in relation to telecare devices. The paper concludes with a reflection on the governance implications of these absences and silences of telecare technologies.

Oudshoorn, N. (forthcoming 2011). *Who Cares? Telecare Technologies and the Transformation of Healthcare*.

Are there rules in "games against nature"? Lessons learnt from the development of an HIV vaccine

Padua, M., muriela.padua@ist.utl.pt, In+, Instituto Superior Técnico, Portugal; DMS, INETI, Portugal

This paper uses the case of the development of an HIV vaccine to examine whether it is possible to identify the sources of uncertainty and to uncover some general patterns of problem solving associated with the very early stages of the technical change that underlies the emergence of radical innovation. The HIV vaccine is a case of product innovation in which the scientific and technological principles are not clear from the outset. The attempts to apply known scientific and technological principles to vaccine design have allowed the identification of the anomalies that characterize scientific and technological development. This vaccine involves a mismatch between 'nature' and theory. However, due to pressures to accelerate its discovery, it has been necessary to convert scientific discoveries into new technology concepts even though the laws of nature were not fully understood so as to shorten the time lag for the discovery of this case of product innovation. The rationale for the study is that this case of product innovation may

become an increasing sort of fact in the life sciences industry. The life sciences industry has generated many hopes and promises but, possibly, due to the scientific and technological uncertainty which surrounds many of its potential applications, the so called biotechnology revolution has not taken place yet. Although it is too early to know whether the issue of accelerated technical change will emerge in the life sciences industry, it might be worth to gain a better understanding of whether there are rules in games against nature (and if so, which ones) in order to identify some of the governance issues which can support the discovery process at these very early stages. This extended abstract is structured in the following sections. The first section sets the problematique of HIV vaccine development, the second ones identifies the gaps in the literature of technical change to deal with this issue, the third section deals with results and the fourth presents conclusions.

1. The problématique: the case study of the development of an HIV vaccine

Twenty years after the first trials, it has become clear that the HIV vaccine is a case of radical innovation – and, moreover, we are still in the very early stages of its discovery. Many different theoretical approaches have been employed to discover a scientific and a technological solution to this problem at hand, but so far none has led to the eagerly awaited solution. The HIV vaccine involves a mismatch between ‘nature’ and theory. The attempts to apply known scientific and technological principles to vaccine design have allowed the identification of the anomalies that characterize scientific and technological development. This vaccine is a case of product innovation in which the scientific and technological principles are not clear from the outset. But, due to pressures to accelerate its discovery, it has been necessary to convert scientific discoveries into new technology concepts even though the laws of nature were not fully understood so as to shorten the time lag for the discovery of this case of product innovation. As such, this is an unusual instance of radical innovation. Indeed, so far, for most cases of vaccine development, scientists and engineers look for technological solutions after the scientific solutions are identified, but in the case of HIV search, research agencies promoted this co-evolution between science and technology at a much earlier stages - when the correlates of immunity were still unknown. However, despite the level of uncertainty which surrounds the development of an HIV vaccine we may need to understand whether it is possible to specify the sources uncertainty and to uncover some general patterns of problem solving associated with the very early stages of technical change in order to provide guidance about the nature of the governance issues which can support its discovery.

2. Literature review

The issues posed by this case study raise new challenges to current science and technology models. Drawing on the idea that invention is about a process of uncertainty reduction, several S&T models have been proposed but they hold to key assumptions which do not apply to the case of the development of an HIV vaccine. In these models it is assumed that science is predictive, e.g., it provides a representation of the problems to be dealt by firms. No sources of uncertainty associated either with science or the very early stages of technology evolution have been identified. In addition the role of science in the early stages of technical change remains poorly understood. Owing to the fact that it is assumed that science predictive it is assumed that science reduces search space instead of opening them. Thirdly, although the literature recognizes the role of invention in technical change, it has focused mainly on the innovation and diffusion phases. Reflecting the existence of these gaps the current concepts used in the literature to account for the sources of uncertainty and patterns of problem solving at different stages of technical change may not be appropriate. This is because most of these concepts have been developed within the context of innovation/diffusion of (given) technology rather than invention or science. As science based invention remains an under researched area in the innovation studies literature we are unclear about the nature of the governance issues which can help support discovery in these early stages.

3. An approach to examine the early stages of technical change

This paper puts forward two arguments. The first one is that it is still possible to stretch theories of technical change to invention and to science. It proposes to stretch the idea that technical change has a logic of its own for the invention phase and to science. It is argued that there are inner working of technology at the level of science and invention. This hypothesis of the inner working of technology has been very fruitful to identify the sources of uncertainty and broad patterns of search which occur at distinctive stages of technical change. In order to build the approach the paper builds on the philosophy of sciences to account for the autonomous development of science and technology. It uses the same principles developed by von Tunzelmann (1995) and other scholars of technical change (Constant, 1974; Dosi, 1982, 1988; Rosenberg, 1969; Nelson and Winter, 1977; Sahal, 1985; Von Tunzelman et al, 2008), to account for technology but it stretches them in new ways. The paper proposes the idea of scientific and technological research programs to account for the nature of uncertainty and patterns of problem solving which take place at the very early stages of technical change. It uses these concepts to identify the sources of uncertainty associated with these very early stages of technical change and to uncover some of the broad search processes to reduce this uncertainty. In addition, it examines how scientific and technological programs interact with each other in order to identify proprieties which characterize the co-evolution between science and technology.

4. Methodology and results

The third section proposes a case-study methodology: the HIV vaccine is used as the case study to examine science-based invention. The methodology relies on a bibliometric analysis from 1987 to 2002. More specifically it relies on Callon's co word analysis (1991). More than 27000 co-occurrences were obtained. The Alamos database on candidates for HIV vaccines has been used.

5. Findings

The fourth section presents the findings, confirming that scientific and technological research programs account for nature of the uncertainty and patterns of problems solving which take place at the early stages of technical change. However the application of the concept of "research programs" to science and technology differs (what is not known in science differs for technology). With regard to patterns of problem solving, the first finding is that in science there is no single hypothesis but a series of hypotheses or positive heuristics that guide problem-solving in the face of anomalies. In this context new auxiliary hypotheses are added to the search space instead of leading to the refutation of Lakatos's hard core. The scientists will attempt to avoid the falsification of the theoretical core of a SRP by protecting themselves behind a protective of auxiliary hypothesis (Lakatos, 1970). The second finding is that there are general and domain-specific heuristics used to guide problem-solving in the face of persistent anomalies. The third finding is that the directions of research to solve anomalies are general and domain-specific. The fourth finding is that these heuristics can compete with or complement each other. The fifth finding is that whereas some of these heuristics are relatively programmed (Newton-Smith, 1981) others are unexpected.

With regard to technology, the first finding is that initially engineers/scientist will attempt to avoid the falsification of the theoretical core of a TRP by protecting themselves behind a protective of auxiliary hypothesis. However in the persistence of anomalies new technological research programs emerge. The third finding is that the directions of research to solve anomalies are general and domain-specific. The fourth finding is that these heuristics can compete with or complement each other. The fifth finding is that whereas some of these heuristics are relatively programmed (Newton-Smith, 1981) others are unexpected.

With regard to the co-evolution of science and invention, the study examines how scientific and technological research programs interact with each other. Four periods are distinguished. Science open up new search spaces (as reduce them). The hypothesis that both bodies of knowledge co-evolve is not simply given; rather, the process has to be managed. Indeed it is shown that often, science and technology evolve out of key with each other. Thirdly, one could argue that to some extent the changes in the boundaries to science define the changes in the boundaries to technology

6. Conclusions

The fifth section presents the conclusions. It opens new puzzles to the dynamics of technical change at the very early stages, namely in the life sciences industry and it looks at the implications of the findings for S&T models and for the concept of technological paradigms.

Key References

- Abernathy, W.J. & Utterback, J. (1978) 'Patterns of industrial innovation', *Technology Review*, 50, pp. 41-47.
- Arrow, K. J., (1969) 'Classificatory Notes on the Production and Transmission of Technological Knowledge', *American Economic Review*, Vol. 59 (2), pp. 29-35.
- Arrow, K.J., (1962) 'Economic welfare and the allocation of resources for invention', pp. 609-626 in: Nelson, R.R., (ed.) *The Rate and Direction of Inventive Activity* (Princeton: Princeton University Press,).
- Callon, M., Courtial, J.P. & Laville, F., (1991) 'Co-word analysis as a tool for describing the network of interactions between basic and technological research: the case of polymer chemistry', *Scientometrics*, 22 (1), pp. 153-205.
- Constant, E., (1974) *The Origins of the Turbojet Revolution*, (Baltimore: Johns Hopkins University Press, 1980).
- Dosi, G., (1982) 'Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change', *Research Policy*, 11, pp. 147-162.
- Dosi, G., (1988) 'Sources, Procedures and Microeconomic Effects of Innovation', *Journal of Economic Literature*, Vol. 26 (September 1988), pp. 1120-1171.
- Dosi, G. & Egidi, M., (1991) 'Substantive and Procedural Uncertainty: an exploration of Economics Behaviors in Changing Environments', *Journal of Evolutionary Economics*, Vol. 1 (2), pp. 145-68.
- Dosi G., Marengo, L., G. & Fagiolo, G., (1996) 'Learning in Evolutionary Environments', Working Paper IIASA (International Institute for Applied Systems Analysis), Laxenburg, Austria.
- Flemming, L., (2001) 'Recombinant uncertainty in Technological search', *Management science*, Vol. 47 (1), pp 117-132.
- Freeman, C. & Perez, C., (1988) 'Structural crisis of adjustment, business cycles and investment behaviour', pp. 38-66 in: Dosi, G., Freeman, C., Nelson, R., Silverberg, G., Soete, L. (eds.) *Technical Change and Economic Theory* (London: Pinter,).

- Frenken, K. & Murmann, P., (2006) 'Toward a Systematic Framework for Research on Dominant Designs, Technological Innovations, and Industrial Change' *Research Policy*, Vol. 35, pages 925-952.
- Lakatos, I., (1978) *The Methodology of Scientific Research Programmes* (Cambridge: Cambridge University Press.)
- Nelson, R.R. & Winter, S.G. (1977) 'In search of useful theory of innovation', *Research Policy*, 6, pp. 36-76.
- Nelson, R.R. & Winter, S.G. (1982) *An Evolutionary Theory of Economic Change* (Cambridge MA & London: Belknap Press of Harvard University Press).
- Marengo, L., Dosi, G., Legrenzi, P. & Pasquali, C., (2000) 'The structure of problem-solving knowledge and the structure of organizations', *Industrial and Corporate Change*, 9, pp. 757-788.
- Pádua, M., (2008) *Search models and ill-structured problems: a case study on the development of an HIV vaccine*, PhD. Thesis, University of Brighton.
- Rosenberg, N., (1969) 'The direction of technical change: inducement mechanisms and focusing devices', *Economic Development and Cultural Change*, 18, pp. 1-24, reprinted in: Rosenberg, N., (1976) *Perspectives on Technology* (Cambridge: Cambridge University Press), pp. 108-125.
- Rosenberg, N., (1982) *Inside the Black Box: Technology and Economics* (Cambridge: Cambridge University Press).
- Sahal, D., (1985) 'Technological guideposts and innovation avenues', *Research Policy*, 14, pp. 61-82.
- Vincenti, W.G., (1990), *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History*, (Baltimore & London: John Hopkins University Press).

Dual dynamics of technological promises and waiting games around nanotechnology

Alireza Parandian, a.parandian@tudelft.nl, Delft University
 Arie Rip, a.rip@utwente.nl, University of Twente
 Haico te Kulve, h.tekulve@utwente.nl, University of Twente

The broad issue of governing newly emerging sciences and technologies (NEST) and especially nanotechnologies must take into account the patterns that emerge and become affordances as well as constraints to the actors involved. Expectations and particularly promises play a key role in such de facto arrangements. For the dynamics of NEST, they create a powerful reference to economic and broader societal benefits. Paradoxically, such general promises can actually hinder the realization of the promised benefits when they lead to waiting games. This paper analyzes such dual dynamics of promises, as they shape emerging *de facto* governance arrangements. The particular cases we analyse in some detail are organic large area electronics (OLAE) and nano-enabled drug delivery systems.

Actually, when empirically tracing developments in the nano-enabled drug delivery and OLAE fields we observed waiting games: the continuing reluctance of actors to invest money and effort in developments, despite recognizing the promises. It appeared to be a matter of games rather than independent individual choices (rational or otherwise) because there are mutual dependencies and informal rules that are followed.

We then asked why such waiting games emerge and continue? We claim that emergence and continuity of such waiting games derives from dual dynamics of promises. The paper will first develop this point conceptually independent of our empirical findings.

We distinguish two types of promise dynamics: umbrella promises and promise-requirement cycles. Umbrella promises are open-ended and remain general, like nanotechnology bringing the third industrial revolution. Umbrella promises can link up to general challenges, like enabling to compete in the global economy, or somehow addressing energy issues or medical options. These general and attractive, but open-ended, promises are accepted or at least considered by a heterogeneous set of actors. Individual actors must pay some attention: they cannot exit easily. The other dynamics occurs when specific promises are made and translated into requirements about performance to be realized. Resources are mobilized and dedicated to allow further development work to be done oriented to the requirements as articulated. There may be bottlenecks, and these then lead to further requirements how to solve them. In this way, promise-requirement cycles become ever more specific until a working artifact or system is realized.

However, umbrella promises are too uncertain for actors to initiate concrete promise-requirement cycles. There is uncertainty about the performance that might eventually be realized, so customers/users are reluctant. And there is uncertainty with the developers whether there will be a demand (since potential users have no incentive to articulate demand). Each of the two sides waits for the other to take a risk. Thus, waiting games are characterized by the presence of an umbrella promise and the absence of (or at best half-hearted attempts at) promise-requirement cycles. Since NEST live on promises, they are vulnerable to waiting games. And this is what we actually find.

In the second part of the paper, we turn to the details of our two case studies. Open-ended promises are produced and circulate in both cases, without strong commitments emerging. Specific promise-requirement cycles are almost absent. We do see attempts to break through waiting games, by different actors and sometimes collective actors. They grapple with dual dynamics of promises, and often fail. Or have only limited results, as when product development occurs but shifts to "safe" developments (e.g. liposome carriers in drug delivery).

While the characteristics of waiting games are visible, we have to check if the emergence and perseverance of these characteristics derive from other sector and/or technology specific factors. In particular, waiting strategies can be the effect of industry structures which shape the interactions between different actors.

Thus, we include more complexity in our analysis. In particular, there is the effect of intersecting value chains which are visible in both of the cases we studied, for nano-enabled drug delivery systems, there is the value chain of carrier development and production, and the value chain of drug development and use in treatments. The sector structure is such that big pharma companies wait for small innovative companies to take risks in innovation, and then take up on the successes. This can be a productive division of labour when there are indeed small companies which take such risks. However, for nano-enabled drug delivery (as well as for some other areas), small innovative companies on their turn wait for the investors including big pharma companies. A specific end market in the clinic is envisaged, but there is no demand (even reluctance).

OLAE as an option combining new materials and new production technologies, serve a variety of value chains. But directions for further development have not crystallized out. Materials producers and printing technology companies are considering OLAE seriously, but actual device and system producers are reluctant, because they see a lack of articulated demand, so no way to choose among different product development options.

Clearly, the situation is more complex. But it is also clear that the other explanations for the emergence of waiting games derive their force from the existence of a diffuse promise. Thus, we can still say that waiting games are predicated on the existence of a diffuse promise about the potential of a technology which circulates in relevant sectors. Technology promises remain on the radar of the various actors, even when little actual (successful) developments take place. As other authors have shown (cf. Kornelia Konrad's analysis of electronic superhighway in the 1990s) umbrella promises can survive a long time despite the lack of successful projects.

There is more to say, e.g. the rise and fall of umbrella promises ("the" hydrogen economy would be an example). In this paper, we conclude with a brief discussion of governance aspects. We have done scenario exercises about attempts to break through waiting games in the two cases. Their analysis, and the responses to them from participants in strategy-articulation workshops allow us to evaluate such "tentative" governance of NEST and consider the possibility of "smart" (i.e. anticipatory) governance.

Changing Patterns of Governance and Management in European Universities: Emerging Paradoxes in Spanish Universities

M. Paloma Sánchez, Autonomous University of Madrid, mpaloma.sanchez@uam.es

Susana Elena European Commission - Joint Research Centre, Susana.ELENA-PEREZ@ec.europa.eu

Higher Education Institutions (HEIs) are critical players in the knowledge-based economy today. Being essential for knowledge production, transmission and dissemination, they are at the forefront of the policy agenda. At European level, the Lisbon Agenda (March, 2000) calls for their particular involvement in the creation of the "Europe of Knowledge". European universities have been immersed in an intense modernisation process driven by both EU-level policies aiming to establish the European Research Area (ERA) and the European Higher Education Area (the Bologna process) and a more general commitment from Member States to reform their Higher Education (HE) sector. These processes aim to foster crucial structural changes to successfully compete with HEIs in other parts of the world (European Commission 2007 and 2009). Internationalization and globalization are also trends that greatly affect the HE sector (Enders, 2004, p.361). Partly as a consequence of such trends, HEIs are today much more conscious of their other duties to society (the so-called *third mission*) and have become multifunction (Laredo 2007), multimission and multipurpose (Bonaccorsi and Daraio 2007). Reforms of national laws on HE in most European countries (ERAWATCH 2008) and supranational institutions (OECD 2007; European Commission 2007; European University Association 2005 and 2007; Esterman and Nokkola 2009), based on New Public Management principles (Sanchez et al. 2009; Schimank 2005), send the following message: universities need more institutional autonomy to better respond to new societal demands and a larger number of stakeholders. To do this, their management systems should more closely reflect the criteria of efficiency and effectiveness observed in the business world. At the same time they should be more accountable to society. The multiplicity of needs to satisfy and the larger number of stakeholders may lead to tensions and new dynamics (Huisman, 2007, p.220) which could call for a serious debate on results assessment (European Commission 2009). The paper draws attention to the current debate on autonomy, and its counterpart, accountability, and how the former is needed if we want to transform our universities into more competitive organizations, able to fulfil the roles society is demanding of them. Our main argument is that the existence of legal or formal autonomy (in theory granted by law) does not guarantee real or effective autonomy because this latter is contingent to the university's governance system. Stemming from this is our argument that it is difficult to really transform universities into more autonomous institutions without in-depth discussions, and eventual changes to the way they are governed in some European countries. By focussing on the Spanish case, we show that a number of paradoxes emerge from the public discourse and owing to these, that the governance style of most Spanish universities, based on collegial models,

may be a constraint on the necessary changes. While a new management style appears to be needed to produce good quality teaching, research, and better links with society, certain characteristics of such a model make the introduction of new management procedures difficult. If this is true, some of the above policy recommendations and reforms might not produce the necessary transformation processes. Eventual changes in the organisational culture and internal dynamics of universities are important current challenges. The arguments presented are illustrated by data taken from the analysis of two Spanish universities (Autonomous University of Madrid and Pablo Olavide University of Seville) following the Grounded Theory methodology. Despite their differences in terms of location, size, age and scientific production, both follow a collegial model with collective styles of governance and face similar managerial problems. The evidence gathered in the analyses of two Spanish universities, using Grounded Theory, suggests that even though the autonomy granted by law to universities is key to setting up the necessary framework conditions it is not enough to transform university practice or internal dynamics. Our argument is that there are organisational and cultural features that hinder the implementation of real autonomy. In the cases analysed, the collegial system of governing appears to be one of the most important constraints on the decision-making process and clearly hinders the implementation of significant change. Since all Spanish public universities follow a collegial system of governance, the results obtained in this research are applicable to most of them. A collegial model, mainly based on the principle of representation of all the key stakeholders, and its election process, which relies more on scientific recognition than the candidate's managerial skills, acts as a barrier to the full implementation of the institutional autonomy that Spanish universities are granted by law. We argue that only with a certain level of hierarchy, which is not provided by the pure collegial model, will it be possible to define objectives and goals, and establish the management systems capable of achieving them. It will also allow for the tough decisionmaking needed in the competitive environment and by an extremely demanding society.

References

- Bonaccorsi, A. and Daraio, C. 2007. Theoretical perspectives on university strategy. In Bonaccorsi, A. and Daraio, C, Ed. Universities and Strategic Knowledge Creation. Specialization and Performance in Europe. PRIME Series. Cheltenham: Edward Elgar.
- Enders, J. 2004. Higher education, internationalisation, and the nation-state: Recent Developments and challenges to governance theory. Higher Education 47: 361-382.
- ERAWATCH 2008. Activities of the EU member states with regard to the reform of the public research base. <http://cordis.europa.eu/erawatch/index.cfm?fuseactin=intService.display&topicIC=585>. Accessed 15 November 2009.
- Esterman, T. and Nokkola, T. 2009. University Autonomy in Europe I. Exploratory Study. European University Association. European Commission. 2007. Green Paper. The European Research Area: New Perspectives. COM (2007) 161 final. April 4.
- European Commission. 2009. Assessing Europe's University-Based Research. European Commission – DG Research. Expert Group on the Assessment of University-Based Research.
- European University Association. 2005. Glasgow declaration: Strong Universities for a strong Europe", European University Association. <http://www.eua.be/publications/>. Accessed 30 June 2009.
- European University Association. 2007. Lisbon declaration: Europe's Universities beyond 2010: Diversity with a common purpose. European University Association. <http://www.eua.be/publications/> Accessed 10 February 2009.
- Huisman, J. 2007. The Anatomy of Autonomy. Higher Education Policy 30 (3): 219-221
- Laredo, P. 2007. Revisiting the Third Mission of Universities: Toward a Renewed Categorization of University Activities? Higher Education Policy 20 (4): 495–500.
- OECD 2007. On the edge: securing a sustainable future for higher education. Report of the OECD/IMHE-HEFCE Project on Financial Management and Governance of Higher Education Institutions. Education Working Paper n° 7.
- Sánchez, M.P.; Elena, S. and Castrillo, R. 2009. Intellectual Capital dynamics in Universities: A reporting model. Journal of Intellectual Capital 10(2): 307-324.
- Schimmank, U. 2005. New Public Management and the Academic Profession: Reflections on the German Situation. Minerva 43: 361-376.

Public communication of research as informal science governance

Hans Peter Peters, h.p.peters@fz-juelich.de, *forschungszentrum jülich*

The paper develops the conceptual model of a mass media based informal governance process for an ongoing project on science governance, and it presents empirical results from a previous project that support the appropriateness of this framework. The basic thesis is that public constructs of research, scientific knowledge and - current or possible future - innovative applications, in particular those visible in the mass media, are received within the scientific community and have steering effects there. I.e. the assumption is that decisions in the research process are influenced

by actual or expected media response to that research and its (expected) outcomes. While the model and the basic thesis are rather general, the mentioned project analyzes these using the neurosciences as a case study.

The expected media effect is conceptualized as a form of “informal governance” because it does not rely on a specific institutional setting but on the mass media’s general function for societal self-governance, and because the impacts are contingent: first, researchers and research organizations have several strategies of dealing with media coverage; secondly, the public constructs of research, knowledge and application are co-shaped by science’s involvement in public communication. Nevertheless, these media constructs also represent normative expectations of the media audience as well as of societal stakeholders, in the case of the neurosciences from the health system, religion or economy, for example. Media coverage of the neurosciences contains cues regarding what kind of research will be considered relevant outside science and what kind of research will meet or hurt normative expectations – positive ones (e.g. therapies) and negative ones (e.g. violation of privacy by thought reading, violation of animal rights, risks for human test subjects).

Empirical results from an international survey of biomedical researchers suggest, in line with Weingart’s “medialization of science” thesis, that scientists are indeed sensitive to media constructs of their research when making decisions in the research process (e.g. choice of research topics, methods, cooperation partners, timing of publications). A survey of decision-makers in the biomedical field also suggests that media coverage is relevant for policy-making. Acting according to media constructs and adapting to expectations expressed there, and trying to shape those expectations by PR strategies, may be a way for science to legitimize research and avoid more explicit and formal science governance. It is thus a more anticipatory and “tentative” mechanism than formal science governance.

Collaborative practices and technological trajectories in large pharmaceutical firms

Ismael Rafols,^{1,2} Alice O’Hare,¹ Antonio Perianes,³ Michael M. Hopkins¹ and Paul Nightingale¹

¹ SPRU –Science and Technology Policy Research, University of Sussex, i.rafols@sussex.ac.uk

² Technology Policy and Assessment Center, Georgia Institute of Technology,

³ SClmago Research Group. University of Madrid

Introduction

It has been claimed that the advent of biotechnology about 30 years ago resulted in a shift in the pharmaceutical industry from an innovation system based on vertically integrated firms to a network structure in which large pharmaceuticals integrate knowledge from a variety of actors, including dedicated biotechnology firms (DBFs) and public research organisations (PROs) (McKelvey et al., 2004). However, there is no evidence that such a shift in industry is having a revolutionary impact on either the provision of healthcare or economic development (Nightingale and Martin, 2004; Hopkins et al. 2007). The investments in biotechnology have highly increased R&D expenditure without significant increases in drug output. Instead of a disruptive industrial path, biotechnology is following a well-established incremental pattern of technological change and accumulation that builds upon, rather than disrupts, previous drug development heuristics.

The purpose of this project is to investigate how large pharma accumulates technological competencies via its interactions with DBFs, PROs, and other organisations in the new regime, which has been characterised as dominated by network-based or distributed innovation.

Methods

We have analysed the publications of the world’s 15 largest pharmaceutical firms from 1995 to 2009. This included the acquisitions, mergers, and subsidiaries of each firm using data from Recap database (www.recap.com) and the individual firm’s annual reports. We selected only document types ‘Article’ ‘Letter’ ‘Note’ ‘Proceeding Paper’ and ‘Review’. This yielded a total: 160,841 records, which were cleaned, processed and analysed using the software *VantagePoint*.

Results

The total number of publications by large pharmaceutical firms has decreased over the last 15 years if one takes into account the publications previously generated by firms that have been absorbed via acquisitions and mergers (see Figure 2). This total decrease in the number of publication is due to a reduction in the overall European-based output, with major decreases observed in the UK, Switzerland and France. The US and Germany maintain their total output. The number of publications by large pharma laboratories in the emerging economies has increased but still remains comparatively low (e.g. 30 pubs/year by Singapore against 1,200 pubs/year in the UK in the last 5 years).

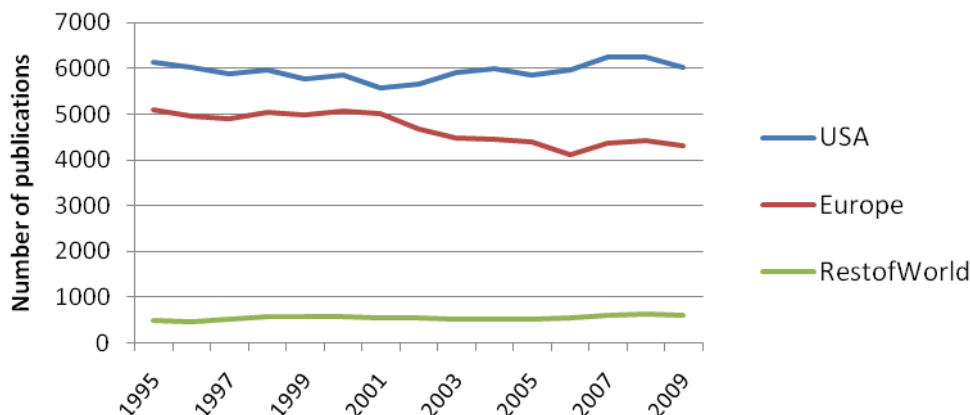


Figure 1. Number of publications by large pharma laboratories.

However, the percentage of pharma publications written in collaboration with other organisations (mainly PROs) has increased by about 60% in Europe and the US. Collaborations with organisations outside Europe or the US have increased more than 120% in the same period. Nevertheless, the collaborative output is still modest in developing countries: less than 120 pubs/year in China in 5 last years, compared to more than 1,200 pubs/year in the UK.

We have also tracked changes of the thematic portfolio of a firm's research, i.e. a proxy of its technological trajectory, building on novel mapping techniques as shown in Figure 2 (Rafols and Meyer, 2010, Rafols et al., 2010). Preliminary results suggest an increase of diversity in the disciplinary portfolio, with a relative decrease of publications in the core disciplines of pharma (such as Biochemistry pharmacology), and a relative increase in more peripheral and applied areas, such as Urology, Ophthalmology, Psychiatry or Rheumatology.

Conclusions

This study supports the view of a shift in the search regime of pharmaceutical firms from internal R&D towards external sourcing and diversification of knowledge –as shown by the absolute decrease in number of pharma publications, but the significant increase in the number of collaborations with PROs. This suggests a pattern by which large pharmaceutical firms acquire and diversify capabilities by buying smaller DBFs and interacting with public research, while at the same time closing down their 'traditional' R&D centres. Such pattern fits with recent analyses stressing the failure of internal pharma R&D to increase drug output in the last decade in spite of biotechnology promises, which is being addressed by means of externalisation of R&D activities (Munos, 2009; Stanley and Morgan, 2010).

The next step of the project is to unveil whether the new technological trajectories are developed in-house, or via alliances and acquisitions. By combining analyses at both social and cognitive spaces, we aim to reveal the co-evolution of pharmaceutical collaboration networks and the new technological competences.

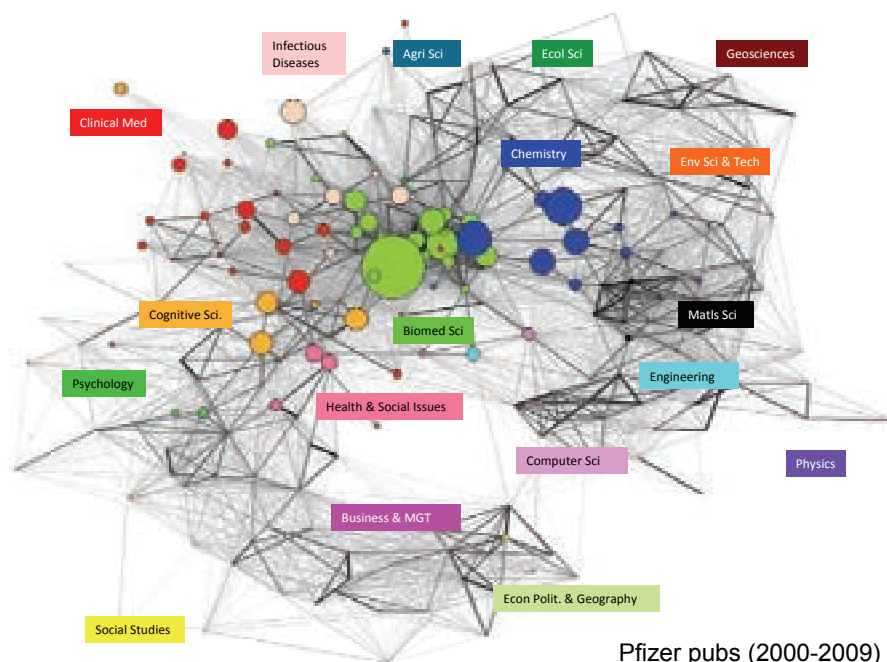


Figure 2: Disciplinary areas of publication of Pfizer (UK) from 2000 to 2009.

References

- Hopkins, M.M. et al. (2007) The myth of the biotech revolution: An assessment of technological, clinical and organisational change. *Research Policy* 36, 566–589.
- McKelvey, M., Orsenigo, L. and Pammolli, F. (2004). Pharmaceutical analyzed through the lens of a sectoral innovation system. Sectoral innovation systems. Concepts, issues and analyses of six major sectors in Europe. F. Malerba. Cambridge, Cambridge University Press: 73-120.
- Morgan Stanley (2010) *Exit research and create value*; Morgan Stanley Research Pharmaceuticals.
- Munos, B. (2009), Lessons from 60 years of pharmaceutical innovation, *Nature Reviews Drug Discovery*; 8; 959-968.
- Nightingale, P., Martin, P. (2004) The myth of the biotech revolution. *Trends in Biotechnology* 22, 564-569.
- Rafols, I. and Meyer, M. (2010) Diversity and Network Coherence as indicators of interdisciplinarity: case studies in bionanoscience. *Scientometrics*. 82(2), 263-287.
- Rafols, I., Porter, A. L. and Leydesdorff, L. (2010). Science overlay maps: a new tool for research policy and library management. *Journal of the American Society for Information Science and Technology*, 61(9), 871–1887.

Scientific Uncertainty, Risk, and Democracy - the case of India

Ravi Rajan, rajanwork@gmail.com, University of California, Santa Cruz

During the past decade, scholarship in the field of Science and Technology Studies (STS) has contributed greatly to our understanding of the interface of risk, science, and democracy. Most of this literature is however on the advanced industrial nations of North America and Western Europe, with little of note on democracies in the developing world. The proposed research project will address this gap by focusing on India, the largest democracy in the third world. It has two parts. Firstly, it will examine three recent controversies that cast light on the social, economic and political contexts that drive the interactions between scientific uncertainty, expertise, policy making and implementation in that context. These controversies are about: a) the processes of environmental impact and hazard analysis in India (studied with the case of the decision about siting a large dam (Tehri) in a seismic Himalayan region); b) policy making on chronic environmental risks such as pollution (approached through the case of the CNG controversy in Delhi); and c) regulating emergent risks (addressed via the case of Bt Brinjal controversy). Secondly, it will explore the viability of STS, as a domain of expertise, to contribute to the building of the new environmental regulatory institutions being built in India today.

Citizens, Visions and Research Agendas – Balancing between Analysis and Deliberation

Mikko Rask¹, The National Consumer Research Centre, Finland

Anders Jacobi⁹, The Danish Board of Technology, Denmark

Zoya Damianova[∞], ARC Fund, Bulgaria

mikko.rask@ncrc.fi

In recent years there has been an increasing interest in “mixed” foresight processes, in which citizens together with experts and stakeholders contribute to strategic intelligence building, thus supporting policy formulation. In the design of such processes it is essential to balance between the roles of analysis and deliberation. Analysis and expert contributions are needed to ensure the relevance and competence of the process, whereas broad-scale deliberations are needed to introduce new perspectives and emerging issues into governance agendas. In the design of such processes, however, it becomes difficult to find a balance between the two components. Too much focus on analysis risks losing the authenticity of deliberative contributions, whereas too much emphasis on broad-scale deliberation risks introducing processes disconnected from their governance contexts. In our presentation we discuss how these issues have been approached in an on-going research project, CIVISTI. The CIVISTI methodology builds on the interplay of foresight and participatory technology assessment, where citizens produce their visions of the future, while stakeholders and experts have the challenging task to “translate” these visions into S&T issues and policy options, thus supporting the process of developing FP8. In the final stage of the process citizens will consolidate the results by adding their comments, and validating - accepting or rejecting - the suggested policies, priorities and processes.

In our view, CIVISTI is innovative in creating “compartmentalized” spaces and productive linkages between citizens and experts in a participatory process aiming at long-term foresight and strategic intelligence building. Similar approaches have previously, and successfully, been tested in the context of risk governance. Unlike in the context of analyzing the risks of specific scientific or technological applications where prevailing societal interests and interest groups can be pronounced, in long-term normative visioning of future such interests and interest groups are not that clear. In risk assessment the role of citizens and societal stakeholders is to clarify norms and preferences and they are confronted with normative positions that mainly are politically established, commonly shared (between different interest groups) and conjoined with substantial knowledge claims and arguments. In long-term foresight normative positions are tentative, highly variant (between different actors and groups), and disjointed from substantial scientific or technical knowledge. These differences in the status and quality of normative claims imply particular methodological challenges, and as we will argue, increases the demand for the high quality of “translational” work by experts and analysts in the context of participatory foresight, and for a new understanding of “authenticity” (of citizen voices and contributions).

Considering the types of methodological challenges that are characteristic to the CIVISTI methodology, in Table 1 we present three “translational stages” in which experts or analysts have specific contributive roles: 1) *prompting stage*, where they are to decide upon the guidelines and stimuli provided for future visioning by the citizens, as well as steer the process of visioning of the future, 2) *analytical stage*, where they are expected to identify commonalities and differences emerging from the visions (the same experts involved during the prompting stage), and 3) *recommendation stage*, where they (experts and stakeholders not being involved in the previous two stages to avoid any bias during their work) have the responsibility to converge citizen visions into actionable policy recommendations. With each stage we characterize the main challenges by identifying “analytic traps” (or risks of overly emphasizing expert contributions and categories) and “deliberative traps” (or risks of overly emphasizing non-expert contributions and categories); and indicate related CIVISTI methodology choices with resulting methodological impacts.

¹ Contact: Mikko Rask, National Consumer Research Centre, P.O.Box 5, 00531 Helsinki, Finland. Email: mikko.rask@ncrc.fi.

⁹ Contact: Anders Jacobi, The Danish Board of Technology, Toldbodgade 12, DK-1253 Copenhagen K, Denmark. Email: aj@tekno.dk.

[∞] Contact: Zoya Damianova, ARC Fund, 6, Alexander Zhendov Str., 1113 Sofia, Bulgaria. Email: zoya.damianova@online.bg,

Table 1 Methodological challenges in the CIVISTI approach

| | "Analytic traps" | "Deliberative traps" | CIVISTI choice | Methodological impact |
|-----------------------------|---|---|--|---|
| Prompting stage | over-definition of problems by experts | un-effective focus of future visioning | minimal constraints for future visioning | high variety of visions and forms of "wishful thinking" |
| Analytical stage | re-establishing prevailing classifications (e.g. PESTE) | lack of categories and overview | moderate level of aggregation | high number of thematic clusters with little comparative insight |
| Recommendation stage | sticking to scientific "realism" | misunderstanding of citizen visions (due to a lacking explanation of vision background) | thematically directed reading of visions and devising of recommendations | focused recommendations reflecting original visions and prevailing research agendas |

In evaluating the balance of "analysis" and "deliberation" in CIVISTI, the two first stages of the process (prompting and content analysis) lead to an emphasis in the deliberative dimension of the process. This in turn lead the experts and stakeholders in a difficult situation, where they should use their expert evaluation and knowledge in devising recommendations that help to bridge citizens' visions into actionable research agendas.

Our preliminary experience is that the design of CIVISTI helped the experts to arrive at interesting and innovative results (for example, citizens in the EU are interested in participatory methods, eager to have radical environmental innovations and develop new forms of human-machine interaction). There are a number of factors that contributed to this. First, even though the "cognitive distance" between citizens visions and expert thinking lead to an initial difficulty of understanding the (scientific) quality of the data (i.e. citizens' scenarios or visions); openly discussing the suspicions by the experts in a "ice-breaking" session prior to the expert workshop helped turn the skepticism into a curiosity towards the forthcoming "societal experiment". Second, while working with the visions, experts were organized in thematic groups working with specific themes with the support of a professional facilitator. This helped the experts to focus on their deliberations and report them effectively. Third, while many of the recommendations include proposals that can be connected to the particular research backgrounds of the experts (e.g. youth or foresight expert proposing educational or futuristic research and policy measures), the instruction of the organizers to make recommendation on particular (and tractable) citizen visions, and the awareness of the forthcoming "validity check" by the citizens, on the other hand, supported the experts to think in the context of the visions.

It is yet too early to say, whether the citizen panels that will validate the experts' recommendations, will find them loyal to the original visions and effective in supporting their realization. In thinking about the role and possibility of a "validity check" in a process that is full of translations, not only linguistic (which should not be underestimated) but between analysts, citizens, experts, stakeholders, and finally policy makers, the traditionally strong criteria of "authenticity" (of citizen voices) becomes obsolete. We acknowledge that all translational efforts should be faithful to the original aspirations of the contributing visionaries. If misunderstanding takes place, however, it can be the motor of productive discussions (as reminded by one of our experts), and what will finally count is the elaboration of the visions in different steps of the process leading to their added value.

Governance as a policy instrument for shaping the higher education systems balancing between autonomy, accountability and academic freedom

Emanuela Reale, CERIS CNR, e.reale@ceris.cnr.it

Objective and aims

The reform of the Governance is one of the main topic on the government agenda for public research organisations, either HEIs or PROs. Changes in the distribution of power, shaping vertical and hierarchical relationships, setting autonomy of the work floor level, and decentralisation are the main features of the HE reforms of the last 20 years in most European countries, generally informed to the managerial paradigm.

In this paper we test the assumption that governance of the HEIs is a instrument of the policy action (Lascoumes, Le Galès, 2004), balancing between autonomy, academic freedom and accountability, affecting the relationships between the State, the HEIs, the intermediaries and the stakeholders. According to the approach by instruments, the paper assumes that path dependency affects the mode of governance, thus the balance between these three factors, as it tends to maintain stable the national HE configuration (Musselin, 2004).

Methodology

We look at the changes of the HEIs' governance over the last 20 years. We take Italy as example in order to analyse the changes of governance across time. Italy is a particular case of long-time unchanged organisational assets of universities (Clark, 1977), where the implementation of reforms has been constrained by policy legacy and academic prominence, despite the Government attempts to steer the system (Reale and Potì, 2009). Recent developments in Government policies are supposed to impact Universities (HEIs) governance, by using both the funding lever and research evaluation, and maintaining a strong emphasis on University autonomy, which grounded on the national basic laws, and was definitely implemented at the end of eighties.

Results

The implementation of autonomy in Italy follows different phases. In a first period (90s) because of the maintenance of the continental model of governance, Italian Universities reacted by enlarging the spaces of academic freedom. In a second period (late 90s) a reverse process started. Governance was not modified, but Government tried to constrain Universities through rules, standards and cutting to the core funding. A more recent government initiative (late 2000s) intervened directly on the space of manoeuvre of the Universities, through a new regulation for the governance, the funding lever as well as the compliance with some standards for the educational activities. Path dependency strongly affected both the government and the organisations' initiatives, changes in the national configuration did not intervene, but phenomena of hollowing out of some HEIs and a general reduction of the equity of the HE system.

References

- Albach P.G. (2001), *Academic freedom: International Realities and Challenges*, The Netherlands, Kluwer Academic Publishers
- Capano, G. (2008), "Looking for serendipity: the problematic reform of government within Italian universities", *Higher Education*, 55, (pp.481-504)
- Clark, B.R. (1977): *Academic power in Italy*, Chicago, The University of Chicago Press
- Huisman J (2007), "The anatomy of autonomy", *Higher Education Policy*, 20, 219-221
- Lascombes P., Le Galès P (2004), *Gouverner par les instruments*, Presses de la Fondation Nationale des Sciences Politiques, Paris
- Moscato, R. (1991), "Italy", In Neave, G. and van Vught, F.A. (eds.), *Prometheus Bound. The Changing Relationship Between Government and Higher Education in Western Europe*, Pergamon Press plc, (pp. 91-108)
- Musselin, C. (2004): *The long march of French Universities*, Taylor and Francis (Routledge), New York
- North D. C. (1990), *Institutions, Institutional Change and Economic Performance*, Cambridge, Cambridge University Press
- Reale E., Potì B. (2009), "Italy. Legal policy legacy and moving to an "in-between" configuration", in Paradeise C, Reale E, Bleiklie I and Ferlie E., *University Governance: Western European Comparative Perspectives*, Dordrecht, Springer

Comparing settled and emerging governance arrangements from a biographical-narrative perspective: the cases of hydraulic engineering and virology

Erwin van Rijswoud, MSc, Radboud University Nijmegen, e.vanrijswoud@science.ru.nl

Biographies of insiders are a valuable resource in understanding the development of policy arrangements from a micro perspective. Not just the history of a governance arrangement, but also the role of leading actors, their considerations and learning processes can be ventured into by studying the biographies of these actors. This presentation will discuss how a biographical-narrative approach can be used to analyze the role of scientists in governance. We demonstrate this by comparing two cases: a relatively novel and tentative arrangement (virology), and a longer existing and stabilized arrangement (water security). A particular focus is on how the aspect of settled and emerging governance arrangements not only impacts the expert roles in policy making, but also emerges in the experts' self-narratives. By probing into years of development of experts, we come across changes of roles, the conditions leading up to that, and the learning process in the performance of expertise.

Based on interviews, source materials and track records, the expert careers are written down as coherent and empirically-grounded narratives, thereby 'explicating an intrinsically meaningful form' (Polkinghorne, 2005, 93). Rather than being the only true reconstruction of past experiences and events, the narratives constitute one possible approach to ordering them coherently. As to the methodological validity of the narratives that emerge in this manner, it is important to see that the production process of narratives takes place on various levels. The first level is the level of the actual events as experienced by the experts involved, the so-called *lived story* (Rosenthal, 2005, p. 27). Subsequently, in the interviews the experts are invited to narrate and reflect on these events retrospectively and from a certain distance. This level can be referred to as the *told story*. Finally, as a result of the interactions, post hoc reflections and reframings between interviewee and researcher, the *written story* as a third level of narrative emerges

(Littig, 2008, par. 17). We take the expert's self-narratives to not just be a source of stories and experiences, but also an extension and a re-presentation of the expert role, that is, the self presentation of experts in interviews mimics their role and performance in situations pertaining to their expert role as such (viz. Goffman, 1959).

As said, the approach is deployed in two cases: virology and hydraulic engineering. Although both human and veterinary virology were settled scientific disciplines, with the advent of new infectious threats in the 1980s (HIV/Aids, BSE, viruses in seals) and the late 1990s (avian influenza, foot and mouth, bioterrorism) the appeal on scientists to take the lead in combating these risks did not orient on research alone (see Van Rijswoud, 2010). Besides probing extensive new research agendas, virologists were also involved in the construction of policy arrangements. Given the pressing need to come up simultaneously with scientific answers, health policy and public communication, a great responsibility resided with scientists to combine these three challenges. What we see is not just how these virologists, as constructors of these arrangements, cope with these challenges, but also how they integrated themselves in these arrangements.

Hydraulic engineers' involvement with politics is not novel; since the late 19th Century their role can be characterized as an early 'displacement of politics' (Schot et al., 2010, p. 367 f.f.): the transfer of agenda setting and problem solving to (expert) bureaucracy. We thus see that the challenges these experts face are channeled and accommodated in existing networks and platforms. Only recently, with reform in advisory councils and the prolongation of the ecological turn in engineering (Disco, 2002) did the engineer's role in politics lose its casualness (Van Rijswoud, In prep.). Unlike with virology, it aren't specific individuals who occupy a position in the arrangement, but professorial chair holders. Expert roles thus are subject to inheritance, and are more formalized.

In methodological and comparative sense we come to draw a number of conclusions. The first is that although the biographical method provides a good micro and development perspective of experts in policy, this internal perspective of mainly self reported events and experiences provides only one sided information on the relations between policy actors, and the political meaning of individual experts. If the aim is to go beyond this self reported narratives, informant interviews should be included extensively. Secondly, when scientists are involved in emerging governance arrangements, the individual scientist and the arrangement become tied together as the arrangements become more settled. They, in short, become 'fossilized' in the arrangements as time progresses, and this can both speed up policy making, as well as hamper it (see Van Rijswoud, 2010, pp. 163-4). Thirdly, for experts in emerging governance arrangements the interactions between policy making and public communication are more as important agenda setting tools than for expert in settled arrangements, whom need not resort to public communication. Finally, the 'settledness' of governance arrangements and the related involvement of experts is not permanent; the more settled governance arrangements, e.g. in hydraulic engineering, can be disrupted, creating conditions that mimic those for truly novel and emerging arrangements. This creates a novel environment for the experts involved to which they have to adopt, and it does involve a resort to public communication as an agenda setting tool.

DISCO, C. 2002. Remaking "Nature": The Ecological Turn in Dutch Watermanagement. *Science, Technology and Human Values*, 27, 206-235.

GOFFMAN, E. 1959. *The presentation of self in everyday life*, New York, Anchor Books.

LITTIG, B. 2008. Interviews mit Eliten - Interviews mit ExpertInnen: Gibt es Unterschiede? *Forum Qualitative Sozialforschung*, 9, 37 paragraphes.

POLKINGHORNE, D. E. 2005. Narrative Configuration in Qualitative Analysis. In: MILLER, R. (ed.) *Biographical Research Methods*. London: Sage

ROSENTHAL, G. 2005. Biographical Research. In: MILLER, R. (ed.) *Biographical Research Methods*. London: Sage.

SCHOT, J., LINTSEN, H. & RIP, A. (eds.) 2010. *Technology and the Making of the Netherlands: The Age of Contested Modernization, 1890-1970*, Cambridge, MA: MIT Press.

VAN RIJSWOUD, E. 2010. Virology Experts in the Boundary Zone Between Science, Policy and the Public: A Biographical Analysis. *Minerva*, 48, 145-167.

VAN RIJSWOUD, E. In prep. Engineering Expertise: Hydraulic Engineers and the Accommodation of the Ecological Turn in The Netherlands.

Constructive Technology Assessment on ecological genomics: challenges and strategies for reflexive learning

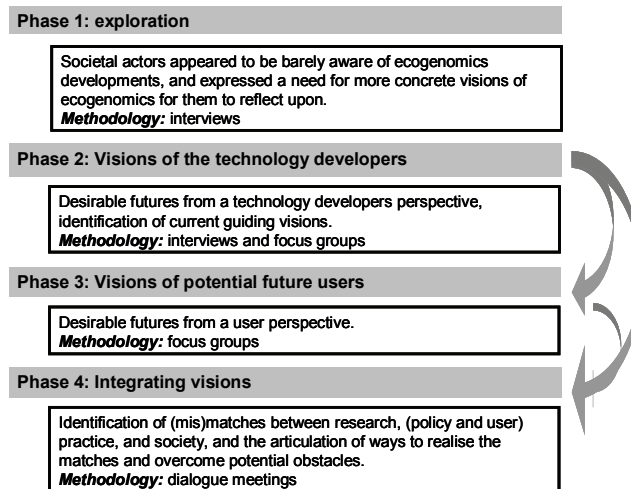
A. Roelofsen, J.E.W. Broerse, J.F.G. Bunders

anneloes.roelofsen@falw.vu.nl, Athena Institute, Vrije Universiteit

Within the framework of the Dutch Ecogenomics Consortium we organised a four year interactive learning and action process (based on Constructive Technology Assessment, CTA (Rip and Misa 1995)) to broaden agenda-setting on ecological genomics. Organising a process of knowledge co-creation within the context of a large national research programme is challenging. The organisation of the research is mostly discipline based, and incorporating social science

research in large R&D collaborations does not automatically imply willingness of technology developers to interact with a diversity of publics. To overcome these challenges, the CTA process on ecogenomics specifically aimed to facilitate reflexive learning between participants.

The process was designed in multiple rounds of interaction, and aimed to stimulate reflexive learning between technology developers and societal actors. In order to address the future oriented character of ecogenomics, we combined our CTA approach with Vision Assessment (Grin and Grunwald 2000). The CTA process was structured in three subsequent steps (see figure 1). First, interviews and focus groups were held with technology developers to investigate the current guiding visions in ecogenomics (Roelofsen, Broerse et al. 2008; Roelofsen, Kloet et al. 2010). Subsequently, groups of potential future users (e.g. farmers, soil companies, hobbyist gardeners) reflected on ecogenomics from their own perspectives in focus groups (Roelofsen, Broerse et al. 2010). As a last step we designed two dialogue meetings that aimed to facilitate a deliberative process between ecogenomics researchers, potential future users and actors related to policy-making (Roelofsen, Boon et al. accepted pending minor revisions).



Throughout the process, technology developers had a central place in reflecting on their practice from a societal perspective. This proved to be crucial to get them committed to the process. Furthermore, technology developers and future users developed and articulated their desirable futures for ecogenomics separately, before entering a dialogue. This gave them the opportunity to get acquainted with the technology, think about related societal aspects, and develop their ideas about desirable future developments. During the dialogue meetings, reflexive learning was observed between technology developers and future users. Participants jointly succeeded in the identification and formulation of matches between science and practice and related short-term actions. Also longer-term effects of the process have been observed on a cross-institutional level (expanding networks and new initiatives), program level (actions of the ecogenomics consortium), and individual level (ecogenomics researchers rethinking their research approach, aims and objectives). Nevertheless, the effects on the research of the Ecogenomics Consortium do not seem to correspond with the reflexive learning observed and the action plans made.

Clearly, the CTA process on ecogenomics functioned as a protected space. Beyond this protected space, factors like power relations, institutional structures and system dynamics, limit the room to manoeuvre and influence the follow-up of results. For example, the discipline-based structure of the Consortium posed a challenge to CTA process, which ideally requires adaptability: options to be open for exploration, and funding possibilities for social relevant opportunities that are being discovered and defined along the way. In this paper we reflect on this challenge of embedding CTA within research programmes, and on potential strategies to institutionalize CTA as a new mode of governance.

Grin, J. and A. Grunwald (2000). Vision assessment: shaping technology in 21st century society; towards a repertoire for technology assessment. Berlin, Springer.

Rip, A. and T. J. Misa (1995). Managing technology in society: the approach of constructive technology assessment. London etc., Pinter.

- Roelofsen, A., W. P. C. Boon, et al. (accepted pending minor revisions). "Shaping the future of emerging technologies in research consortia: Learning in multi-stakeholder dialogues." *Research Policy*.
- Roelofsen, A., J. E. W. Broerse, et al. (2008). "Exploring the future of ecological genomics: Integrating CTA with vision assessment." *Technological forecasting and social change* 75(3): 334-355.
- Roelofsen, A., J. E. W. Broerse, et al. (2010). "Engaging with future technologies: how potential future users frame ecogenomics developments." *Science and Public Policy* 37(3).
- Roelofsen, A., R. R. Kloet, et al. (2010). "Guiding visions in ecological genomics: a first step to exploring the future." *New Genetics & Society* 29(1): 19-36.

Promising Science, Managing Expectations: Constructing UK Biobank as a Promising Technology

Alex Rushforth, University of Surrey, a.rushforth@surrey.ac.uk

This poster will draw from and expand upon earlier research from my Masters dissertation, which analysed the construction of performative texts in publicly-available UK Biobank documents and webpages. A number of quotes have been purposively sampled in order to illustrate findings and arguments generated by the research (to be discussed and demonstrated around the poster). Research on the 'sociology of expectations' is used to elucidate the rhetorical construction of these texts, and the interests and assumptions they carry.

Background

UK Biobank is a large-scale biomedical database set-up recently in the UK by the Medical Research Council, Wellcome Trust charity and Department of Health, which attempts to collect, store and distribute biomedical samples, lifestyle information and medical details of 500,000 British adults. Volunteers donating their information are asked to return for follow-up studies so as to provide longitudinal data on how health and diseases develop over time. Some of the 'banked' resources will be made available for withdrawal by researchers, in both public and private institutions.

As Gottweis and Petersen (2008) observe, biobanks are seen as being of central strategic importance to the future knowledge economies of many developed nations. Indeed biobanks are said to be at the 'cutting-edge' of developments in post-genomic knowledge creation and application, with advocates emphasising the promise they offer as powerful social technologies for the future. In 2009, Time Magazine listed biobanks as one of the 'Top 10 ideas changing the world right now'.

Despite such promises, there are also fears and concerns over the potential misuse of UK Biobank, as well as questions about its scientific and strategic importance and efficacy. The project has undoubtedly placed great emphasis on conducting 'genuine' *engagement* and *dialogue* with its audiences, in an effort to allay their misgivings. However some critics have questioned both the execution of these governance measures and their motives (Corrigan & Petersen 2008).

Hitherto UK Biobank and similar projects have provoked a great deal of STS discussion around ELSA-based issues. However, perhaps surprisingly, biobanks have for the most part escaped explicit attention from 'sociology of expectations'. Most of the questions which have concerned the expectations literature can be applied readily to UK Biobank, as a prominent example of prospective technology based on a powerful set of promises, specifically to alleviate real-time material needs, create a future 'moral economy', and strengthen the future 'health and wealth' of the UK. Likewise there are a number of voices projecting counter-visions, thereby carrying alternative sets of interests.

Purpose

The purpose of this poster is to critically consider the promissory rhetoric deployed by UK Biobank and delineate some of the interests and assumptions behind them. The rationale for displaying (mainly) quotations is to generate discussion about future discourses and narratives constructing performative representations of UK Biobank. The quotes also enable us to consider the tensions that can arise in creating publicly available information, which must fulfil commitments to be *open* and *engage* with the public over the intended development and usage of UK Biobank, whilst simultaneously exercising promissory work essential for interesting and enrolling participants. I will be on hand to outline where these two interests intersect the quotations and the implications of rhetorical strategies used to resolve them.

UK Biobank has made large quantities of documents publicly-available from its official website. Documents and the website's written texts were used as data sources. Emergent themes were compared with 'experiential data' (Strauss 1987) drawn from sociology of expectations studies. The dissertation was limited to a text-based analysis, although it is instructive to consider the primary purposes of official websites to attract and inform interested actors. As such the homepage (including written texts) presents an idealised 'frontstage' representation of the organisation.

Findings

Although the precise character of the promises are related to certain temporal and spatial parameters unique to the project's development (Borup et al. 2006), there are a number of characteristics which those interested in promissory texts will find familiar. The quotations capture key performative elements in the texts including agency, time and velocity (Michael 2000).

The 'retrospecting of prospects' and the 'prospecting of retrospects' (Brown & Michael 2003) are apparent, whereby expectation statements were mediated through performative representations of past and present technoscientific promises. Its narrative form typically begins with positive statements about past or current progress. This is quickly followed by a deficiency statement proclaiming significant inadequacies and the importance of a future where these can be overcome. Finally 'narrative joints' emerge, as characters linking the deficient present to a desirable future (Wilkie & Michael 2009). At various points, the narrative joint is either UK Biobank itself or the 'heroic' participants of the project.

Whilst certain quotes are promissory and anticipatory in a relatively straightforward sense, others appear explicitly deflationary and tentative in their projections about the purposes and applications of the project. This would appear to correlate with Ratto's (2006) observation that biobanks are deliberately more cautious in their promissory language than earlier large-scale genetics-based initiatives such as the Human Genome Project.

However, analysis found the form and content of these statements to carry still the strategic interests and assumptions of the organisation. For instance, statements informing the reader of the longitudinal time-scale of the project's expected 'pay-off' also carry performative representations of a present lacking UK Biobank, and of a future in which the project appears to be facilitating uninhibited linear progress in medical science.

Discussion

The analysis serves as a reminder that although institutions such as UK Biobank may not make the kind of 'wild' promissory statements found in other areas of the biosciences (see Fortun 2001), they still offer hope to audiences, some of whom will undoubtedly have real-time material needs. There are a number of reasons for ambivalence to these findings, as despite possible benefits, there is a possibility that these promises may not be delivered; that they carry the interests of some groups and not others; and that they can be based on (sometimes erroneous) sets of assumptions. As such, the dilemmas of expectation-building (Brown 2003) seem to apply just as much to biobanking as any other area of innovation in contemporary biomedical science.

Weak signals in the governance of emerging technologies: the case of nanotechnology

Petra Schaper-Rinkel, Petra.Schaper-Rinkel@ait.ac.at, AIT Austrian Institute of Technology GmbH

What is regarded as nanoscience and nanotechnology (NST) today is a field formed and shaped by various actors and in the end negotiated in the political sphere. The field of nanotechnology policy is not determined by government nor by industry or science, it evolves in a contingent – but nevertheless structured – process of governance where multiple actors interact in a dynamic setting. Within this processes, signals indicating the possibility of future change – "weak signals" – attracted increasing attention.

Regarding weak signals in a positivistic tradition as given entities that indicate future change, one could say that the former weak signals were ('correctly') identified by scientists, industry, policy-makers and so NST became an emerging issue in science and innovation policy. Regarding weak signals in a post-positivistic way (and emphasizing that governance studies need to analyze how fields of emerging technologies are constructed through discourse), weak signals can be understood as "boundary objects" that link different social worlds, such as science, politics, industry, NGOs and media. In this view the way signals become relevant (regarded first as weak signals and then as elements of an emerging technology) itself is part of the governance process. In this paper we examine the development of the governance of nanotechnology as a case in which weak signals are simultaneously identified and constructed, assessed and shaped and along the way constructed.

The weak signals that became relevant for the governance of nanotechnology were related to three main emerging issues within the governance of Nanotechnology: first, the issue of identity and boundaries of the emerging technology – to distinguish between realistic and unrealistic expectations: What are the most far-reaching yet achievable opportunities of nanoscience and nanotechnologies? What are weak signals for future change, what are signals 'only' rooted in science fiction? Second, the issue of relevance: What are (weak signals for) the most promising directions for future nanotechnology research and development and what are the criteria for assessing its relevance? Third, regulatory issues, where weak signals indicating future risks are highly disputed: how to speed up development of nanotechnologies while avoiding risks.

This paper discusses how actors from government, academia, industries, and civil society negotiate the boundaries of nano-science and nano-fiction by identifying, assessing, shaping, and contextualizing weak signals. The aim of the paper is to analyze the role of weak signal in complex governance processes and in different governance approaches.

Economic principles and scientific practice: The case of research groups in the field of advanced materials research.

Anna Schleisiek, KIT, Karlsruhe, anna.schleisiek@kit.edu

The “Anti-economic economy” of science, how Pierre Bourdieu has termed it, is the specific form of scientific self-interest, characterised by unselfishness, gratuitousness¹ as well as the ability to sense where prestigious research topics lie and the strive for recognition amongst colleagues (Bourdieu 1998). It is the “altruism that pays” as in other economies of symbolic goods, which is the primary characteristic of the scientific field. In this quality lies the difference from the “ordinary” economy, which is centred on material goods. The autonomy of the scientific field can be measured in its ability to stay true to these characteristics and by the degree to which forces within the scientific field are independent of the forces from other social fields. To Bourdieu, it is the ability of the fields’ actors to break or specifically form constraints or demands from other social fields, which determines the scientific fields’ autonomy.

During the last 20 years research governance in European countries has been transformed. Germany is a recent case for this transformation, leading to a more market oriented research governance (de Boer et al. 2008). All Institutions of the publicly funded research system in Germany such as Universities or Research Organisations are affected by this process, which is driven by „initiatives“ from the political field. One can identify two main objectives of these “initiatives”, one is directed at the organisation of scientific practice, where in order to achieve excellence through competition, economic principles are implemented as organisational principles following the idea of the market-form as best organisational principle. The other objective is directed at the commercialisation of research results, which should be increased in order to achieve economic growth for the society through innovation. A popular example for this new research governance is the introduction of New Public Management (NPM), with which instruments from business administration are introduced into universities as organisational principles. A popular approach to characterise this transformation is the term “Economisation” (Ökonomisierung) (e.g. Schimank 2008, Weingart 2008), describing it as a process of adoption or enhancement of economic principles of action into non-economic social spheres, here into the scientific field (Schimank 2008). While this process affects all disciplines and institutions of the scientific field in some way, emerging technologies are a special case. More than in any other technological field, researchers are expected to fulfil societal expectations of innovation and economic growth. But while new Governance instruments are being implemented into Germany’s public research organisations, there is still little empirically based knowledge on the scientific practices in the field of emerging technologies or on the effects of this new governance on scientific practices in this or other scientific fields. But do the “classic” characteristics of scientific practices even apply here? To fully understand the implications of this new research governance for this scientific field the analytical focus has to be directed at the micro-level and take research team’s day-to-day practice into focus.

How is the scientific practice of research teams in advanced materials research affected by the introduction of economic principles through new modes of governance? With this poster I will introduce my PhD Project addressing this research question. Further research questions are: What are demands and expectations these research teams have to meet? What roles are 2 organisational settings, here Universities and Germany’s two major publicly funded research organisations, playing for research teams’ scientific practices? These questions will be addressed in a micro-sociological study using methods of qualitative social research like participant observation in a case study approach comparing the research teams in different organizational settings. With this poster I will focus on the analytical framework guiding my study, which is based on theoretical concepts by Pierre Bourdieu and Robert K. Merton and on the empirical design of the study.

References

- Bourdieu, Pierre, 1998: *Vom Gebrauch der Wissenschaft*. Konstanz: UVK Universitätsverlag Konstanz.
- de Boer, Harry F., Jürgen Enders and Uwe Schimank, 2008: Chapter 3: Comparing Higher Education Governance Systems in Four European Countries. Pages 35-54 in: Soguel, N. C. and P. Jaccard (Ed.): *Governance and Performance*.
- Schimank, Uwe, 2008: *Ökonomisierung der Hochschulen - eine Makro-Meso-Mikro-Perspektive*. Pages 622-635 in: Rehberg, Karl-Siebert (Ed.): *Die Natur der Gesellschaft*. Frankfurt am Main/ New York: Campus.
- Weingart, Peter, 2008: *Ökonomisierung der Wissenschaft*. Pages 477-484 in: *NTM: Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin*. Basel

The emergence of a "global challenge" policy priority: an analysis of Scandinavian countries' S&T policy responses to climate change

Lisa Scordato, Antje Klitkou, Trond Einar Pedersen

Norwegian Institute for Studies in Innovation, Research and Education NIFU STEP, tep@nifustep.no

Introduction

The Scandinavian countries constitute a rather similar group of countries in terms of culture, societal values and institutional set up, but their economic and industrial specialisation differ significantly. In Sweden, Norway and Denmark the nearly four decades after 1973 have been decisive in shaping the current energy structure.

The objective of this paper is to examine how core concepts in transition management theory can be used as an analytical model for understanding policy processes of handling climate change and energy transitions in the Scandinavian countries. Questions to be answered include: (i) what type of energy transition occurred in the three countries? (ii) what made them successful (or not)? (iii) how do the transitions reflect differences in national energy policies? (iv) How can differences be explained and what can we learn from this?

Theoretical framework

Drawing upon transition theory (Kemp and Loorbach, 2007) we describe and make a comparative analysis of the changes that have taken place in the three Scandinavian countries' energy systems over the last decades. The empirical analysis of the cases is directed towards three distinct levels of policy, from the transition literature: *the strategic level* (processes of vision development, strategic discussions, and long term goal formation), *the tactical level* (processes of agenda building, coalition building) and *the operational level* (policy instruments, implementation through agencies). Moreover, a framework for policy integration is derived comprising three types of policies:

1. *Science policy*: sustainability assessments of system innovations, studies of past and ongoing transitions, focusing on the role of policy and usefulness of various governance models;
2. *Innovation policy*: the creation of innovation alliances, R&D programmes for sustainable technologies, the use of transition experiments, and alignments of innovation policies to transition goals;
3. *Sector policy*: niche policies (through procurement, regulation or the use of economic incentives), the removal of barriers to the development of system innovations, and formulation of long term goals and visions to give direction to research and innovation.

In this paper three possible transition pathways are considered: *incrementalism*, *goal oriented modulation* (or *transition management*) and *planning*.

Methodology

The data for the empirical cases was collected by reviewing the grey literature (articles in news papers, policy documents and reports). The data is to a large extent based on data collected for a policy project on energy and innovation policy in the Nordic in 2008. The analysis concluded on common and diverging characteristics, challenges, framework conditions, energy-technology specialization and finally, on cases of good practice in key technologies (Klitkou, Pedersen, Scordato, & Mariussen, 2008). Data also included information collected through meetings with energy technology experts and policymakers from the Nordic countries. For the purpose of this article newer data has been added where available and relevant.

Transition management towards energy sustainability in the Scandinavian countries

In Sweden, strong government policies put significant pressure on the energy system to adopt cleaner forms of energy. Electricity generation in Sweden today is almost fossil-free, with nearly 50% of electricity production from hydro power and the remainder from nuclear power. During the last decade the share of renewable energy has increased rapidly, with biomass accounting for the largest part of that increase. The vision in Swedish energy policy is that the country will obtain all its energy from renewable energy sources in the long term.

Similarly, the Norwegian government supported clean electricity production. The result today is that nearly all electricity generation originates from hydropower. However, the petroleum driven economy of Norway is confronted with specific challenges in efforts to combine and reconcile profitable oil and gas extraction with ambitious climate and environmental goals.

In Denmark, coal and natural gas are still extensively used for district heating and electricity production, despite of very good results regarding renewable energy sources. Denmark has also made strong efforts for improved energy efficiency, and strengthening of the electricity grid. The Government is also supporting renewable energies, with especially wind power as a successful example.

The energy mix in the Scandinavian countries reflects the different pathways of energy sector innovation and industrial development over the last 30 to 35 years. Energy policy has certainly played an important role. After the oil crisis in 1973 Scandinavian governments developed different strategies to address the crisis and to ensure the security of energy supplies. The different strategies revealed that the countries organized energy policy in different ways. The different paths of energy policy in the Nordic countries have resulted in the establishment of country-specific organization of energy policy and energy R&D funding systems.

Conclusions

Two recurring features seem to matter: the long-term horizon and dedication of central actors towards a reasonably specified objective, and the systemic nature of the development processes. Long-term horizon and dedication of central actors imply the presence of a policy system, an R&D system and industrial actors who share views and beliefs about future options and scenarios. A reasonably strong degree of policy integration between science, innovation and sector policies has been present, implying coordination of efforts and thereby incrementalism in the transitions towards common objectives. The event history analysis indicates that there has been a clear shift in the countries energy policy priority in the first decade of the 21st century. In parallel with international trends national policy makers have adopted the paramount goal of climate change in strategy making and rhetoric about energy transitions. Policy makers in all three countries follow the international and EU jargon and are thereby transferring it to the country specific conditions and policies. The question ahead is whether the three countries are able to reinforce the four decades of transition towards sustainable development as a response to the international and national policy domains. There are forces of path dependency and inertia, in Norway in relation to fossil fuels regime and in Sweden in relation to nuclear power, which are challenging the policy integration between science, innovation and sector policies in particular.

References

Kemp, R., Loorbach, D., & Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development and World Ecology*, 14(1), 78-91.

Automation of Transport, an emerging technology still in the making.

Claus Seibt, claus.seibt@ait.ac.at, AIT Austrian Institute of Technology GmbH

Classical areas in the field of EST are genomics, synthetic biology and converging technologies. Looking at past emerging science and technologies, hindrances and drivers “in the making of these technologies” can be observed and the changing modes of governance along the technology path-ways can be reconstructed and discussed. The approach behind this research is to look from a policy study perspective at sequences of governance within the emergence of new technologies. As a first example it will be looked at the automation or cybernation of transport, which started as EST in the 50ties or even earlier and is today if you are looking at particular areas like road transport “still an emerging technology.

The cybernation of transport is still an emerging technology. The vision or Leitbild of automation of transport is deeply attached to the cybernetic paradigm engraved in transport engineering practice. Although transport engineers today often ask themselves, why automation in transport should further proceed, and if driverless and autonomous systems are really reasonable, there is still a strong trend to further follow the paradigm. Even the converging technologies are discussed now, to have the driver connected by driver assistance system to the automat turning from cybernation to a perspective of cyborgation.

The paper will explore the sequence of governance (modes of governance) along the paths of an emerging technology (in this case automation of transport), and will then try to systematize and look at other emerging technology fields (which started later to emerge). He will explore if there could be a typology of certain modes of governance for particular stages in the emerging (sequence).

On one hand this approach may be too courageous, because EST areas are much too different in context. On the other hand modes of technology governance may be much stronger driven by current and past institutional arrangements and with that different types of governance reproduced.

Building governance in Portugal: some reflections upon the Digital Cities and Regions Program

Maria João Simões, University of Beira Interior and University of Minho
Domingos Santos Polytechnic Institute of Castelo Branco and University of Minho
domingos.santos@ese.ipcb.pt

The purpose of this article is to contribute for the debate about the construction of governance spaces which guarantee the continuity of the regional development public policies, thus articulating actors and optimizing strategic projects in order to improve regional competitiveness and sustainability.

The call by European Union policymakers for wider and more direct involvement in improving European governance is coupled with the increased usage of new information and communications technologies by public administrations across the EU. Portugal is involved in a catching-up process with high investments in the areas of

innovation and ICT infrastructures, nonetheless governance remains a field of action that deserves further attention and discussion.

Based on the analysis of the Portuguese Digital Cities and Regions Program, we argue that the interest in the “digital” has been constructed around a rather narrow set of empirical and theoretical issues concerning mainly to technological innovation, neglecting other strategic political areas, such as the politics of governance and state re-territorialization around the city-region, the technological and social innovation, the role of democracy and citizenship in city-regions politics, and tensions around social reproduction and sustainability across the city-regions. These questions will be analysed and discussed in the light of the Portuguese experience and some final considerations will be outlined concerning the weaknesses and strengths of digital cities and regions governance. The analytical work was based on observations in different Portuguese digital cities and regions with the ultimate goal of increasing regional competitiveness and cohesiveness.

Governance theories and concepts came from entrepreneurship domain but rapidly overtake disciplinary boundaries and inform a great diversity of areas namely development and innovation, and scientific and technological policies. We attend a paradigm change from government for governance facing the problems complexity, the speed of change and the growing uncertainty, namely of the impacts of science and technology. This research area is yet relatively new attending a proliferation of concepts and theories.

Against other scientific domains namely, Jayal (2009)¹ pointed out that social scientists share the assumption that the governance is more concerned to processes and results than the existence or the number of institutions; in this sense, governance institutional design is essentially a means rather than an end itself. As Graham *et al.* (2003:2)² also says governance “is not only about where to go, but also who should be involved in deciding, and in what capacity”. Governance itself is not good or bad, depending of the chosen processes, of the achieved goals and of the quality of goals.

We consider the governance of cities and regions in the knowledge economy as a form of concerted action by a number of actors that takes place in a dynamic context that can only be partially influenced by policy. The move towards e-governance not only impacts the efficiency and effectiveness of public service but also has the potential to transform the nature of government interactions with both individuals and businesses. The governance encompasses not only a reduction of government centrality but also a capacity to manage the social set (Mayoukou *et al.* 2003:13)³. There is the need of new forms of regulation intermediate which connect public, private, economic and social interests, which become compatible the efficacy, the efficiency, the legitimacy, the transparency, and also the justice and the equity.

From the governance concept and the dimensions presented by Edgar *et al.* (2006)⁴ and also by OECD (2004)⁵, we take into account the next analysis dimensions for digital cities and regions: (i) strategic vision and leadership; (ii) stakeholders and people participation; (iii) organization and performance; (iv) accountability.

The evidence provided by this research work shows that investments in ICT infrastructures, although very necessary, haven't been sufficient to create a sustainable knowledge-based in Portugal. Most initiatives under the Digital Cities and Regions Program have been leading to interventions very much focused on infra-structure and undervaluing intangibles. There are no standard solutions for cities and regions; knowledge-based development depends on the specificities of their institutions, history and culture – it is, in fact, path dependent.

The results into digital cities and regions were very different. Nevertheless, there seems to be some common features shared by “winners” cities and regions among them were some governance dimensions:

- ✓ the existence of political will and commitment;
- ✓ the existence of dynamic leadership
- ✓ the ownership of a rigorous diagnoses adjusted to the context;
- ✓ a strategic framework to guide action;
- ✓ the building of effective and diversified partnerships;
- ✓ the creation of mechanisms to stimulate innovation and support the creation, dissemination and sharing of information and knowledge;
- ✓ the level of academic qualification of the human resources as well as an attractive context for the establishment of the knowledge workers.
- ✓

¹ Jayal, Niraja (2007), “Review essay: On Governance”, *Current Sociology*, nº 55, pp. 126-135.

² Graham, J., B. Amos and T. Plumptre (2003) *Principles for good governance in the 21 st century*, Ontario: Institute On Governance, Policy Brief nº 15.

³ Mayoukou, Célestin *et al* (2003), *Gouvernance du Développement Local*, Paris: L'Harmattan.

⁴ Edgar, Laura *et al* (2006), “Partnerships: putting good governance in practice, Institute on Governance”, available in http://www.iog.ca/publications/2006_partnerships.pdf [2007].

⁵ OECD (2004), *Principles of Corporate Governance*, available in <http://www.oecd.org/dataoecd/32/18/31557724.pdf> [2008].

But even in “winner” cities and regions some crucial governance dimensions were not taking into account: the people participation and the accountability issue.

The “loser” digital cities and regions share the following features:

- ✓ difficulties to change from a (e)government model to (e)governance one;
- ✓ the difficult of partnership implementing and functioning and of involving a more representative and wide-ranging number of actors, namely crucial actors connected to the innovation systems;
- ✓ the necessity of developing mechanisms that deepen their strategic reflection capacity;
- ✓ the need of investing, in each territory, in a more articulated way information society policies with industrial, innovation, scientific research and urban and regional policies.

Within this perspective, our analysis calls for policies that consider long term approaches of dynamic environments, which require to be continuously monitored and evaluated. Regional and city managers’ and planners’ attention could – indeed should – shift towards the ‘softer’ but critical issues of filling the knowledge, expertise, innovation and governance gaps.

Stimulating and fostering socially innovative projects has become a vital and necessary component of urban and regional social change. More in-depth research is needed into the governance of knowledge economy. The study of territorial e-governance practices throughout the world is an area that clearly requires ongoing research.

Key-words: governance, innovation, social innovation, territory, digital territories.

Governance in Action—Continual Permutations of Practices and Structures. The Example of Society and Genomics Intermediaries

Peter Stegmaier, University of Twente, p.stegmaier@utwente.nl

Governance, innovation in governance, and the governance of emerging sciences and technologies (EST) is mostly addressed in terms of the policy issues (like a specific technology and its governance), political contexts, wider frameworks of legal regulation and ethical reasoning, problems to be governed and solutions to be probed, and even of normative technocratic and democratic claims. This is only half of the picture. This paper puts emphasis on “governance in action”, on situated negotiation and institutionalization, and on the interactionist *understanding* of innovation journeys of governance.

This conference’s theme assumes that some ‘governance’ plays with tentativeness and flexibility (unlike “steering”, or the direct execution of power). It further assumes that “governance’ becomes tentative when it is designed as a dynamic process to manage interdependencies and contingencies. ‘Tentative governance’ typically aims at creating spaces of openness, probing and learning instead of trying to limit options for actors, institutions and processes. It answers political and organizational complexities with *explorative* strategies, instead of relying only on orthodox or preservative means.” (conference website)

While, e.g., science policy-making may try to promote desired effects, the actor constellations and institutional arrangements, deliberations and decision-making may be too complex as to reach aims straight on. Yet, easy solutions are not in sight. Research and policy-making often seem to undertake somewhat ad hoc movements in search of the right constellations and opportunities, strategies and breakthroughs. Thus, it is even more important to investigate on the scene how in practice sense is made of science governance under such conditions, and how this can be theorized by conceptual means sensitive enough for everyday governance practices and for the ongoing social change under which governance is enacted.

What this paper suggests is the necessity to look at governance practice in its situatedness, in its processual (re-/de-) ordering, and that this can be achieved best through an explorative approach to governance analysis. This approach is called praxeographic, as it is characterized through “ethnographic” methods of investigation in the middle of the governance processes that shall be focused upon. The foundation of this approach is derived from social-constructivist, interactionist and ANT theorizing which enable the researcher to trace governance in its daily enactment and processuality. This is meant as an alternative to rather structuralist/systemic, normative, positivist, and speculative approaches.

Empirical examples stem from field research on the institutionalization of science intermediaries in the Netherlands and the United Kingdom.

Governance challenges in the field of Synthetic Biology

Dirk Stermerding, Bart Walhout, Rathenau Institute, The Hague, The Netherlands
d.sterderding@rathenau.nl

Synthetic Biology is the latest prime example of a new and emerging field conceived as 'key technology of the future' which may lead to a 'next industrial revolution'. In this paper we discuss (tentative) governance in this field as a challenge which relates to both *opportunities* for innovation and *concerns* about societal and ethical implications. In policies of innovation we can observe a recurrent pattern, whereby emerging technologies on the one hand are perceived in terms of opportunities by those acting as promoters of a particular technology, and on the other hand are perceived in terms of concerns by groups in society acting as critical responders. This pattern has a clear precedent in the history of the GMO debate and is also clearly visible in the case of synthetic biology. In response to this pattern, attempts are being made to bridge the traditional gap between policies of innovation and policies of regulation. Thus, we see a move in policies of innovation, especially in the European Union, to so-called 'responsible innovation' which proposes to integrate studies of ethical, legal and social implications (ELSI) and activities of technology assessment (TA) into innovation programmes in the field of emerging S&T, including nanotechnology and synthetic biology.

In the international literature the aim of responsible innovation has been connected to the notion of 'anticipatory governance'. This notion is based on two key assumptions. The first assumption is that, in understanding the societal implications of innovation, *anticipation* is important because emerging technologies are shaped by visions of future, that is by promises and expectations about future applications and societal progress on the basis of which investments are made in new and emerging technologies. The second assumption refers to the notion of *governance*, that is to the point that emerging technologies are shaped by complex interactions between a variety of actors rather than top-down government. From this perspective of anticipatory governance, TA activities should not focus on the societal impacts of technology (which still have to materialize), but on the choices made in the process of innovation and the promises and expectations which inform these choices. Moreover, activities of TA should not only address decisions of the government (as has been often the case in more traditional forms of TA), but will have to involve a variety of stakeholders in society. In this way, TA contributes to the aim of responsible innovation by stimulating a timely and collective process of learning and assessment.

Responsible innovation, however, not only has implications for the approach of TA in terms of 'anticipatory governance'. It also implies a distinction between two different kind of challenges that have to be considered in activities of TA. On the one hand, emerging S&T may challenge existing *regulatory frameworks* in society. Thus, synthetic biology is seen as raising future challenges for established regimes of regulation relating to biosafety, biosecurity and intellectual property rights. On the other hand, emerging S&T may also challenge deeply rooted *normative and symbolic conceptions* in society, as for example notions of fairness and equality, or conceptions of nature and life in the case of synthetic biology.

In this paper we argue that in the face of these two different kinds of challenges, the modes and requirements for responsible innovation will also be significantly different. Whereas issues of regulation will already be highly framed by existing governance arrangements relating to questions of risk and ownership, processes of normative and symbolic sense making are much more open and diverse. In the first case, the main challenge is how to organise proactive and reflexive processes of learning in order to cope with new issues of regulation arising from developments in synthetic biology. In the second case, governance involves a much more demanding task of defining spaces in which normative and symbolic concerns can be articulated in the context of particular and future opportunities and applications of synthetic biology.

Genomics as a new innovation regime: implications for governance

Dirk Stermerding, Roel Nahuys, University of Twente, d.sterderding@utwente.nl

The rise of genomics in the field of human genetics involves significant changes in the practices and the networks in which knowledge is produced. In the literature this transformation has been described as a transformation from an internal 'hidden' research system, embodied in a network of hospital based laboratories and clinics, to a more expanded external research system, linking academic and commercial interests in the field of human genetics. In this paper we consider this transformation as the evolution of a new *innovation regime* and we discuss the implications of this transformation for the *governance of knowledge production*.

As a starting point for our discussion, we introduce a multilevel perspective in which we conceptualize a multi-actor world of innovation by different poles, representing the different activities which characterize a process of innovation. In this world we identify particular innovation regimes by describing (1) the identity of actors involved, (2) the kind of knowledge and products exchanged, (3) the rules of co-ordination, and (4) the relations and divisions of labour between actors. Then, we will show how, in terms of our conceptual framework, genomics may be described as a new innovation regime characterized by a mode of co-ordination that, compared to earlier clinically oriented

research practices in human genetics, is much more top-down and data driven and is guided by general promises of scientific and societal progress. As such, this genomics innovation regime reflects changes in the larger innovation landscape, as is testified by the history of the Netherlands Genomics Initiative (NGI). Finally, we will discuss the implications of this new innovation regime for the governance of knowledge production, focussing on practices of 'valorisation'. In the efforts of NGI, valorisation has been defined mainly in economic terms, emphasizing the commercialisation of knowledge in genomics innovation. Although this notion of valorisation nicely fits in with the new genomics innovation regime, it also seems to neglect other modes of knowledge transfer in health innovation.

International collaboration in nano S&T as a change mechanism in research institutes¹

Inga Ulnicane-Ozolins² and Stefan Kuhlmann, University of Twente
i.ulnicane-ozolins@utwente.nl, s.kuhlmann@utwente.nl

As search for novelty and originality is one of the main characteristics of science (e.g., Merton & Storer, 1973), an important question is about institutional and organizational arrangements that support continuous search for new knowledge. Established institutions and organizations over time tend to develop their routines, path-dependencies or even inertia (e.g., Peters, 2005; Scott, 2008). These features might be important for ensuring some stability and predictability but they also might hamper emergence and development of new knowledge.

Empirical evidence from the emerging field of nano S&T³ suggests that international research collaboration among public research organizations (institutes and universities) can be one of the mechanisms⁴ individual scientists and research institutes use to develop new research topics and initiate and support new research groups⁵. If existing resources of scientific organizations are typically pre-allocated to established research lines, the initiation of international collaboration (e.g., in the form of a collaborative research project) can help to mobilize additional intellectual, technical and financial resources needed to explore new topics. In established physics and chemistry research institutes international interdisciplinary collaboration can be one of the mechanisms to start new research lines and research groups in nano S&T, thus, facilitating change of *de facto* (formal and informal⁶) governance of research institutes along thematic, organizational and resource dimensions⁷.

While international research collaboration might be a rewarding strategy when it succeeds in finding a new mix of knowledge and skills and developing novel research lines, it can also be a demanding effort taking into account high competition for international projects and effort needed to build a productive collaboration and reconcile different organizational cultures, financial and reward systems. Therefore, an important question is *under what institute level conditions international collaboration acts as a sustainable change mechanism allowing development of new important research lines and groups? And when thematic and organizational changes triggered by international collaboration might be difficult to sustain?*

Empirical evidence suggests that international research collaboration is a more efficient change mechanism when it is supported by three types of *complementary* measures. Firstly, *recruitment and empowerment of early career researchers* (PhD students and Post Docs) can facilitate change for a couple of reasons. Young researchers could have less investment in and thus less attachment to established research lines and collaborative arrangements of the institute. Moreover, early career researchers typically spend more time on research and less on administration (Merton & Zuckerman, 1973 [1972], pp. 524-525), which could also help them to explore and establish novel research lines. Secondly, international research collaboration is more likely to work as organizational change strategy if it receives *hierarchical support from organizational leadership* and is *linked with existing research lines and organizational structures* in the institute. Thirdly, new research lines and research groups initially supported by international collaboration could be more sustainable over longer term, if they could also receive financial support from other funding types such as *institutional funding* and *national project funding*.

However, empirical data also reveal a number of institute level conditions under which changes initiated by international collaboration *might not be sustainable*. Firstly, one of the risk factors is *high financial dependence* of new

¹ This presentation is based on research funded by the Deutsche Forschungsgemeinschaft (FOR 517).

² i.ulnicane-ozolins@utwente.nl

³ Within this ongoing research project, so far 36 semi-structured interviews have been undertaken (February 2009-June 2010) with nanoscientists collaborating internationally in German, Dutch, Belgian and French public research organizations (institutes and universities).

⁴ Other ones include recruitment, mobility, personal grants, new in-house collaborations or national projects.

⁵ International collaboration is not always used as a change mechanism, as it can also be pursued to support existing research themes and groups but such situations fall outside the theme of this presentation.

⁶ Based on North's (1990) approach to institutions, which includes formal rules, their enforcement and informal conventions and codes of behavior.

⁷ Operationalization of governance of research institutes along thematic, organizational and resource dimension is based on Heinze & Kuhlmann (2008).

research lines and groups on *international collaborative projects* over a longer period of time. As the success rates in international project competitions are typically lower than in national project competitions and international projects are also administratively more demanding than national ones, it might be difficult to sustain new research line or group mostly on international funding. Secondly, it might also be risky if a new research line and group has *limited links to established research organization*. Thirdly, international research collaboration might not promote organizational change in a sustainable way if it is based only on initiative of individual scientist (group leader) and does not have a support from hierarchal leadership and/or organizational culture.

As international research collaboration brings together scientists located in different national research organizations with different mixes of supportive or hampering factors, the same collaboration might act as a change mechanism more in some collaborating organizations than in others.

Heinze, T., & Kuhlmann, S. (2008). Across institutional boundaries? Research collaboration in German public sector nanoscience. *Research Policy*, 37(5), 888-899.

Merton, R., & Storer, N. (Eds.). (1973). *The Sociology of Science. Theoretical and Empirical Investigations*. Chicago: The University of Chicago Press.

Merton, R., & Zuckerman, H. (1973 [1972]). Age, Aging, and Age Structure in Science. In R. Merton & N. Storer (Eds.), *The Sociology of Science. Theoretical and Empirical Investigations* (pp. 497-559). Chicago: The University of Chicago Press.

North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

Peters, B. G. (2005). *Institutional Theory in Political Science: The 'New Institutionalism'* (2nd ed.). London: Continuum.

Scott, W. R. (2008). *Institutions and Organizations: Ideas and Interests* (3rd ed.). Los Angeles: Sage.

Research teams as complex systems and implications for research governance

Eleftheria Vasileiadou VU University Amsterdam, eleftheria.vasileiadou@ivm.vu.nl

Keywords: research governance, complexity, complex systems, collaboration, ARIMA

Research collaboration has increased in both the natural and social sciences. Especially in science policy circles scientific collaboration is actively promoted. However, collaboration costs: overhead resources, additional coordination efforts, time spent to understanding each other's results. These challenges are more pronounced in distributed collaborations, which require distinct governance mechanisms.

Even though scientific collaboration has been on the increase, there is little theorizing on scientific teams. The paper aims to fill in this gap, by introducing a conceptualisation of a research team as complex system, with the aims to (1) utilise dynamic methodologies; (2) identify appropriate governance mechanisms.

Collaborative research teams operate as complex systems, whose dynamics are driven by interactions between their members and elements of their contexts. There are three levels of dynamics that shape the collaborative team: the local, the global and the contextual dynamics. Local dynamics refer to the activities of the individual researchers in their local institutes. Local dynamics give rise to global (team-level) dynamics that are shaped by them: processes such as team-wide communication, coordination, productivity, conflicts and conflict-resolution mechanisms. Contextual dynamics refer to the impact of the contexts in which the team belongs to, which shape and constrain the local and global dynamics: the scientific context but also the wider socio-political context which may provide funding, relevant audience for the results etc.

The paper builds on a longitudinal study of two distributed research teams, reported in previous articles. Both teams were Framework Programme collaborations. DELTA was a research team consisting of eight local groups, and studying the impact email in organisations. ERICOM was a team of eight local groups from European countries, studying the use of Web for the science-technology-economy system.

Complex systems have fuzzy boundaries that separate them from and connect them to their embedded contexts. Elsewhere, I have analysed how the concept of complex systems can help us distinguish the relevant contexts of a distributed research team (Vasileiadou 2009b). These different contexts are very influential, among other things, on the eruption and development of conflicts in the team. In both teams all conflicts were, at least partially, caused by tensions between: (i) governance structures at the local level where the individual researchers were working every day; (ii) the governance structures that emerged in a more or less formalised manner at the level of the team; and (iii) governance structures posed or emergent in the context in which the team was embedded: the broader European research context with the funding agency as an influential part of this. Given the de facto multiple leadership levels in FP distributed collaborations, conflicts can also be caused because of different interests and objectives of the individuals having the multiple leadership roles.

In a subsequent study (Vasileiadou 2009a), the conceptualization of the two teams as complex systems enabled the use of ARIMA modelling of the team communications, which allowed for empirical identification of the level of complexity in each team. Different types of ARIMA models indicated different degree of complexity: the

extent to which the models were stationary or not, the sign of the coefficient, and the need for differencing (integrated models). More precisely, DELTA was identified as having lower degree of complexity, with team-wide online communications that were described by stationary models and formulas with negative coefficient values, which indicated a negative feedback loop. ERICOM was identified as having a higher degree of complexity, with non-stationary models, path dependence indicated by integrated models and formulas with positive coefficient values, which indicated positive feedback loops.

In a subsequent paper on the two teams, we studied the link between productivity and the level of communication of the researchers, exploring the governance needs of the two teams (Vasileiadou and Vliegenthart 2009). We established that meetings hold a prominent place in the coordination of distributed teams, as they are positively linked with all measures of productivity. For the use of internet, however, the results were different. In the team with lower complexity, the positive effect of email communication on fractional productivity was smaller than for the team with higher degree of complexity. In collaborative teams with high complexity, the use of team-wide email as a coordination and communication mechanism makes a (positive) difference, more so than the team with low complexity. The study showed that teams with high complexity have higher coordination and communication needs than teams with low complexity.

The results suggest that collaborative research teams do operate as complex systems. First, the application of the concept in distributed teams suggested that there are three dynamics that merit investigation: the local dynamics; the global dynamics; and the contextual dynamics. From a research governance perspective this implies distinguishing governance mechanisms at these three levels, but also investigating how governance mechanisms at one level influence governance mechanisms at another level. Second, understanding teams as complex systems also helps gain an insight into different governance needs of and mechanisms for different types of teams: teams of high complexity seem to have additional coordination needs which can be covered, apart from face-to-face meetings, also by electronic communication.

This conceptualisation of research teams as complex systems can help us introduce a future research agenda. A number of hypotheses linking the three dynamics can be formulated and validated with the use of agent-based modelling. A model using individual researchers as agents, and starting from known rules of behaviour could explore how interactions at the local level bring about team-level phenomena and how contextual developments can influence research teams. Further, using multivariate ARIMA we can investigate the relationship between variables at the team level: How is task-oriented versus socio-emotional communication linked with productivity? To what extent do conflicts hinder team processes, such as efficiency?

As collaboration among researchers is increasing, and governance structures become the bottleneck, understanding research teams as complex systems, which connect to their environment through their porous boundary, which emerge from the local interactions between individual researchers, which strive to achieve their aims, and maintain themselves as systems, provides a unique advantage.

References

- Vasileiadou, E. 2009a. "Stabilisation operationalised: Using time series analysis to understand the dynamics of research collaboration." *Journal of Informetrics* 3:36-48.
- . 2009b. "Working Apart Together; Using ICTs in research collaboration." Unpublished PhD dissertation Thesis, Faculty of Social Sciences, University of Amsterdam, Amsterdam.
- Vasileiadou, E. and Rens Vliegenthart. 2009. "Research productivity in the era of the internet revisited." *Research Policy* 38:1260-1268.

Integrated nature design: lessons from the Veluwe border lakes in The Netherlands

Vikolainen V., Bressers J.T.A., Lulofs K.R.D.
University of Twente, v.vikolainen@utwente.nl

Emerging approach

'Building with Nature' is a new design approach for river-, coastal- and delta areas that lays emphasis on the integration of nature with infrastructural and economic conditions. This approach moves away from defensive design strategies that minimize negative effects towards designs that maximize eco-system potential. This implies using nature's status and dynamics as a starting point to create designs where new infrastructure is developed alongside improved eco-systems. The consortium of Dutch industry and academia is the main proponent of this approach, which they refer to as eco-dynamic design and development (EcoShape, www.ecoshape.nl). In our research the terms 'Building with Nature' and integrated nature design are synonyms.

Regulatory problem

In the past, defensive design strategies in the field of waterways and ports encountered difficulties complying with the EU Bird- and Habitat directives (79/409/EEC and 92/43/EEC) that form the legal basis for the Natura 2000 biodiversity

network. As a result, projects were often disrupted, delayed or cancelled, increasing public costs and causing political turmoil. Examples of legal disputes that involve the implementation of Bird- and Habitat directives are abundant in the Netherlands as well as the other EU Member States (van Hooydonk, 2006). A widespread image in the Netherlands is that economic developments are 'locked up' as the result of Natura 2000 implementation. Integrated or 'Building with Nature' designs have not yet been extensively applied in projects and their possibilities within Natura 2000 are not widely researched.

Research design and methodology

Our case study compares two coastal zone development projects in a quasi experimental design setting. Both projects are located in the Natura 2000 protected area Veluwe border lakes: Waterfront-North Harderwijk (Harderwijk) and Coastal zone Zeewolde (Zeewolde). Both authorities took the protected area into consideration: Zeewolde proposed an integrated ecological design, while Harderwijk aimed to offset negative effects on protected area against the positive. An active local NGO dedicated to the protection of birds lodged an appeal against both projects. Despite similar amount of biodiversity loss, geographical location and legislative framework in force, the Administrative Jurisdiction Division of the Dutch highest administrative court (the Court) ruled differently in each case: Harderwijk was reversed and Zeewolde was approved in 2008 and 2009 respectively (cases nr. 200706044/1, 200706194/1; and nr. 200800948/1). The researchers' interest was triggered by the question whether integrated nature design could, among other factors, explain the variance in judicial outcome. And if it did contribute to the judicial success of Zeewolde project, what can we learn about the application of such designs in Natura 2000 areas?

Case study results

Our case study presents a bottom-up reconstruction of project processes and uses modus operandi method (Scriven, 1976) to analyze seven rival explanations of the Court decisions. The influence of the following four factors was constant across cases and did not explain the difference in outcome: geographical borders of the Natura 2000 area; access to the Court for interested parties; the judicial review procedure and the implementation of Bird- and Habitat directives in Dutch legislation. The following three factors were most influential for the outcome:

Integrated nature design: the municipality of Harderwijk aimed to balance the negative and positive interventions on nature for the whole Waterfront area; positive interventions were but a combination of existing nature development plans without a clear overarching ecological idea. In Zeewolde, on the other hand, ecological design was fine-tuned to Natura 2000 conservation objectives at an early stage so that its final result supported recovery or even improvement of habitats of the protected species.

Project administration: three zoning plans were drawn up to incorporate various interests at stake in Harderwijk (recreation, industry and ecology, residential development). Nevertheless, the development of the whole coastal area proceeds as a single spatial plan since 1998. Over the years, its ecological design was repeatedly checked against changing nature conservation objectives and the last of such 'checks' did not follow the correct procedure as the municipality was under pressure to enact the zoning plan. In Zeewolde, residential and coastal (recreational) developments were separated early on, with residential zoning plan finalized first. Thereafter, it took two years to finalize the coastal development plan, without significant changes in conservation objectives taking place.

Scientific findings: In both cases the authorities carried out an ecological assessment and argued that no significant effects on nature would take place. However, the legislative framework does not specify any criteria for such assessments and scientific information in ecology always contains a degree of uncertainty. This makes actors' perception of the certainty provided by the scientific data a decisive factor. Zeewolde authorities handled this data with more confidence compared to their Harderwijk counterparts.

Lessons learned and way forward

Drawing on this analysis, we conclude that integrated nature design strengthens the chances of the project being approved in Court. Presentation of the scientific data could either strengthen or weaken the case in Court, depending on the actors' confidence in their own design and the way they handle the scientific data. Administrative complexity could, in the long run, undermine the extent of integration of nature into the design as well as the presentation of underlying scientific data. The implementation of Natura 2000 legislation sets a number of important conditions that must be taken in account but does not explain the variance in Court decisions. Therefore we argue that, once the legislation is implemented, room can and should be sought within the existing framework, to realize both economic and ecological goals. As the example of Harderwijk and Zeewolde shows, a coastal development project in a given Natura 2000 areas has more chances of success if its design integrates nature and provided that project administration and scientific findings are managed well.. Furthermore, integrated nature design is recognized by the European Commission as a strategy to facilitate infrastructure projects close to or within Natura 2000 protected areas. In its "Guidelines on the implementation of the Birds- and Habitat directives in estuaries and coastal zones" the European Commission recommends the "working with nature" concept to design projects (draft 03.06.2010, official

publication expected in 2010). Thus, integrated nature design could potentially offer a solution to existing regulatory issues.

References

- Case 200706044/1 and 200706194/1 *Waterfront-Noord* [22.10.2008] Administrative Jurisdiction Division of the Council of State, Afdeling Bestuursrechtspraak
- Case 200800948/1 *Kustzone Polderwijk Zeewolde* [29.04.2009] Administrative Jurisdiction Division of the Council of State, Afdeling Bestuursrechtspraak
- Directive 79/409/EEC on the Conservation of wild birds [25.4.1979] OJ L 103 p.0001-0018
- Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora [22.07.1992] OJ L 206 p.0007-0050
- EcoShape "Building with Nature", on-line www.ecoshape.nl
- European Commission, *Guidelines on the implementation of the Birds- and Habitat directives in estuaries and coastal zones; with particular attention to port development and dredging*. Draft version 03/06/2010. Older versions can be accessed from: <http://circa.europa.eu/Public/irc/env/estuary/library>
- Hooydonk, E., van, 2006. *The impact of EU environmental law on waterways and ports*. Sixth Framework Programme, Maritime Transport Coordination Platform. Maklu Press, Antwerp
- Scriven, M., 1976. Maximizing the power of causal investigations: the modus operandi method. In: G.V. Glass, ed. *Evaluation Studies Review Annual*. Vol. 1; Sage Publications: Beverly Hills/London, 101-118

Foresight as Tentative Governance Instrument – Evidence from Germany

Philine Warnke, Fraunhofer Institute for Systems and Innovation Research
philine.warnke@isi.fraunhofer.de

The paper is exploring the role of foresight as an instrument of research, technology and innovation (RTI) policy in a tentative governance context. We set out from expanding the concept of systemic policy instruments towards tentative governance phenomena and discuss the implications for foresight. As an empirical case the recent German BMBF-Foresight-Process is investigated. On the base of the findings we argue that foresight may play a major role in modulating tentative governance provided that it succeeds in opening up and re-framing established perceptions of emerging science and technology (EST) realms.

The emergence of tentative governance is suggesting a number of new approaches to research-technology-and innovation policy. If tentative governance becomes the dominant mode of re/configuration of innovation-systems, the ability to experiment may become an important indicator for innovation capability. Enabling fluidity, the ability to form tentative organisations-communities and quickly reconfigure into new ones based on the ease of establishing transparency and trust within diverse constellations of actors, may become a major RTI policy objective.

Modulating tentative governance may require continuously challenging established perceptions of emerging science and technology (EST) trajectories. Opening up EST arenas, fostering diversity (Könnölä et al. 2007) and breaking-up non-reversibilities (van Merkerk, van Lente 2005), may become as relevant for RTI policy as building durable platforms, consensus and shared visions.

Accordingly, "tentative policy instruments" will most likely stem from the portfolio of reflexive governance with an emphasis on collective learning and experimentation such as foresight, transition management, strategic niche management and constructive-technology-assessment (CTA).

However, as CTA scholars emphasised early on, these instruments are bound to evolve along with the broader societal context and will therefore take a different turn in a tentative governance framework.

In particular foresight may have a more prominent role to play. Due to its ability of opening up socio-technical spaces and learning platforms and of forming new combinations of diverse elements (Smits, Kuhlmann 2004) it seems a suitable approach to mediate "loci of intervention" (Rip, Schot 2002) in a more fluid governance context. Also within other instruments such as transition management or strategic niche management foresight approaches may be deployed more extensively when negotiation processes are more broadly established in society (Warnke, Heimeriks 2008).

Already now, when it comes to emerging science and technology issues, foresight is facing tentative governance situations. Unlike other instruments that set out from a given goal and clearly defined subjects, foresight rarely deals with already recognised fields of EST but is usually deployed in early phases of agenda-setting to identify ESTs in the first place. It is therefore often operating within a contested realm of diffuse and contradictory expectations (Brown et al. 2000).

In many cases, the very definition of an upcoming EST field is created-negotiated within foresight processes. In the early phases of nanotechnology and more recently in the case of "converging technologies" foresight processes played a major role in establishing shared definitions and concepts.

In a framework of tentative governance, this boundary setting work may become even more prominent. Foresight may increasingly find itself in the role of mediating demand oriented and “technology push” perspectives on EST issues in order to generate context specific “loci of intervention” for a wide range of diverse RTI settings.

However, setting-up new arenas within the established order of the RTI landscape is challenging to current foresight theory and practice. It means moving from a stance of optimisation of predefined pathways, or even exploration of different options towards imagining changes in the conditions of change – thereby experimenting with new sense making frames (Miller 2007). It also requires moving beyond the realm of science and technology that can be measured and investigated with scientometric methods towards the messy and complex world of socio-technical co-evolution and with the outcome. Finally, it requires a move from universal frameworks such as megatrends and key technologies to and the specific conditions of the local context at hand. Priorities stemming from such reflexive foresight processes will transcend established policy realms and disciplinary boundaries.

Today foresight rarely operates in this “disruptive” mode but rather remains within predefined EST perceptions. Many foresight exercises all over the world come up with similar priorities often echoing findings from prominent think tanks. Partly this is due to the methodological difficulty of questioning anticipatory assumptions. Another reason however is the deep entrenchment of existing perceptions of RTI dynamics into institutional contexts and in particular organisational structures across the RTI landscape. Defining what constitutes an “emerging science and technology field” enables actors to align expectations and mobilise resources (Borup et al. 2006). Therefore, proposing new configurations and re-opening “closed” debates means challenging power constellations (Hard 1993).

Organisations across the S&T landscape such as universities, research institutes, funding programmes and last but not least ministries (that often fund Foresight processes) are organised according to currently perceived EST realms. Proposing new configurations therefore often means challenging the very preconditions of the Foresight project.

The BMBF-Foresight-Process is a case in point. It did not set out to challenge existing RTI structures but in the contrary kept very closely to the categories of the well established paradigm of the German Hightech-Strategy. Nevertheless, in the course of the process these boundaries were partly revisited. The Foresight ended up with proposals for priorities for German RTI policy that transcend established disciplinary configurations and perceptions of EST arenas within the RTI landscape including the organisational structure of BMBF itself. In particular, two of the tentative priorities “human-technology co-operation” and “production consumption 2.0” are proposing a change of perspective and suggest the opening of new RTI arenas with a different set of actors. Based on the BMBF foresight experience we argue that in a context of tentative governance the degree of structural responsiveness of policy making bodies substantially influences its ability to modulate innovation trajectories.

- Borup, N.; Brown, N.; Konrad, K.; van Lente, H. (2006): The Sociology of Expectation in Science and Technology. In: *Technology Analysis & Strategic Management*, 18 (3/4), pp. 285-298.
- Brown, N.; Rappert, B.; Webster, A. (eds.) (2000): *Contested futures : A sociology of prospective techno-science*: Ashgate Publ. Ltd, Aldershot/UK.
- Hard, M. (1993): Beyond Harmony and Consensus: A Social Conflict Approach to Technology. In: *Science, Technology & Human Values*, 18, pp. 408-432.
- Könnölä, T.; Brummer, V.; Salo, A. (2007): Diversity in foresight: Insights from the fostering of innovation ideas. In: *Technological Forecasting and Social Change*, 74 (5), pp. 608-626.
- Miller, R. (2007): Futures literacy: A hybrid strategic scenario method. In: *Futures*, 39 (4), pp. 341-362.
- Rip, A.; Schot, J.W. (2002): Identifying loci for influencing the dynamics of technological development. In: Sorensen, K.; Williams, R. (eds.): *Shaping technology, guiding policy : Concepts, spaces and tools*. Elgar Publ. Ltd., Cheltenham, UK; Northampton, MA, USA, pp. 155-172.
- Schot, J.; Rip, A. (1997): The past and future of constructive technology assessment. In: *Technological Forecasting and Social Change*, 54 (2-3), pp. 251-268.
- Smits, R.; Kuhlmann, S. (2004): The rise of systemic instruments in innovation policy. In: *International Journal of Foresight and Innovation Policy*, 1 (1/2), pp. 4-32.
- van Merkerk, R.; van Lente, H. (2005): Tracing emerging irreversibilities in emerging technologies: The case of nanotubes. In: *Technological Forecasting and Social Change*, 72 (9), pp. 1094-1111.
- Warnke, P.; Heimeriks, G. (2008): Technology Foresight as Innovation Policy Instrument: Learning from Science and Technology Studies. In: Cagnin, C.; Keenan, M.; Johnston, R.; Scapolo, F.; Barre, R. (eds.): *Future-Oriented Technology Analysis. Strategic Intelligence for an Innovative Economy*. Springer, pp. 71-87.

New Modes of Governance of Complex Systems in the Era of Autonomous Technology

Johannes Weyer (Technische Universität Dortmund), johannes.eyer@tu-dortmund.de

New modes of governance

New technology allows for new modes of governance, which go beyond traditional modes of decentralized self-regulation (“market”) or centralized control (“hierarchy”). This applies especially for large-scale, networked, highly automated infrastructure systems. At first sight the current trend is decentralization, e.g. in the electricity system, in air transportation or in electronic networks.

However a paradox emerges, since even decentralized systems face the need of coordination, especially if high reliability is at stake. Systems of that kind cannot simply rely on the mechanism of self-organization and wait for emergent effects to occur. New modes of governance which combine the problem-solving capability of local coordination with the needs of global stability in the overall system have to be found.

Can we (re-)construct societies at the computer screen?

If we want to study governance issues, we first have to know, how societies work, e.g. we need a model of the coordination of actors (at the micro level), the integration of the social system (at the macro level) as well some concepts about the interplay of micro and macro. The model of sociological explanation (MSE) of Hartmut Esser is an appropriate concept because it combines the micro and the macro perspective and allows for a detailed analysis of three major aspects, namely: the logic of situation (macro-micro-link), the logic of selection (the decision-making process at the micro level), and the logic of aggregation (micro-macro-link).

Additionally the Esserian MSE is highly formalized, so we can use it for computer simulation, which is a new method for the study of the dynamic of large social systems consisting of heterogeneous actors with different capabilities, interests, strategies etc.

Simulation software such as NetLogo allows for agent based modelling and simulation (ABMS) which enables social scientists to study non-linear processes and the emergence of complex patterns at the macro level (such as the phenomenon of segregation of population groups). These complex structures emerge simply out of the recursive interactions of agents, which behave according to very simple rules at the micro level. ABMS thus allows for laboratory experiments with social systems and the exploration of alternatives, e.g. by changing the internal parameters of agents such as strategy, memory capacity and so on.

The canteen model

At the canteen of the Technische Universität Dortmund we observed that the length of waiting queues differs from time to time. We asked ourselves: Can we explain it? In terms of ABMS the question has to be replaced by: Can we construct it? By the use of NetLogo we created the canteen model, consisting of three types of actors (the glutton, the money-saver and the foodie), which have to choose between three meals with different properties (tasty, much, cheap). Most important: The choice of each actor (micro level) partly depends on her/his individual preferences (eat much, save time and so on), and partly on the state of the system (macro level), i.e. the current length of the waiting queues, which is a result of previous decisions, which are result of ... and so on.

The canteen model thus is well suited to analyse the interplay of micro decisions and macro patterns in a dynamic perspective, since things change constantly. The method of computer simulation is the only one in social sciences that provides this opportunity.

The test runs show that most foodies decide for the tastiest meal, as had been expected, but some make other choices. There is no simple pattern of decision-making, but it depends on a complex interplay of actor's strategy and her/his perception of the situation.

Furthermore, social actors do not behave according to a simple stimulus-response pattern. In contrast to ants and bees, which also produce complex patterns at the macro level, the decision-making even at the individual level is a complex process, which can be analysed for example by means of the Esserian MSE, as mentioned above.

Similar as in the case of ants and bees, however, the result of decentralized coordination is complexity at the macro level – sometimes accompanied by emergent effects that may be undesirable, unpredictable or even risky as e.g. in the case of high-risk technology.

Smart governance by smart technology?

Thus the question arises, if social processes and social systems as described above can be controlled in a way that helps to avoid undesirable outcomes. For different reasons we want to control society (or societal subsystems) and direct them into a desirable direction, e.g. for the sake of environmental protection, sustainability, gender issues, equality of opportunities and more.

How can we control a scenario of that kind, depicted in the canteen model? In principle there are three levers:

1. Changing the rules of decision-making at the *micro-level*;
2. Changing the rules of the game at the *macro-level*;
3. Re-shaping the *boundary conditions* of actors' decision-making.

Especially the final item points to the role of smart technology in coordination processes. Smart, autonomous technology can play a dual role, since it improves the ability of the actors to make their decisions independently and to coordinate at a local level, thus fostering decentralization. However, smart technology also allows for a real-time networking of all components of a large-scale system, thus fostering a trend towards recentralization. It is an open question, which new mode(s) of governance will finally succeed and provide the pattern of governing the network society.

Computer simulation may help to explore these new modes of governance – but only given that this method is driven by a reasonable theory of the modern network society.

The Strategic Governance of Nanotechnology: Social Struggles for Public Acceptance.

Joscha Wullweber, University of Hamburg, j.wullweber@jpbberlin.de

The success and social enforcement of new technologies depends heavily on their public acceptance. Concerning the discourse on genetic engineering, the ‘perception wars’ have been lost by industry and governments. In short, the GM-industry went from ‘wow’ to ‘yuck’ to ‘bankrupt’.

In the nanotechnology discourse actors are aware of these failures. Political and economic actors want to avoid another backlash like the one over genetically modified foods. At the same time, they intend to democratise the process. The paper shall show that especially governmental institutions have learned from the conflict over genetic engineering. They pursue new strategies to gain acceptance for nanotechnology. Some of these strategies aim at integrating potentially antagonistic positions and critical actors into the hegemonically structured discourse. Others bring forward public ‘nano-dialogues’ to inform the public.

The term governance is used here to emphasise the contingent, diffuse, and precarious character of strategic ‘steering’. The process of governance implies different hegemonic and counter hegemonic strategies to stabilise and destabilise a hegemonically structured discourse. Hence, governance is not a neutral process but one in which social actors try to enforce their interests. In this light, the governance of nanotechnology – the techno-political process of establishing nanotechnology within society – implies primarily the social struggle for its acceptance.

The paper brings forward an international political economy approach that is based on theories of discourse and hegemony. A discourse is understood as a structure which shapes and reflects the social, economic, and (techno-)political context. Discourses – and power included therein – display not merely a certain level of social reality, but become the site in which reality is negotiated. Hegemonic practice shapes discourse, which in turn provides the conditions of possibility for hegemonic articulation. Framed like this, hegemony is a type of social relation and entails the widening of a particular set of discourses towards a certain horizon of social orientation and action.

Thus, the paper offers a perspective which highlights political interests and strategies within the governance process of nanotechnology. Even though hegemonic strategies are very successful in integrating critical actors, resentments increase, because until now their critique has had almost no policy outcome. Hence, the struggle for nanotechnology has just begun.



A

| | |
|----------------------------|----|
| Aanestad..... | 43 |
| Aarts..... | 61 |
| Abrishami..... | 11 |
| Adams..... | 12 |
| Albert de la Bruhèze | 33 |
| Ariani Fatimah..... | 13 |

B

| | |
|--------------------|--------|
| Barjak..... | 15 |
| Barker | 17 |
| Beerkens | 17 |
| Below | 20 |
| Bengaly | 30 |
| Benneworth | 21 |
| Benninghoff | 22 |
| Berg, van den..... | 18 |
| Bitsch | 22 |
| Blümel..... | 23 |
| Boon..... | 73, 81 |
| Borrás..... | 24 |
| Böschen | 24 |
| Boschma | 47 |
| Brandl | 24 |
| Braun | 22 |
| Bressers | 111 |
| Broerse | 99 |
| Brugnach..... | 51 |
| Budde..... | 25 |
| Bunders..... | 99 |
| Büscher | 86 |

C

| | |
|-----------------------|----|
| Cock Buning, de | 65 |
| Coenen..... | 27 |
| Cox | 17 |
| Cozzens..... | 27 |
| Crane..... | 54 |

D

| | |
|-----------------------------|----|
| Daemmrich | 29 |
| Dalohoun ¹ | 30 |
| Damianova..... | 96 |
| Delemarle | 31 |
| Dendler | 32 |
| Dijksterhuis..... | 33 |
| Dorbeck-Jung | 34 |

| | |
|------------|----|
| Dugué..... | 30 |
|------------|----|

E

| | |
|--------------|----|
| Eccles..... | 15 |
| Edler | 35 |
| Elena..... | 91 |
| Enders | 74 |
| Engwall..... | 45 |
| Evar | 37 |

F

| | |
|-----------------------|----|
| Fallon..... | 37 |
| Flanagan | 38 |
| Flipse | 39 |
| Forsberg | 40 |
| Frenken | 47 |
| Friedrichsmeier | 41 |
| Fuller | 54 |

G

| | |
|------------------|----|
| Gazsó..... | 49 |
| Gill | 24 |
| Gläser | 48 |
| Gorga..... | 22 |
| Groenendijk..... | 60 |

H

| | |
|---------------------|--------|
| Hanseth | 43 |
| Hardeman | 47 |
| Hasse | 44 |
| Hauser | 49 |
| Hedmo..... | 45 |
| Heimeriks | 50 |
| Hernández..... | 45 |
| Hoedemaekers | 78 |
| Hoek, van den | 51 |
| Hoekstra | 51 |
| Holl | 53 |
| Hopkins | 54, 93 |
| Huat..... | 30 |

J

| | |
|-----------------|----|
| Jacobi | 96 |
| Jakobs..... | 55 |
| Jongbloed | 17 |

K

| | |
|-------------|----|
| Kaiser..... | 49 |
|-------------|----|

| | |
|-----------------|------------|
| Kanerva | 57 |
| Karo | 58 |
| Kattel | 58 |
| Kica | 60 |
| Klerkx | 61, 64, 73 |
| Klitkou | 104 |
| Kloet | 65 |
| Konrad | 25, 67 |
| Korbee | 68 |
| Krol | 51 |
| Kuhlmann | 109 |
| Kulve, te | 90 |
| Kurt | 70 |

L

| | |
|-------------------|--------|
| Laranja | 38, 70 |
| Larédo | 71 |
| Laudel | 74 |
| Leeuwis | 64 |
| Leišytė | 72 |
| Lente, van | 73, 75 |
| Lettkemann | 48 |
| Leydesdorff | 76 |
| Lovett | 13 |
| Lulofs | 111 |
| Lyall | 75 |

M

| | |
|-----------------------|--------|
| Marris | 77 |
| Meijer | 81 |
| Meulen, van der | 78, 83 |
| Meyer | 15 |
| Mölders | 80 |
| Moors | 81 |
| Most, van der | 82 |
| Murdock | 83 |

N

| | |
|-------------------|---------|
| Nahuis | 84, 108 |
| Nightingale | 54, 93 |

O

| | |
|------------------|----|
| O'Hare | 93 |
| Oost, van | 85 |
| Orwat | 86 |
| Osseweijer | 39 |
| Oudshoorn | 86 |

P

| | |
|----------------------|-----|
| Pádua | 87 |
| Paloma Sánchez | 91 |
| Parandian | 90 |
| Passarge | 44 |
| Pedersen | 104 |
| Perianes | 93 |
| Peters | 92 |

R

| | |
|---------------------|--------|
| Rafols | 76, 93 |
| Rajan | 95 |
| Rama | 53 |
| Ramuz | 22 |
| Rask | 96 |
| Reale | 97 |
| Rijswoud, van | 98 |
| Rip | 75, 90 |
| Robinson | 15 |
| Rodriguez | 60 |
| Roelofsen | 99 |
| Rushforth | 101 |

S

| | |
|----------------------|-------------|
| Santos | 105 |
| Schaper-Rinkel | 102 |
| Schimank | 48 |
| Schleisiek | 103 |
| Schroeder | 15 |
| Scordato | 104 |
| Seibt | 105 |
| Senou | 30 |
| Simões | 105 |
| Smith | 75 |
| Soumonni | 27 |
| Spranger | 24 |
| Steffensen | 20 |
| Stegmaier | 75, 107 |
| Stemerding | 83, 84, 108 |

T

| | |
|--------------------|----|
| Throne-Holst | 31 |
|--------------------|----|

U

| | |
|------------------------|-----|
| Ulnicane-Ozolina | 109 |
| Uyarra | 38 |

V

| | |
|-------------------|-----|
| Van Mele..... | 30 |
| Vasileiadou | 110 |
| Vikolainen | 111 |
| Vossensteyn..... | 21 |

W

| | |
|-------------------|----|
| Wal, van der..... | 47 |
|-------------------|----|

| | |
|----------------|-----|
| Walhout | 108 |
| Warnke..... | 113 |
| Weyer..... | 115 |
| Williams..... | 75 |
| Woodson | 27 |
| Wullweber..... | 116 |